RECORD OF DECISION

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
KENSINGTON GOLD PROJECT

USDA Forest Service
Tongass National Forest - Chatham Area
Juneau Ranger District

DECISION TO BE MADE

This Record of Decision documents my selection of the alternative that will be used to revise the 1992 Plan of Operations for the Kensington Gold Project. This decision is based upon the analysis and evaluations in the Final Supplemental Environmental Impact Statement as well as information incorporated by reference from the 1992 FEIS and ROD.

ALTERNATIVES CONSIDERED IN DETAIL

Four alternatives were evaluated, including the No Action Alternative. This range of alternatives addressed the major issues associated with this project. The three action alternatives differed from each other in the type and location of various project components.

The alternatives are summarized as follows:

Alternative A - No Action - As a result of this alternative, the Forest Service would not approve the proposed 1996 revisions to the 1992 Plan of Operations. The No Action Alternative consists of Alternative F as identified in the 1992 FEIS and selected by the Forest Supervisor in the 1992 ROD and modified to address requirements identified by the Environmental Protection Agency during their 1994 review of the NPDES permit application.

Ore processing	Underground crushing, surface grinding, flotation, and cyanidation with the final product being gold bars.
Waste Rock	Stored in a 15-acre stockpile at the mill site, about 50 percent used in tailings embankment, road, and foundation construction.
Tailings Management	Disposal in an impoundment in Sherman Creek, no backfill.
Diversions	Diversions of Ophir and Sherman Creeks designed for 100-year, 24-hour storm event.
Mine Drainage and Mill Effluent	Discharge to tailings impoundment, then piped to marine discharge point 1/2 mile off shore in Lynn Canal north of Point Sherman, treatment by enhanced settling in impoundment.

Employee Transportation	Helicopter from Juneau Airport.
Supply Transportation	Barge to Comet Beach facility.
Power Supply	2 LPG generators at the mill site, one LPG generator at Comet Beach.
Employee Housing	Onsite personnel camp south of Sherman Creek.
Borrow Area	Sand and gravel quarries near the process area (130 acres) within impoundment drainage.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade and revegetate, route streams over tailings impoundment.

Alternative B - Proposed Action - This alternative consists of the operator's proposal to modify the 1992 Plan of Operations and differs from Alternative A in the following:

Ore processing	Underground crushing, surface grinding and flotation, offsite transport of flotation concentrate for further processing.
Waste rock	Temporary 15-acre pile at mine portal, all waste rock used in DTF construction and backfill.
Tailings Management	Placement of dry tailings in the dry tailings facility (DTF), engineered drainage system, paste backfill minimum of 25 percent of all tailings, tailings trucked to DTF. 60-foot wide haul road from mill to DTF.
Diversions	Diversion above the DTF, Ophir Creek diversion around the mill site, both designed for 100-year, 24-hour storm event.
Mine Drainage and Mill Effluent	Mill effluent recycled; mine drainage discharged to Sherman Creek after treatment by enhanced settling in ponds, and precipitation/filtration; runoff/leachate from DTF discharged to Camp Creek.
Stream Crossings	Bottomless arch conduits for crossing Upper Sherman Creek and Ivanhoe Creek.
Power Supply	4 diesel generators at the mill site, one diesel generator at Comet Beach, diesel fuel trucked to the process area from the beach storage facility.
Employee Housing	Onsite personnel camp north of Sherman Creek.

Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the sand and gravel quarry.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade and revegetate, maintain diversion above the DTF - increase to 500-year, 24-hour event capacity.

Alternative C - This alternative is the same as Alternative B with the following exceptions:

Mine Drainage and Mill Effluent	Marine discharge of mine drainage and DTF effluent to Lynn Canal. Discharge of process area runoff to upper Sherman Creek, enhanced settling in ponds.
Power Supply	4 diesel generators at the mill site, one diesel generator at Comet Beach, diesel fuel piped to the process area from the beach storage area.

Alternative D - This alternative is the same as Alternative B with the following exceptions:

Tailings Management	Placement of dry tailings in the DTF, engineered structural berm around three sides of the tailings pile, backfill 25 percent of tailings. Tailings slurry piped from mill to DTF.
Stream Crossings	Bridges for crossing Sherman Creek, Upper Sherman Creek, and Ophir Creek.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

Alternative D is the environmentally preferred alternative. The environmentally preferred alternative is the one which causes the least damage to the biological and physical environment, and which best protects, preserves, and enhances historic, cultural and natural resources.

DESCRIPTION OF THE FOREST SERVICE SELECTED ALTERNATIVE

The selected alternative will be used to revise the 1992 Plan of Operations for the Kensington Gold Project.

Based on the analysis and evaluation in the Final Supplemental Environmental Impact Statement for the Kensington Gold Project, and portions of the 1992 FEIS incorporated by reference, it is my decision to select Alternative D.

Approval of the wastewater discharge site is outside the authority of the Forest Service. If EPA, through their permitting authority, were to approve marine discharge of wastewater, rather than freshwater discharge of wastewater as described in Alternative D, the Forest Service will approve the surface facilities required for marine discharge as outlined in Alternative C.

RATIONALE FOR THE DECISION

Alternative D differs from the other action alternatives in that it requires an engineered structural berm around three sides of the DTF, the tailings slurry is piped to the DTF from the mill rather than trucked, and bridges rather than bottomless arch conduits are used for crossing Upper Sherman Creek and Ivanhoe Creek.

I selected Alternative D because it best addresses issues identified during scoping and comments received concerning the DSEIS. While some alternatives better address individual issues, the Selected Alternative provides the best mix for addressing all the issues at an acceptable level.

Under Alternative D, as well as Alternatives B and C, the flotation concentrate would be shipped off-site for processing. This will provide several secondary benefits in terms of reducing potential environmental impacts. Off-site processing will eliminate the need for onsite use of cyanide and the risk of accidental cyanide release. It will also eliminate concerns regarding disposal of CIL tailings. With no CIL tailings production and new paste backfill techniques, the operator will be able to backfill a minimum of 25 percent of the tailings and reduce the volume of tailings disposed on the surface. Since cyanide destruction will no longer be required, the use of chlorine will be reduced to only what is required for domestic water treatment.

Dry tailings disposal, as described in Alternative D, will result in more visual impacts during the life of the mine than wet tailings disposal since the wet tailings impoundment would screen many of the facilities and revegetation of the impoundment face could begin immediately. Dry tailings disposal does, however, have a greater potential for successful reclamation and will require much less long term maintenance. It will eliminate the need to disturb a large section of Sherman Creek and reroute streams over reclaimed tailings. The use of a dry tailings facility will address many concerns regarding long term stability.

The operator has proposed to utilize diesel fuel for power generation, rather than LPG as approved in the 1992 ROD. Based on the information presented in the 1992 FEIS and this SEIS, I do not see a compelling reason to require one type of fuel over the other and, therefore, am approving the use of diesel fuel as requested. Both diesel fuel and LPG can easily meet air quality permit requirements. While the use of LPG would result in slightly lower emissions and slightly lower risk of spills, it would also require a separate, more elaborate and more visible storage facility. Since substantial amounts of diesel fuel will still be required for other aspects of the project, the use of LPG would not eliminate the need for diesel fuel transfer, transportation and storage at the site. There would be a slight increase in the risk of spills from increased diesel use but the diesel would be transported, handled, and stored according to an SPCC plan and State spill response requirements. Any impacts from spills would be limited by transfer timing restrictions, equipment design, and prompt spill response capability.

The approval and permitting of wastewater discharge under the Clean Water Act rests with EPA. The analysis in the FSEIS indicates that wastewater discharge into freshwater, as described under Alternatives B and D, will meet all permit requirements of other agencies without the use of a mixing zone. Utilization of a freshwater discharge site will address substantial controversy concerning the effects of a marine discharge, and associated mixing zone, on local commercial fisheries.

Alternative D requires construction of a structural berm around three sides of the dry tailings facility to minimize the risk of pile failure. This type of berm is based on proven technology and has a high probability of being effective. The operator will monitor tailings saturation and performance, allowing for further fine tuning of the DTF without fear of failure. Implementation of Alternative D minimizes the risk of tailings pile failure and allows the operator the flexibility to manage tailings disposal under a variety of climatic conditions. If the operator can demonstrate through monitoring and evaluation that tailings can be placed to a level of stability acceptable to the Forest Service, I will consider modifications to the berm design in the future.

The use of bridges under Alternative D instead of bottomless arch conduits at several haul road stream crossings will reduce the potential for stream channelization, erosion of bed materials, and channel downcutting. This will reduce the potential for degradation of aquatic habitat at these road crossings during operations and improve the potential for stream rehabilitation during reclamation of the road and mill site.

Because of reduced truck traffic, the use of a slurry line in Alternative D will reduce fugitive dust emissions when compared to truck transport of tailings in Alternatives B and C. The potential for a slurry spill as a result of pipeline rupture is minimized because of the use of double-walled pipe with check valves and pressure sensors.

Considerable concern was expressed during the preparation of this document about potential cumulative effects of the the Kensington Gold Project in conjunction with several other proposed or potential projects in the Berners Bay area. The FSEIS includes an expanded discussion addressing this concern. The alternative which I have selected results in very little direct or indirect effect to Berners Bay and has no direct relationship to any other projects except the proposed Juneau Access Road. Although no relationship exists at this time, I recognize the possibility that it could exist at some unspecified future date if changes to the project, such as development of the Jualin Mine, use of hydropower from Lace River, or changes to employee housing and transportation were proposed. These changes would require additional environmental analysis prior to approval.

PUBLIC INVOLVEMENT

A Notice of Intent to prepare a supplemental environmental impact statement was printed in the Federal Register on July 22, 1996. Public scoping meetings were held in Juneau on August 7, and in Haines on August 8, 1996. The Draft SEIS was sent to the public in February 1997 with the Notice of Availability published in the Federal Register on February 21, 1997. On March 6, 1997 members of the Interdisciplinary Teams from the Forest Service and our third party contractor, SAIC, were available at the Juneau Ranger District to answer questions from the public. Public hearings on the Draft SEIS were held in

Juneau on March 25, and in Haines on March 26, 1997. More than 50 comment letters on the Draft SEIS were received from the public.

All meetings were announced on local radio stations and in local newspapers in both communities. In addition, newspapers in Juneau and Haines printed many articles on the proposed Kensington Gold Project.
The following significant issues were identified for consideration in the SEIS.

Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit must meet water quality standards. Concerns were raised that the wastewater discharges permitted through the NPDES process meet water quality standards.

The potential for and effects of failure of the DTF should be considered. The risks, liability, and contingencies, as well as environmental effects, of a DTF failure should be discussed.

The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized. Concerns were expressed that the visual impacts of the DTF, road, borrow pits, temporary camp, fugitive dust, and diesel emissions from power generation could negatively affect tourism.

Use of diesel fuel instead of liquified petroleum gas (LPG) for power generation may result in increased air emissions. There is concern that burning diesel fuel, as well as other project modifications, would increase emissions of air pollutants, including carbon dioxide.

The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources. The increase in transportation, handling, and use of diesel fuel for power generation could increase the potential for spills.

MITIGATION, MONITORING, AND RECLAMATION

The FSEIS, Chapter 2, Mitigation and Monitoring lists the mitigation measures required as part of Alternative D that are designed to ensure that all practicable means have been adopted and will be implemented to avoid or minimize potential environmental impacts from the selected alternative during construction, operation, and project reclamation. These mitigation measures have been used successfully in other projects with similar types of activities. As a result, they are considered effective and are made part of this decision. Mitigation and monitoring plans will be submitted by the mine operator as part of the revised Plan of Operations. Mine construction may not begin until the Plan of Operations is approved.

Environmental monitoring programs that meet the requirements of the Forest Service, EPA, ADEC and other agencies will be implemented. These programs will be designed to determine compliance of the project with the Plan of Operations, other Federal, State and local permits, and to validate the projected effects of the project's construction, operation, reclamation and post-closure conditions. Impacts that result in violations of regulatory stipulations will require alterations of project operations or additional mitigation actions.

A summary of monitoring activities, including the various authorities and the responsible parties, are identified in Table 2-3 of the FSEIS. For resources under the authority of the FS, details of the the monitoring programs will be approved as part of the Plan of Operations. For resources under the regulatoryauthority of other agencies, the details of monitoring will be provided as required in that agency's permits.

ALASKA COASTAL MANAGEMENT PLAN

The State of Alaska sets standards and criteria for consistency determinations with the Alaska Coastal Management Plan. While Federal lands are excluded from the coastal zone, Section 307(c)(2) of the Coastal Zone Management Act states,"Any Federal agency which shall undertake any development project in the coastal zone of the state shall insure that the project is, to the maximum extent practicable, consistent with the approved management program."

The ACMP regulations in 6 AAC 85.020 require that each district coastal program develop goals and policies related to coastal management. These policies must be consistent with ACMP standards at 6 AAC 80. For the CBJ, these policies are established in the Juneau Comprehensive Plan, Part Two, Coastal Management Program (JCMP), effective on November 20, 1986. The following sections describe how the selected alternative, Alternative D, for the Kensington Gold Project is consistent with the specific enforceable policies in the JCMP. Only the JCMP sections that apply to the Kensington Gold Project are discussed.

Coastal Development (JCMP, Section 2)

The Comet Beach dock facilities are identified as coastal development. The construction and use of these facilities have been determined to be necessary and consistent with JCMP standards because: (1) this is a water-dependant use, (2) it is the only feasible and prudent location, and (3) the facilities would be constructed in a manner that is consistent with 33 CFR Parts 320-322 and minimizes adverse impacts on physical shore features, visual resources, fish habitat and passage, and navigation.

Geophysical Hazards (JCMP, Section 3)

The north sand and gravel borrow area and the Ophir Creek diversion are located in an area with landslide and snow avalanche potential. There is not a significant risk to human health or physical property at these sites. The Ophir Creek diversion will be removed at closure and the natural drainage restored. As discussed in Section 4.4 of the FSEIS, BMPs will be used during construction and operation to minimize erosion and the site will be revegetated at closure. The DTF design is based on withstanding the maximum credible earthquake. With the engineered structural berm and ongoing monitoring program, the potential for failure that could affect surrounding resources or endanger human health is minimal. This is consistent with JCMP standards.

Transportation and Utilities (JCMP, Section 6)

The transportation system for the selected alternative, except in accessing dock facilities, has been sited inland from beaches. Mitigation measures have been included to minimize road visibility from the beach. There are no stream crossings in the anadromous fishery in Lower Sherman Creek. Two crossings in Upper Sherman Creek and one in Ivanhoe Creek will be constructed with bridges to ensure fish passage and avoid impacts on fish habitat. In-stream construction will be avoided during critical stages for aquatic life. The project is consistent with JCMP requirements for transportation.

Mining and Mineral Processing

The enforceable policies of this section generally require consistency with other sections of JCMP.

Subsistence (JCMP, Section 10)

The FSEIS and 1992 FEIS have shown that there is little or no subsistence use of the Point Sherman area. Under the selected alternative, there will be no impacts on subsistence fishing opportunities. This is consistent with the JCMP standards to recognize and assure subsistence opportunities.

Habitat (JCMP, Section 11)

The Comet Beach dock facility will require dredging of approximately 2.3 acres. This will result in a localized disturbance of cobble beach habitat. The potential for significant effects on the overall availability of marine habitat and sport, commercial, and subsistence fishing opportunities is negligible. Wetlands are found throughout the site. None of the wetlands are unique and all losses, except at the DTF, will be temporary. Loss of wetlands associated with the DTF will not impact important habitat. All discharges from the site will meet human health and aquatic life water quality standards at the discharge points. Under the selected alternative, effects on stream flows and habitat in Sherman Creek will be minimized. Minimum instream flows established by ADF&G will have to be met and natural drainages will be restored at closure. This is consistent with JCMP standards.

Air, Land, and Water Quality (Section 12)

Under the selected alternative, the air emissions and water discharges from the project would comply with all applicable State air and water quality standards. The project is also consistent with all applicable land use designations. The site would be completely reclaimed and revegetated at closure.

Conclusion

In this analysis, the Forest Service has determined that the selected Alternative meets the JCMP standards to the maximum extent practicable. In addition, all feasible and prudent steps to maximize conformance with the JCMP have been taken.

FINDINGS REQUIRED BY OTHER LAWS

Tongass Land and Resource Management Plan

This decision is consistent with the 1997 Tongass Land and Resource Management Plan. The site is located in an area designated as Modified Landscape with a Minerals Prescription. The emphasis for management in this area is encouragement of minerals development in an environmentally sensitive manner and limited to the area necessary for efficient, economic, and orderly development. The long-term goal is reclamation consistent with a Modified Landscape designation.

ANILCA Section 810, Subsistence Evaluation and Finding

The effects of this project have been evaluated to determine potential effects on subsistence opportunities and resources. There is no documented or reported subsistence use that would be restricted as a result of this decision. The potential competition caused by population increases in Juneau could be controlled by regulations pertaining to Federal lands, which would reduce the season and/or bag limit by non-rural residents.

Coastal Zone Management Act of 1972, as amended

The Coastal Zone Management Act requires the Forest Service, when conducting or authorizing activities or undertaking development directly affecting the coastal zone, to insure that the activities or development be consistent with the approved Alaska Coastal Management Program to the maximum extent practicable. I have determined that the proposed activities are consistent with the Alaska Coastal Management Program to the maximum extent practicable.

Endangered Species Act of 1973

A biological evaluation has been completed for this action which documents that no Federally listed threatened or endangered species will be affected by this decision.

National Historic Preservation Act of 1966

The Forest Service program for compliance with the National Historic Preservation Act includes locating, inventorying and nominating all cultural sites that may be directly or indirectly affected by scheduled activities. This activity has been reviewed by a qualified archeologist and a determination made that no known cultural resources will be impacted by this action.

Floodplain Management (E.O. 11988)

This activity is located within floodplains as defined by Executive Order 11988. This action has been designed to minimize potential harm to or within the floodplains.

Protection of Wetlands (E.O. 11990)

This activity is located within wetlands as defined in Executive Order 11990. I have determined that (1) that there is no practicable alternative to such construction, and (2) that the selected alternative includes all practicable measures to minimize harm to wetlands which may result from such use.

Recreational Fisheries (E.O. 12962)

Based on the analyses for water quality and fisheries and pursuant to Executive Order 12962, I have determined that there will be no significant effect to recreational fisheries.

Environmental Justice (E.O. 12898)

I have determined that in accordance with Executive Order 12898 this project does not have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

IMPLEMENTATION DATE:

Implementation of decisions made by the Chatham Area Forest Supervisor, which are subject to appeal pursuant to 36 CFR part 215, may occur on, but not before, 5 business from the close of the appeal filing period. The appeal filing period closes 45 days after publication of legal notice of this decision in the Juneau Empire newspaper, published in Juneau, Alaska.

RIGHT TO APPEAL OR ADMINISTRATIVE REVIEW

This decision is subject to administrative review (appeal) pursuant to 36 CFR Part 215. A written notice of appeal must be filed with the Appeal Deciding Officer:

Phil Janik, Regional Forester
Regional Office
P.O. Box 21628
Juneau, Alaska 99802-1628

The Notice of Appeal must be filed within 45 days of publication of notice of this decision in the Juneau Empire.

In accordance with 36 CFR Section 215.14, it is the responsibility of those who appeal a decision to provide the Appeal Deciding Officer sufficient evidence and rationale to show why the Responsible Official's decision should be remanded or reversed. The written notice of appeal filed must meet the following requirements:

1. State that the document is a Notice of Appeal filed pursuant to 36 CFR part 215.
2. List the name, address, and telephone number of appellant;
3. Identify the decision document by title and subject, date of the decision, and name and title of the Responsible Official;
4. Identify the specific change(s) in the decision that the appellant seeks or portion of the decision to which the appellant objects;
5. State how the Responsible Official's decision fails to consider comments previously provided, either before or during the comment period specified in 36 CFR 215.6 and, if applicable, how the appellant believes the decision violates law, regulation, or policy and, if applicable, specifically how the decision violates the law, regulation, or policy.

CONTACT PERSON

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GARY A. MORRISON
Chatham Area Forest Supervisor

8/1/97
Date

Kensington Gold Project
Final Supplemental
Environmental Impact Statement

VOLUME I

United States Department of Agriculture
Forest Service
Tongass National Forest

August 1997

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SUMMARY

SUMMARY

In July 1992, the Forest Service approved a Plan of Operations for the Kensington Gold Project (1992 Plan of Operations). The 1992 Plan of Operations reflects the Forest Service Record of Decision (ROD) issued on January 29, 1992, for the Final Environmental Impact Statement (1992 FEIS). The 1992 Plan of Operations addresses the alternative selected by the Forest Service—Alternative F, Water Treatment Option 1. Alternative F consists of underground mining; ore processing, including onsite cyanidation; a tailings impoundment; marine discharge of process wastewater; and various support facilities, including use of liquefied petroleum gas (LPG) for power generation.

As cooperating agencies, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps of Engineers) were responsible for issuing RODs prior to issuing permits. Neither agency issued a ROD or permits. EPA prepared the *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994) to evaluate short- and long-term water quality impacts and potential long-term ecological consequences of the alternative selected in the Forest Service 1992 ROD. EPA developed findings and recommendations to assist the Corps of Engineers in determining whether the proposed project would comply with Section 404(b)(1) guidelines of the Clean Water Act.

The Kensington Gold Project was originally a joint venture between Coeur Alaska (a subsidiary of Coeur d'Alene Mines Corporation) and Echo Bay Exploration (a subsidiary of Echo Bay Mines, Ltd.). During summer 1995, Coeur Alaska assumed 100-percent interest in the Kensington Gold Project. On June 24, 1996, Coeur Alaska, Incorporated, submitted a Revised Plan of Operations (1996 Revised Plan of Operations) to the U.S. Department of Agriculture, Forest Service, Tongass National Forest, Chatham Area, for proposed project changes to the Kensington Gold Project. The revision includes offsite transportation of flotation concentrate, thereby eliminating onsite cyanidation; dry disposal and backfilling of tailings; fresh water discharge of process wastewater; use of diesel fuel for power generation; and modifications to the facility layout.

The Forest Service has determined that a decision on the 1996 Revised Plan of Operations would be a major Federal action requiring a Supplemental Environmental Impact Statement (SEIS) under the National Environmental Policy Act (NEPA). The Council on Environmental Quality (CEQ) issues NEPA regulations and guidelines. Each Federal agency is responsible for developing its own regulations and guidelines for compliance with NEPA. This Final SEIS was prepared in accordance with applicable CEQ and Forest Service regulations and guidelines and in cooperation with EPA and the Corps of Engineers. This Final SEIS only considers the proposed changes to the project. Elements of the Kensington Gold Project that are not proposed for modification from the 1992 Plan of Operations were evaluated in the 1992 FEIS and are not addressed in this document.

This summary briefly describes the primary contents of the Final SEIS as follows:

- Chapter 1, Purpose of and Need for Action—Describes the Proposed Action-based project revisions submitted by the operator and the purpose and need for the Proposed Action; discusses the need for preparation of the SEIS and issuance of other Federal, State, and local permits; and identifies issues raised during the scoping process and addressed by this analysis.
- Chapter 2, Description of Alternatives, Including the Proposed Action—Describes how the alternatives were developed, describes the Proposed Action, and identifies alternatives to the Proposed Action.
- Chapter 3, Affected Environment—Provides updated and supplemental information collected since the 1992 FEIS on the physical and biological environment and socioeconomic conditions that would be affected by the alternatives.
- Chapter 4, Environmental Consequences—Describes the potential environmental consequences of all alternatives.

This summary provides an overview of the Final SEIS, including important information from Chapters 1 through 4. Beyond the information in the 1992 FEIS, additional documentation of the environmental analysis is contained in the planning record, which is available to the public at the Juneau Ranger District Office.

PURPOSE OF AND NEED FOR PROPOSED ACTION

The purpose of and need for the Proposed Action is to reduce the potential impacts from a mixing zone in marine waters; increase the assurance of meeting water quality standards; minimize the potential impacts to Ophir, Ivanhoe, and Sherman Creeks; reduce operational and maintenance requirements and long-term closure liabilities; and increase the economic efficiency of the mine. Modifications to the 1992 Approved Plan of Operations include offsite processing of flotation concentrate and dry tailings disposal.

The Forest Supervisor for the Chatham Area of the Tongass National Forest is the Responsible Official for this decision. Based on the analysis provided in the Final SEIS, he may select one of the alternatives discussed herein, select an alternative that combines components of more than one alternative, or select an alternative that includes additional mitigation measures. As cooperating agencies, EPA and the Corps of Engineers will adopt this Final SEIS and issue their own RODs in conjunction with their respective permits for the Kensington Gold Project.

To assist in identifying issues and concerns related to the proposed modifications to the Kensington Gold Project, the Forest Service, EPA, and Corps of Engineers mailed approximately 360 scoping letters to the public on July 15, 1996. Two public scoping meetings were held: one was held in Juneau, Alaska, on August 7, 1996, and the other was held in Haines, Alaska, on August 8, 1996. The following significant issues were identified during scoping for the project changes:

- Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit meet water quality standards.
- The potential for and effects of failure of the dry tailings facility (DTF) should be considered.
- The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized.
- The use of diesel fuel instead of LPG for power generation may result in increased air emissions.
- The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.

Compliance with other laws is normally guaranteed through a separate permitting process that would commence after an alternative is selected. For the Kensington Gold Project, permits or approvals are required from the following agencies:

- Federal
  - Forest Service (Revised Plan of Operations Approval)
  - EPA (NPDES permit, Spill Prevention, Containment, and Countermeasure [SPCC] Plan, and Facility Response Plan [FRP])
  - Corps of Engineers (Section 404 and Section 10 permits)
  - Fish and Wildlife Service (Threatened and Endangered Species Consultation and Bald Eagle Protection Act Compliance)
  - National Marine Fisheries Service (Threatened and Endangered Species Consultation)
- State of Alaska
  - Division of Governmental Coordination (Alaska Coastal Management Plan Certification)
  - Department of Environmental Conservation (NPDES and 404 Permit Certification, Air Quality Permit, Solid Waste Permit, Oil Discharge Prevention and Contingency Plan [C-Plan])
  - Department of Natural Resources (Water Right Permits and Tidelands Permit)
  - Department of Fish and Game (Fish Habitat Permits)
- City and Borough of Juneau (Large Mine Permit and Juneau Coastal Management Program Consistency Review).

DESCRIPTION OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

The Forest Service is required by NEPA to consider alternatives to the Proposed Action that address significant issues identified during the scoping process. The original EIS process broadly considered all issues related to the entire Kensington Gold Project. The 1992 FEIS addressed potential options for each project component. Options were then screened to determine their ability to address significant issues. The options surviving the screening process were used to develop alternatives for detailed consideration in the 1992 FEIS.

As discussed previously, this SEIS only addresses the proposed project modifications. Options and alternatives have been developed based on the significant issues identified during scoping for the 1996 Revised Plan of Operations. The following discussion summarizes the project alternatives studied in detail.

Alternative A – No Action

NEPA requires that a No Action Alternative be considered in all environmental documents. For the Kensington Gold Project, the Forest Service No Action Alternative (SEIS Alternative A) is Alternative F, Water Treatment Option 1, as described in the January 1992 Forest Service ROD and modified, as necessary, to address comments provided in the TAR. EPA and the Corps of Engineers have not issued RODs to date. The EPA and the Corps of Engineers No Action Alternative would deny permits for portions of the project within their jurisdictions. This alternative was evaluated fully in the 1992 FEIS and the analysis is not repeated in this Final SEIS.

Alternative A consists of an underground mine; ore-processing facility, including flotation and cyanidation; a tailings impoundment; marine terminal; and ancillary facilities. Both flotation and cyanidation tailings would be managed in the tailings impoundment. Cyanidation tailings would undergo cyanide destruction. Enhanced settling would be accomplished in the tailings impoundment. The effluent from the impoundment would be piped to Lynn Canal for discharge approximately one-half mile offshore north of Point Sherman. Waste rock would be managed in a pile near the 800-foot adit. About 50 percent of the waste rock would be used in construction; the remainder would be permanently managed in the pile.

Alternative B – Proposed Action

Alternative B consists of the operator's proposal as described in the 1996 Revised Plan of Operations. Modifications to the 1992 Approved Plan of Operations include offsite processing of flotation concentrate and dry tailings disposal at approximately Site B identified in the 1992 FEIS. Flotation concentrate would be placed in sealed containers and transported offsite for final processing. At least 25 percent of the flotation tailings would be paste backfilled. The remaining tailings would be managed in the DTF. Mine drainage would undergo precipitation and filtration and be combined with process area runoff in a sediment pond. The sediment pond would discharge to upper Sherman Creek. The DTF would be designed to limit infiltration into the tailings. Waste rock and coarse and fine till would be used in DTF construction. All waste rock generated by the mine would either be used in DTF and process area foundation/bench construction or be backfilled. Till would be obtained from a 27-acre borrow area northwest of the process area. DTF seepage and runoff would be collected in a sediment pond and discharged to Camp Creek. Diesel fuel would be used for power generation. The locations of the helicopter pad, marine terminal, laydown area, and personnel camp are modified from the 1992 Approved Plan of Operations.

Alternative C – Marine Discharge

Alternative C is the same as Alternative B, with the exception of marine discharge of mine drainage and pipe transport of diesel fuel from the marine terminal to the process area. Mine drainage would undergo underground settling and then be transported via pipeline towards Lynn Canal. DTF effluent would be combined with the mine drainage. The combined flow would be discharged to Lynn Canal approximately 300 feet offshore north of Point Sherman. The discharge would be through a diffuser, and the required mixing zone would be substantially smaller than under Alternative A. Diesel fuel would be transported via an above-ground, double-walled steel pipeline that would generally parallel the haul road from Comet Beach to the process area. This alternative is intended to address the issues of potential for diesel fuel spills and impacts on water quality.

Alternative D – Modified DTF Design

Alternative D is the same as Alternative B, with the exception of a modified DTF design and piping of tailings from the process area to the DTF. Under this alternative, an engineered structural berm would be constructed around three sides of all cells of the DTF to enhance geotechnical stability. Tailings slurry would be piped to a dewatering plant at the DTF site. Reclaim water would be piped back to the process area for reuse. This alternative also includes the use of bridges rather than conduits for three road crossings in upper Sherman and Ivanhoe Creeks. This alternative is intended to address issues of potential failure of the DTF and impacts on water quality.

Management, Mitigation, and Monitoring

Environmental management and mitigation measures are designed to ensure that potential environmental impacts would be minimized during construction, operation, and closure of the Kensington Gold Project. In general, the operator has incorporated extensive mitigation into the 1996 Revised Plan of Operations. This includes likely requirements under permits and approvals for the project. Several additional measures have been incorporated into this document. For example, there is a contingency for treatment of DTF effluent if monitoring indicated higher than anticipated pollutant levels in the effluent.

Similar to the 1992 FEIS, the operator would coordinate with Federal, State, and local agencies in implementing a monitoring program that addresses water resources, air quality, geotechnical stability, and wildlife.

Comparison of Alternatives

The alternatives for the proposed modifications to the Kensington Gold Project are compared and evaluated in the following table based on the issues identified during the scoping process.

Summary of Potential Impacts of Each Alternative by Significant Issues

Alternative	Summary of Potential Impact
Water Quality (from discharges)	
Alternative A - No Action	Marine – Levels of cyanide, metals, and total suspended solids in effluent discharge could meet water quality standards with a mixing zone. No impacts to fisheries expected. Sediment accumulation is expected in the vicinity of the outfall. Some heavy metal accumulation could occur only in sedentary, bottom-dwelling organisms (e.g., tubified worms and polychaetes) near the outfall. Fresh water – Construction of the tailings impoundment and diversions initially would increase sediment loads along a 1,000-foot downstream portion of pink salmon spawning habitat in Sherman Creek. Sediment loadings at closure would depend on reclamation success and geotechnical impacts.
Alternative B - Proposed Action	Marine – No direct marine discharge of process water. Fresh water discharges ultimately would reach Lynn Canal, but compliance with all standards would minimize any marine impacts. Fresh water – Discharges would comply with all technology- and water quality-based permit limits without a mixing zone. Accomplished through mitigation for water quality impacts, including mine water treatment, offsite processing of sulfide concentrate, and blasting BMP. Construction of the DTF and other facilities and runoff during active operations could increase sediment loads to Sherman Creek and the unnamed creeks in the Terrace Area. Any sediment impacts mitigated by polymer added settling ponds, BMPs during construction and operation, and complete reclamation.
Alternative C - Marine Discharge	Marine – Levels of metals and total suspended solids in effluent discharge would meet water quality standards with mixing zone. No impacts to fisheries expected. Sediment accumulation expected in the vicinity of the outfall. Some heavy metal accumulation could occur only in sedentary, bottom-dwelling organisms (e.g., tubified worms and polychaetes) near the outfall. Fresh water – Similar to Alternative B, except no discharge of mine drainage or DTF effluent to fresh water. Water quality impacts mitigated by offsite processing, blasting BMP, and sediment control.
Alternative D - Modified DTF Design	Same as Alternative B.
Air Quality (increased emissions, including CO_2)	
Alternative A - No Action	Air quality impacts would be well below allowable Federal and Alaska ambient air quality standards.
Alternative B - Proposed Action	Air emissions of NO_X, SO_2, CO, and total suspended particulates would be greater than Alternative A but still below air quality standards. NO_X emissions mitigated by SCR, particulates by baghouses and water sprays. CO_2 emissions slightly higher than Alternative A.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Similar to Alternative B, except that vehicle emissions would be slightly reduced, along with less fugitive dust from the road.

Summary of Potential Impacts of Each Alternative by Significant Issues (continued)

Alternative	Summary of Potential Impact
Geotechnical Considerations (potential failure of tailings unit)	
Alternative A - No Action	Tailings dam would be constructed using a modified centerline technique and would be designed to withstand maximum probable storm event and seismic event for the region. Ongoing monitoring during operation. Avalanche control features.
Alternative B - Proposed Action	DTF would be designed to maintain unsaturated tailings through engineered drainage system and temporary and permanent barriers. Design would account for maximum credible seismic event. Intensive ongoing monitoring during operations; pre-designed contingencies, including berm, depend on monitoring results.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Modified DTF design would include engineered structural berm. Berm would mitigate potential effects of instability in DTF.
Spill Potential From Increased Use of Diesel Fuel	
Alternative A - No Action	Limited use of diesel fuel.
Alternative B - Proposed Action	Increased risk of spill due to increased diesel usage primarily for power generation. Diesel would be transported, handled, and stored according to SPCC Plan, C-Plan, and FRP requirements. Any impacts limited by transfer timing restrictions, equipment design, and prompt spill response capability. Diesel transport from Comet Beach to mill by truck.
Alternative C - Marine Discharge	Similar to Alternative B, except double-walled pipe used to transport diesel from laydown area to mill.
Alternative D - Modified DTF Design	Similar to Alternative B.
Visual Impacts	
Alternative A - No Action	Primary visual impact would involve Sherman Creek tailings dam (270 ft high x 2,400 ft long).
Alternative B - Proposed Action	At full construction, DTF (220 ft high x 5,000 ft long) would average about 150 feet above treeline. Downslope would be reclaimed upon completion, and individual cells would be reclaimed fully immediately after completion. Borrow pits, roads, and facilities hidden by the tailings impoundment under Alternative A would be visible to marine traffic. Increased road width and traffic compared to Alternative A. DTF height limited by maximizing backfill. Alternative B includes measures to limit visual effects of DTF, borrow areas, and roads. Dust control and concurrent reclamation would be used to minimize emissions.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Same as Alternative B.

AFFECTED ENVIRONMENT

The 1992 FEIS presents extensive information on the environment potentially affected by the Kensington Gold Project. The following additional information was compiled and studies completed to support preparation of the Final SEIS:

- Acid-base accounting of the ore body waste rock and flotation tailings indicates low acid generation potential.
- Data from Eldred Rock in the vicinity of the project and regional precipitation data were analyzed to estimate average annual precipitation levels of 47 inches at sea level and 58 inches at the 800-foot elevation.
- Additional hydrologic modeling was performed to revise estimates of both high and low characteristic stream flows throughout the Sherman Creek basin.
- Continued monitoring of ground and surface water quality and stream flows has provided similar results to those presented in the 1992 FEIS.
- The small streams in the vicinity of the proposed DTF are ephemeral, and water quality is comparable to Sherman Creek.
- Further studies were conducted of currents in Lynn Canal north of Point Sherman. These studies indicate that eddies influence nearshore water movement. These effects extend as far as one-half mile offshore.
- As discussed in the 1992 FEIS, the Point Sherman area is a major commercial fishery. A natural fish barrier approximately 1,000 feet upstream from the mouth of Sherman Creek confines anadromous fish, including pink salmon, to the lowest segment of the creek. Resident Dolly Varden char populations occur above the fish barrier. The ephemeral streams in the vicinity of the proposed DTF do not support fish populations.
- The wetlands inventory for the site was expanded. Most of the project area is classified as wetlands. The proposed DTF area is forested wetlands and muskeg with dense mats of organic material and saturated soil conditions.
- Further cultural resource surveys confirmed the absence of sites eligible for listing on the National Register of Historic Places. Consultation with Alaska Natives was undertaken to identify traditional cultural resources in the area.
- Socioeconomics data for the Juneau and Haines areas were updated, with populations and total employment increasing moderately since 1990. In November 1996, the Juneau population was estimated to be 30,209. The Haines Borough population is 2,373, although the population varies seasonally.

ENVIRONMENTAL CONSEQUENCES

Chapter 4 of this SEIS provides the basis for comparing the alternatives. The chapter discusses the potential environmental effects associated with implementation of the action alternatives compared to the No Action Alternative. The analysis only addresses resources affected by the proposed project modifications. For other resources, the reader is referred to the 1992 FEIS.

Air Quality

The extent of air pollutant concentration increases from all alternatives would be very localized. The emission rates of nitrogen oxides, particulate matter, sulfur dioxide, carbon monoxide, and carbon dioxide would be similar under Alternatives B through D and higher than Alternative A. These higher emission rates would be primarily due to diesel power generation rather than LPG. Under all alternatives, however, combined stack and fugitive emissions from all sources would be less than National Ambient Air Quality Standards. Visibility effects from air emissions would be comparable for all alternatives and would be consistent with the applicable visual quality objectives. Visible emissions under Alternatives B through D would be similar to a cruise ship stack or Juneau's diesel-fired power-generating station.

Geotechnical Considerations

The centerline tailings dam construction method under Alternative A has an extremely low potential for failure, based on design standards and experience with many similar existing units worldwide. Avalanche control structures were added to Alternative A in response to the TAR. Under Alternatives B and C, DTF stability would depend on design features to keep the tailings from reaching saturation. However, there is currently a low to moderate potential of widespread saturation occurring during operations that could cause failure. This is primarily because of uncertainty whether design criteria could be achieved in practice and lack of proven examples of similar designs at existing mines. Extensive operational monitoring and pre-designed contingencies would lower the potential for failure during operations. Under Alternative D, an engineered structural berm would be incorporated into the DTF design and would minimize the risk of a significant failure if tailings became saturated.

Surface Water Hydrology

All alternatives would have some impact on flows in the Sherman Creek drainage through water withdrawals. Water demands are similar under each alternative: 190 gallons per minute (gpm) for Alternative A and 234 gpm for Alternatives B through D. Under Alternatives B and D, discharge of treated mine water would augment Sherman Creek flows (i.e., limiting flow reductions to the segment between withdrawal and discharge). With marine discharge under Alternatives A and C, Sherman Creek flows would be reduced by eliminating the existing fresh water mine drainage discharge to the South Ophir Creek tributary. Under all alternatives, instream flow requirements established by the Alaska Department of Game and Fish (ADF&G) would have to be met. Mine water would be used to provide an alternative water supply for the project.

All alternatives would include stream diversions. Alternative A would include 2.1 miles of diversions of Sherman and Ophir Creeks. These streams would be routed across the tailings impoundment at closure. Alternatives B through D would include 2.3 miles of diversions: a shorter diversion of Ophir Creek, a diversion for run-on water above the process area, and two run-on diversions around the DTF. Under Alternatives B through D, Sherman Creek would not be diverted. The natural drainage, including Ophir Creek, would be restored at the process area at closure. The diversions at the DTF site would be enlarged at closure to limit run-on.

Surface Water Quality

Alternatives A and C would not involve fresh water discharges of mine drainage or DTF effluent. Under Alternatives B and D, fresh water discharges would meet water quality-based permit limits at the discharge point. Offsite processing of sulfide concentrate under Alternatives B through D would virtually eliminate onsite acid generation potential.

The total area of disturbance that would generate sediment is comparable under all alternatives. Under Alternative A, the tailings impoundment discharge would be required to meet NPDES permit limits for sediment loadings. This would be accomplished through use of enhanced settling techniques. Sediment loadings from runoff from construction activities and facilities located outside of the impoundment drainage would be controlled using best management practices (BMPs). Under Alternatives B through D, sediment loadings from the process area and DTF would be limited by enhanced settling in ponds. Runoff from construction, the haul road, and the till borrow area would be addressed by BMPs. Concurrent reclamation of the DTF and restoration of the remainder of the site to pre-mining conditions to the extent possible would avoid any potential sediment-related impacts after closure.

Alternative A poses water quality-related risks associated with spills of diesel fuel, chlorine, cyanide, and LPG. Alternatives B through D eliminate spill risks from cyanide use. Only a small amount of chlorine would be used for water treatment. Increased potential for a diesel spill is associated with Alternatives B through D.

Ground Water Hydrology and Quality

Under all alternatives, potential hydrogeologic impacts from mine development would be very localized because of the confined nature of the aquifer. Under Alternative A, tailings seepage would be collected and returned to the impoundment during operations. Under Alternatives B through D, any tailings seepage that bypassed the DTF foundation drains would not affect ground water quality because of the inert characteristics of the flotation tailings. As noted above, offsite processing of sulfide concentrate would minimize the acid generation potential. Any accidental spill of diesel fuel could affect ground water quality; however, the probability of a spill is very low under all alternatives. Only Alternative A poses a ground water quality risk associated with cyanide.

Aquatic Resources – Marine

Alternative A would require a marine water mixing zone with a 31:1 dilution, involving approximately 13,700 cubic feet of water (a cube 24 feet on a side), to ensure compliance with water quality-based effluent limits for cyanide; several other parameters would require smaller mixing zones. The tailings impoundment discharge would be located one-half mile offshore to ensure complete mixing and to avoid the nearshore fishing area. A nearshore discharge (300 feet offshore) of combined mine drainage and DTF effluent could occur under Alternative C because of a smaller mixing zone requirement, less than a 5:1 dilution, involving approximately 825 cubic feet of water (a cube approximately 9 feet on a side), only for copper. The DTF and mine drainage discharges to fresh water under Alternatives B and D would not affect Lynn Canal. In addition, the marine sanitary discharge under Alternatives B and D would not adversely affect Lynn Canal. Marine spills of cyanide, LPG, diesel, and chlorine could occur under Alternative A. Under Alternatives B through D, increased diesel transport to the site would be the primary spill concern. The primary risk is associated with fuel transfer from the barge to the shore.

Aquatic Resources – Fresh Water

Alternative A would include a loss of 6,000 feet of habitat in the upper Sherman Creek drainage with potential fish mortality of 400 to 500 Dolly Varden. Alternatives B through D would temporarily eliminate 2,450 feet of habitat in Ophir Creek with potential fish mortality of 125 to 170 Dolly Varden. The ephemeral streams that would be disturbed by the DTF do not support fish populations. Under all alternatives, ADNR instream flow requirements for protection of aquatic life would have to be met. Fresh water discharges of process water under Alternatives B and D would be required to meet water quality-based effluent limitations at the discharge point.

Vegetation and Wetlands

All alternatives would affect vegetation and wetlands. Alternative A would disturb approximately 280 acres of vegetation, while Alternatives B through D would disturb between 250 and 270 acres. Under all alternatives, the entire site would be revegetated at closure. During operations, Alternative A would affect about 270 acres of wetlands, while Alternatives B through D would affect between 240 and 260 acres. The tailings impoundment under Alternative A would primarily impact palustrine forested wetlands; the DTF would affect palustrine scrub-shrub wetlands generally removed from Sherman Creek. Following closure under Alternative A, palustrine wetlands would be allowed to develop on the impoundment, although the physical alteration of the drainage would preclude complete wetlands restoration. Wetlands would be lost permanently at the DTF site. As part of mitigation, sediment ponds would be left as open water.

Cultural Resources

Additional surveys determined that none of the alternatives would affect pre-historic or historic sites eligible for listing on the National Register of Historic Places. Through consultation with Alaska Natives, the Point Sherman area was determined to be a traditional cultural property. None of the alternatives directly or indirectly affect this area.

Visual Resources

Under Alternative A, the primary visual impact would be the tailings impoundment. Under Alternatives B through D, the borrow pits and DTF would have the most significant visual effects. A larger portion of the road would also be visible. Reclamation and revegetation of these areas would reduce these impacts after closure.

Socioeconomic Resources

Socioeconomic impacts associated with the Kensington Gold Project are primarily driven by population. The peak operation workforce under Alternative A would be about 36 percent higher than under Alternatives B through D. At peak employment, Alternative A would represent about 2.8 percent of the population of Juneau, while peak employment under Alternatives B through D would be about 2.1 percent of the population. Alternative A would have a greater impact on the tight Juneau housing market. Up to 40 Haines residents and 7 Skagway residents could be employed during the operational period of the mine.

Transportation

The primary transportation differences among the alternatives are related to onsite and offsite transport. Alternatives B through D would eliminate the offsite and onsite risk of a cyanide spill. Under all alternatives, there is a very low risk of a spill associated with a barge sinking. Based on the operating experience of a major barge supplier of diesel fuel, the frequency of spills during transfer operations is about once every 500 transfers. Under Alternative A, there is a 33-percent chance that one spill event could occur during the 14-year life of the mine. Under Alternatives B through D, the risk from such transfers is between 1 and 2 spills over the life of the mine. The maximum extent of any spill from a transfer would be 880 gallons. Under all alternatives, onshore fuel storage and transfer would occur in areas with secondary containment. For Alternative A, the risk of a truck accident potentially resulting in a diesel fuel spill is 1 in 7,000 per year. For Alternatives B through D, this risk would be about 1 in 900 per year. The maximum potential spill would be the capacity of the trucks—5,000 gallons. The risk of a diesel pipeline rupture and spill under Alternative C is about 1 in 500 per year, with a maximum potential spill of 17,000 gallons. The effects of any spill would be mitigated by prompt spill response.

For tailings transport under Alternatives B and C, the risk of a truck accident and tailings spill would be about 1 in 80 per year with a maximum potential spill of 50 tons. The risk of a tailings pipeline rupture and spill under Alternative D would be about 1 in 700 per year with a total potential release of 270,000 gallons (2,650 tons) of tailings slurry.

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CHAPTER 1

PURPOSE OF AND NEED FOR PROPOSED ACTION

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1. PURPOSE OF AND NEED FOR PROPOSED ACTION

Background

This Final Supplemental Environmental Impact Statement (SEIS) was prepared in order to consider a Revised Plan of Operations to develop, construct, and operate a gold mine. Coeur Alaska, Incorporated, a subsidiary of Coeur d'Alene Mines Corporation, is the proponent of the proposed Kensington Gold Project, which would be located on public and private lands in Southeast Alaska. Figure 1-1 shows the location of the Kensington Gold Project.

This Final SEIS was prepared under the direction of the U.S. Department of Agriculture, Forest Service, Tongass National Forest, which is the lead agency. The U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (Corps of Engineers) are cooperating agencies to the Forest Service in preparation of this SEIS (40 CFR 1501.6).

The Chatham Area Forest Supervisor signed the Forest Service Record of Decision (ROD) for the 1992 Final Environmental Impact Statement (1992 FEIS) on January 29, 1992. Based on this ROD, the Kensington Joint Venture, a partnership between Coeur Alaska and Echo Bay Exploration, Incorporated, a subsidiary of Echo Bay Mines Corporation, submitted a Plan of Operations for the Kensington Gold Project in February 1992. On July 17, 1992, the Forest Service approved the Plan of Operations with various conditions, including completion of a reclamation plan and monitoring plan and posting of a reclamation bond. These items were not completed, and not all of the necessary permits were obtained from other agencies.

EPA and the Corps of Engineers participated as cooperating agencies and will issue RODs in conjunction with their respective permit decisions. Neither agency has issued a ROD or permit to date. EPA prepared the *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994) to evaluate potential short- and long-term water quality impacts and potential long-term ecological consequences of the selected alternative identified in the Forest Service ROD. EPA developed findings and recommendations to assist the Corps of Engineers in determining whether the proposed project would comply with Section 404(b)(1) guidelines of the Clean Water Act. EPA made six recommendations to address its findings:

- Additional wastewater treatment is needed.
- Further analysis of sediment loads in the proposed diversion structures is needed.
- Further analysis and redesign are required to address the avalanche hazard.
- The marine outfall needs to be moved to deeper water, or more information is needed for the proposed location.
- New leach tests for metals mobility and kinetic testing for potential acid generation are required. Further analysis of residual cyanide and its breakdown products is needed.

  Additional analyses of ore samples are needed to determine whether bulk samples used to project effluent quality are representative of the ore body.

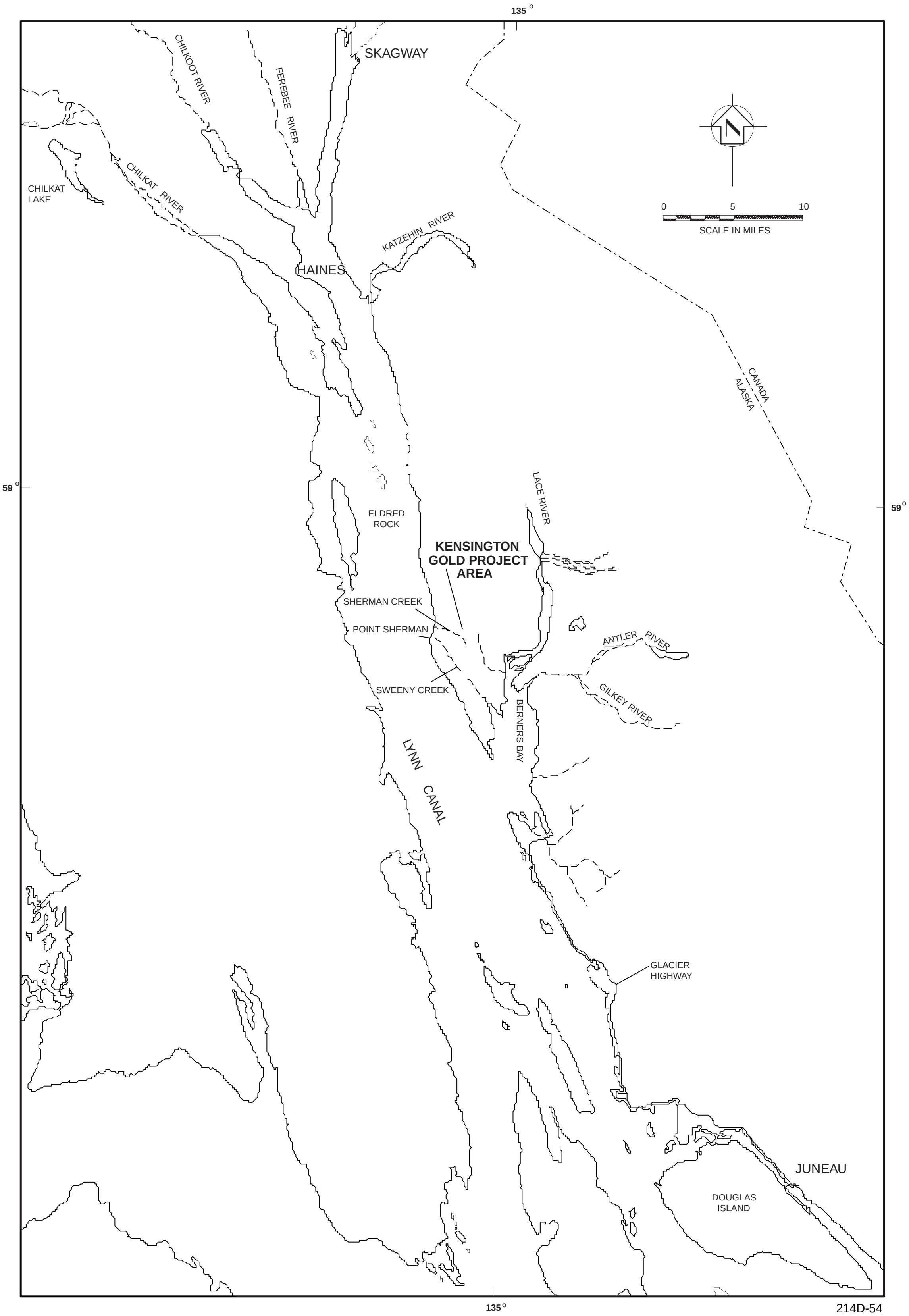

Figure 1-1. Location of Kensington Gold Project

This Final SEIS discusses the changes recommended in the TAR.

During summer 1995, Coeur Alaska became the sole operator of the Kensington Gold Project. In October 1995, the operator submitted an Amended Plan of Operations for the Kensington Gold Project. The primary modifications include 1) enhanced treatment of tailings effluent with discharge to Sherman Creek, 2) stabilization and backfilling of cyanidation tailings solids, 3) use of diesel generators for onsite power generation, 4) construction of avalanche control structures, and 5) relocation of the laydown and helicopter pad facilities. On October 16, 1995, the Forest Service published an initial Notice of Intent to prepare an SEIS for the proposed changes to the Kensington Gold Project. Public scoping meetings were held in October 1995.

In response to issues raised during the scoping process and meetings with Federal, State, and local agencies and other interested parties, the operator submitted a Revised Plan of Operations to the Forest Service in June 1996 (i.e., 1996 Revised Plan of Operations). On July 22, 1996, the Forest Service published a new SEIS Notice of Intent for the 1996 Revised Plan of Operations. The 1996 Revised Plan of Operations includes:

- Offsite processing of flotation concentrate (no onsite cyanidation)
- Construction of a dry tailings facility (DTF) between Sweeny and Sherman Creeks
- Backfill of at least 25 percent of flotation tailings.

All aspects of the operator's proposed operations as they affect National Forest surface resources are subject to a Plan of Operations (36 CFR 228) and Council on Environmental Quality (CEQ) regulations (40 CFR 1500). The SEIS must analyze the direct, indirect, and cumulative impacts associated with the proposed changes to the Plan of Operations. Based on this analysis, the Forest Service may approve the 1996 Revised Plan of Operations or require the operator to modify its proposal.

The 1992 FEIS analyzed the effects of developing the Kensington Gold Project. This Final SEIS only analyzes the effects of the 1996 Revised Plan of Operations.

Purpose and Need

The purpose of and need for the Proposed Action is to reduce potential impacts from a mixing zone in marine waters; increase assurance of meeting water quality standards; minimize the potential impacts to Ophir, Ivanhoe, and Sherman Creeks; reduce operational and maintenance requirements; minimize reclamation and long-term closure liabilities; and increase the economic efficiency of the mine.

1.1 PROPOSED ACTION

Modifications to the 1992 Approved Plan of Operations include offsite processing of flotation concentrate and dry tailings disposal at approximately Site B identified in the 1992 FEIS. Flotation concentrate would be placed in sealed containers and transported offsite for final processing. At least 25 percent of the flotation tailings would be paste backfilled. The remaining tailings would be managed in the DTF. Mine drainage would undergo precipitation and filtration and be combined with process area runoff in a sediment pond. The sediment pond would discharge to upper Sherman Creek. The DTF would be designed to limit infiltration into the tailings. Waste rock and coarse and fine till would be used in DTF construction. All waste rock generated by the mine would either be used in DTF and process area foundation/bench construction or be backfilled. Till would be obtained from a 27-acre borrow area northwest of the process area. DTF seepage and runoff would be collected in a sediment pond and discharged to Camp Creek. Diesel fuel would be used for power generation. The locations of the helicopter pad, marine terminal, laydown area, and personnel camp are modified from the 1992 Approved Plan of Operations.

1.2 RESPONSIBLE OFFICIAL AND DECISION TO BE MADE

The Forest Supervisor for the Chatham Area of the Tongass National Forest is the responsible official for those portions of the project within the jurisdiction of the Forest Service and will document his decision in a Record of Decision based on the analysis presented in this Final SEIS. The responsible official may make the following decisions:

- Select the No Action Alternative
- Select an action alternative without modification
- Select an alternative that combines project components of more than one alternative
- Select an action alternative and require additional mitigation measures.

1.3 SCOPING AND PUBLIC INVOLVEMENT

As required by the National Environmental Policy Act (NEPA) (CEQ 1501.7), the Forest Service provided for an early and open process to determine the scope of issues to be addressed and to identify significant issues related to proposed modifications to the Kensington Gold Project.

As indicated previously, the Notice of Intent to prepare an SEIS for the 1996 Revised Plan of Operations was published in the *Federal Register* on July 22, 1996. The Forest Service had mailed approximately 360 scoping letters to the public on July 15, 1996. The letter described the proposed changes to the Plan of Operations and the SEIS process. The letter also announced that public scoping meetings would be held in Juneau, Alaska, on August 7, 1996, and in Haines, Alaska, on August 8, 1996. Advertisements were placed in the *Juneau Empire* newspaper on August 1, 4, and 6, 1996, and the *Chilkat Valley News* in Haines on August 1, 1996, announcing the public meetings.

The public meetings were held at Centennial Hall in Juneau on August 7, 1996, and at the City Council Chambers in Haines on August 8, 1996. Both meetings were open to the public and provided an opportunity for the public to learn about the project and the SEIS process from the Forest Service, EPA, and Corps of Engineers, as well as identify issues they wanted analyzed in the SEIS. In addition, representatives from Coeur Alaska attended the meetings to answer questions about the proposal.

Twenty-seven letters were received from the public in response to scoping. In addition, the 1992 FEIS and scoping conducted during October and November 1995 were reviewed for issues and comments.

The Notice of Availability for the Draft SEIS for the Kensington Gold Project was published in the *Federal Register* on February 18, 1997. More than 500 copies were distributed to the public. On March 6, 1997, members of the Forest Service Interdisciplinary Team and Science Applications International Corporation were available at the Juneau Ranger District to answer questions from the public. Public hearings on the Draft SEIS were held in Juneau on March 25, 1997, and Haines on March 26, 1997. In addition, more than 50 comment letters on the Draft SEIS were received from the public. Appendix A presents the letters and responses to each comment. The Final SEIS was revised as appropriate, based on the comments received.

1.4 SIGNIFICANT ISSUES

Significant issues are used to formulate alternatives to the Proposed Action. The following significant issues were identified during the scoping process:

- **Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit meet water quality standards.** Concerns were raised that the wastewater discharges permitted through the NPDES process meet water quality standards.
- **The potential for and effects of failure of the DTF should be considered.** The risks, liability, and contingencies, as well as environmental effects, of a DTF failure should be discussed.
- **The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized.** Concerns were expressed that the visual impacts of the DTF, road, borrow pits, temporary camp, fugitive dust, and diesel emissions from power generation could negatively affect tourism.
- **Use of diesel fuel instead of liquefied petroleum gas (LPG) for power generation may result in increased air emissions.** There is concern that burning diesel fuel, as well as other project modifications, would increase emissions of air pollutants, including carbon dioxide.
- **The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.** The increase in transportation, handling, and use of diesel fuel for power generation could increase the potential for spills.

Table 4-1, presented in Chapter 4, describes the units of measure used to differentiate how each alternative addresses the issues.

1.5 OTHER ISSUES

Some issues raised during the scoping process were determined to be non-significant in the context of the NEPA analysis. These issues, therefore, were not used in developing alternatives; however, some were used in evaluating the potential impacts of the alternatives. The following list presents the non-significant issues and the reasons for this determination:

- **The cumulative impacts with other projects in Berners Bay should be considered**. CEQ regulations for implementing NEPA require agencies to consider cumulative impacts when preparing an EIS. These are the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Therefore, the SEIS is required to consider the cumulative effects of other projects. Because cumulative effects are discussed in this Final SEIS for all alternatives, this was not considered a significant issue. Chapter 4 considers differences among the alternatives.

- **The location of offsite cyanide or other processing of concentrate should be evaluated.** The operator indicated that flotation concentrate would be processed at an existing facility in the United States or another country. If the facility were in the United States, the mill site where the ore concentrate would be processed must be a permitted facility. The concentrate must be processed within the terms and conditions of that permit. If the concentrate were sent to a new facility or an existing facility in the United States not permitted to receive Kensington concentrate, additional permitting and analysis might be required. Such permitting and analysis is beyond the scope of this SEIS.

  The 1992 FEIS analyzed the effects of cyanidation. If the flotation concentrate were shipped offsite for processing, while some effects might differ, the overall effects would generally be similar. Different permitting authorities would be involved, depending on the location of the concentrate processing.

- **Mine worker safety should be addressed.** The U.S. Mine Safety and Health Administration (MSHA) regulates worker health and safety aspects of mines. Authorized MSHA representatives would inspect the operation routinely and would be involved in educational and safety training. Coeur Alaska would be responsible for providing MSHA with reports of accidents, injuries, occupational diseases, and related data. This issue is outside the scope of this Final SEIS.

- **The SEIS should evaluate possible transportation changes.** The 1992 FEIS considered several transportation options. Transport of workers to the mine by helicopters flying from Juneau's airport was selected as part of the selected alternative in the 1992 Forest Service ROD. Coeur Alaska has not submitted any proposed changes to this option. If any changes are proposed, the need for additional NEPA analysis would be determined.

- **The socioeconomic evaluation of the 1992** FEIS **should be updated.** The Forest Service updated the socioeconomic analysis presented in the 1992 FEIS for this Final SEIS. The results of the Final SEIS socioeconomic analysis are generally comparable to the 1992 FEIS and were not considered a significant issue. Chapter 4 discusses differences among the alternatives.

- **The potential should be evaluated for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, the personnel camp, snow disposal areas, and diversion ditches. Riparian areas need to be maintained to minimize sediment input to fresh water.** This issue is considered during EPA permitting of storm water discharges from these areas and in design of best management practices for sediment control. Chapter 4 discusses differences among the alternatives.

- **The potential for reduction in fish habitat due to water withdrawal should be considered.** This issue would be considered during permitting of water withdrawal by the Alaska Department of Natural Resources. The Forest Service and the Alaska Department of Fish and Game would be consulted. Chapter 4 discusses differences among the alternatives.

- **The potential for adverse effects on fish habit because of undersized culverts should be considered.** This issue would be addressed by site-specific best management practices during road design. Under all alternatives, the culverts would be sized to minimize adverse impacts to fish habitat.

- **EPA must require quality assurance/quality control as part of a monitoring program and provide for periodic splits or duplicate sampling for analysis at an independent laboratory to ensure accuracy of an operator's data.** EPA would consider this during preparation of an NPDES permit.

- **Under all alternatives, the reclamation plan should ensure maintenance or improvement of ground and surface water quality.** The final reclamation plan would meet agency requirements for protection of surface and ground water quality.

- **Site-specific variances should not be granted for mixing zones.** While the State has provisions for short-term variances, the operator has not requested any "site-specific variances" for fresh or marine waters. The operator has instead applied for and received permanent site-specific criteria for TDS and sulfate for Sherman and Camp Creeks. Issuance of these criteria is solely the authority of the State and EPA and is beyond the scope of the NEPA process. The operator has not requested mixing zones for Sherman or Camp Creek.

1.6 AGENCY RESPONSIBILITIES (PERMITS AND APPROVALS)

1.6.1 Federal Government

U.S. Forest Service

NEPA Compliance and ROD on Final SEIS
Approval of 1996 Revised Plan of Operations
Section 106 of the National Historic Preservation Act Compliance
Sections 313 and 319 of the Clean Water Act Compliance
Compliance with Executive Orders
Consistency with 1997 Tongass Land and Resource Management Plan

The Forest Service is the lead agency in the preparation of the Kensington Gold Project SEIS. The Forest Service's authority to require, evaluate, and approve or modify the operator's 1996 Revised Plan of Operations is based on the 1897 Organic Act, which is described in 36 CFR Part 228. If another agency cannot meet its regulatory responsibilities, the Forest Service is ultimately responsible for ensuring that Federal and State regulations are implemented on National Forest System lands.

All alternatives are consistent with the 1997 Tongass Land and Resource Management Plan (USFS, 1997b). The site is located in an area designated as Modified Landscape with a Minerals Prescription. The emphasis for management in this area is encouragement of minerals development in an environmentally sensitive manner and limited to the area necessary for efficient, economic, and orderly development. The long-term goal is reclamation consistent with a Modified Landscape designation.

The Gilkey River was determined suitable as a Wild River by the Tongass Land and Resource Management Plan (USFS, 1997b). The Forest Service must protect rivers found suitable as Wild until Congress determines to designate them as Wild Rivers. The Kensington Gold Project would have no effect on the Gilkey River. Consequently, its eligibility would not be affected.

Under the previous Tongass Land Management Plan as amended (1979), the Kensington Gold Project was located in an area designated as Land Use Designation (LUD) II. This designation allowed for mineral activities with the long-term goal of maintaining the wildland character of the area.

Prior to approving the 1996 Revised Plan of Operations, the Forest Service must comply with Section 106 of the National Historic Preservation Act (NHPA). Compliance with the NHPA generally involves 1) identification of historic properties that might be affected, 2) assessment of effects to those properties, 3) consultation with the State Historic Preservation Office and interested parties, and 4) comment by the Advisory Council on Historic Preservation if historic properties could be affected.

Under agreement between the Forest Service and ADEC, the Forest Service has committed to fulfilling specific responsibilities to ensure that activities on National Forest

System lands are consistent with the requirements of Clean Water Act (CWA) Sections 319(b)(2)(f), 319(k), and 313 and Executive Order 12088. Section 319 addresses nonpoint source pollution, and Section 313 and Executive Order 12088 require the Forest Service to adhere to the goals set forth in State water quality standards.

Executive Order 12962 requires Federal agencies to evaluate the potential effects of proposed Federal actions on recreational fisheries. Recreational fishing at the Kensington Gold Project site is limited. This Final SEIS complies with Executive Order 12962 by considering the potential impacts of each alternative on water quality, habitat, and transportation. In addition, Executive Order 12898 requires Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of proposed activities on minority and low-income populations. This document addresses Executive Order 12898 by considering the potential impacts of each alternative on such populations.

U.S. Environmental Protection Agency

Participation as Cooperating Agency
NEPA Compliance for Permits Under Its Jurisdiction
Clean Water Act Compliance
Clean Air Act Compliance
Notification of Hazardous Waste Activity

EPA is a cooperating agency with the Forest Service on the Kensington Gold Project Final SEIS.

EPA has primary responsibility for implementation of Sections 301, 306, 311, and 402 of the CWA. EPA shares responsibility for Section 404 with the Corps of Engineers.

Sections 301 and 306 of the CWA require EPA to establish numeric limitations or criteria for discharges of water pollutants. Section 301 specifically requires EPA to establish technology-based effluent guidelines for new sources. These criteria must be met at the "end of pipe" where the discharge occurs. The new source performance standards applicable to this facility are described in 40 CFR Part 440.104. In addition, Section 301 requires that all NPDES permits include effluent limitations protective of water quality.

Section 311 of the CWA establishes requirements relating to discharge or spills of oil or hazardous substances. EPA requires each facility that handles substantial quantities of oil to prepare a Spill Prevention, Containment, and Countermeasure Plan (SPCC) and a Facility Response Plan (FRP).

Section 402 of the CWA establishes the NPDES program. This program authorizes EPA to permit point source discharges of effluent, including process wastewater and storm water. Discharges must meet all effluent limitations, including water quality-based standards, established under other CWA sections.

In accordance with Section 511(c)(1) of the CWA, NPDES permit actions for new sources are defined as major Federal actions subject to NEPA (40 CFR Part 6, Subpart F). EPA, as a cooperating agency with the Forest Service for this Final SEIS, will issue a ROD in conjunction with the final permit action.

Section 404 of the CWA authorizes the Corps of Engineers to issue permits for the discharge of dredged or fill materials into waters of the United States. EPA also has authority under Section 404 for reviewing project compliance with Section 404(b)(1) guidelines, Section 404(b) elevation authority, and Section 404(c). Under Section 404(c), EPA may prohibit or withdraw the specification (permitting) of a site upon determination that the use of the site would have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, or recreational areas.

The most basic goals of the Clean Air Act are to protect public health and welfare. Section 309 of the Clean Air Act requires EPA to review and comment on EISs. In addition, EPA approves State implementation plans for air quality and reviews Air Quality Control Permit to Operate applications, including prevention of significant deterioration requirements.

U.S. Army Corps of Engineers

Participation as Cooperating Agency
NEPA Compliance for Permits Under Its Jurisdiction
Section 404 Permit – Clean Water Act (Dredge and Fill)
Section 10 Permit – Rivers and Harbor Act

The Corps of Engineers is a cooperating agency with the Forest Service on the Kensington Gold Project Final SEIS.

Section 404 of the CWA authorizes the Corps of Engineers to issue permits for discharge of dredged or fill material into waters of the United States. The act prohibits such a discharge except pursuant to a Section 404 permit. To the degree that they affect waters of the United States, various activities undertaken in connection with mining operations could require a Section 404 permit. Such activities include road or bridge construction, construction of dams for tailings storage or water storage, and stream diversion structures.

The Corps of Engineers is responsible for determining whether a proposed action complies with Section 404(b)(1) guidelines. A Section 404 permit cannot be issued without such compliance. Appendix B presents a draft of the Corps of Engineers Evaluation of the Discharge of Dredged and Fill Material in Accordance with Section 404(b)(1) Guidelines, as well as the public notice for the draft Section 404 permit.

All Federal agencies, including the Corps of Engineers, must comply with Executive Orders 11990 and 11988 with respect to impacts to the Nation’s wetlands and/or floodplains. The Corps’ regulatory program provides flexibility when considering the national goal of “no net loss” for wetlands. This goal cannot always be achieved on an individual project-by-project basis. The Alaska District of the Corps of Engineers would consider site-specific conditions and impacts when determining the extent of compensatory mitigation required for wetland losses. Wetlands in the area to be affected by the proposed Kensington Gold Project were identified using the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Federal Interagency Committee for Wetland Delineation, 1989). Of specific note, the Corps of Engineers would regulate the excavation of the wetlands and placement of construction fill at the DTF site (under the 1996 Revised Plan of Operations) as fill activity under Section 404. EPA would regulate effluent discharge from the DTF under a Section 402 permit.

Pursuant to the Rivers and Harbors Act of 1899 and Section 103 of the Marine Protection, Research, and Sanctuaries Act, the Corps of Engineers has permitting authority to regulate various activities that affect traditionally navigable waters. Pursuant to Section 10 of the Rivers and Harbors Act of 1899, a permit is required for any structure or work that could obstruct traditionally navigable waters. The Kensington Gold Project marine terminal would require a Section 10 permit.

U.S. Fish and Wildlife Service

Threatened and Endangered Species Consultation
Bald Eagle Protection Act Compliance

The U.S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act, as reauthorized in 1982, and the Bald Eagle Protection Act of 1940, as amended. For the Kensington Gold Project, the Forest Service must consult with the USFWS regarding any threatened or endangered species that might be impacted by the proposed project. If any impacts are projected, specific design measures must be developed to protect the affected species.

National Marine Fisheries Service

Threatened and Endangered Species Consultation

For the Kensington Gold Project, the Forest Service must consult with the National Marine Fisheries Service in accordance with the Endangered Species Act, the Marine Mammal Protection Act, and the Research and Sanctuaries Act. If any impacts are projected to any threatened or endangered marine species, specific design measures must be developed to protect the affected species.

1.6.2 State and Local Government

Alaska Division of Governmental Coordination

Coastal Management Program Certification

The Division of Governmental Coordination (DGC) administers the Alaska Coastal Management Program (ACMP). DGC coordinates State reviews of activities in the coastal zone involving State and Federal permits. The consistency review provides a streamlined, coordinated process for reviewing and issuing State permits for proposed development projects affecting natural resources and uses in Alaska's coastal zone. In addition to coordinating projects that require State permits, DGC is responsible for coordinating consistency reviews for direct Federal actions (e.g., Corps of Engineers dredging permit) and projects that require Federal permits (e.g., an NPDES permit).

Coastal development projects are reviewed to ensure consistency with the standards of the ACMP, given at 6 AAC 80, and the enforceable policies of approved local coastal district programs. For each project, the ACMP and consistency review regulations provide a structure for public notice, project review, issue resolution, and decisionmaking with the full involvement of State agencies, local coastal districts, and the project applicant.

DGC previously reviewed elements of the Kensington Gold Project and issued a finding (AK820622 01C) on October 30, 1992. This finding indicated consistency with the ACMP. Because proposed changes were submitted, State review of the new project configuration will be required.

Alaska Department of Environmental Conservation

The Alaska Department of Environmental Conservation (ADEC) is responsible for major water and air quality permits associated with the Kensington Gold Project. Under Section 401 of the CWA, ADEC responsibilities include certification of EPA's NDPES permit and the Corps of Engineers Section 404 permit. ADEC must certify that the requirements of these permits would comply with State water quality standards. These standards include designation of the beneficial uses of the water, as well as numerical and narrative water quality criteria established to protect the beneficial uses.

ADEC is responsible for the following major permits, which would be required for the proposed project:

- Section 401 Certification of the Corps of Engineers Section 404 permit
- Section 401 Certification of the EPA NPDES permit
- Engineering review and approval of the sanitary wastewater treatment and disposal systems
- Solid waste permit for the construction, operation, and maintenance of solid waste facilities, including the DTF, and for the management of non-combustible domestic refuse and recyclable goods
- Approval of Oil Discharge Prevention and Contingency Plan (C-Plan) for management of and spill response for petroleum materials
- Air Quality Control Permit to Operate to construct, modify, and operate facilities that produce air emissions.

Alaska Department of Natural Resources

The Alaska Department of Natural Resources is responsible for the following:

- Water rights permits, which authorize the use of surface and subsurface waters of the State and include compliance with instream flow requirements established by the Alaska Department of Fish and Game
- Tideland permit, which is a State lease required for permanent improvements to tidelands
- Right-of-way for marine outfall, barge landing, fuel transfer facility, and concentrate transfer facility.

Alaska Department of Fish and Game

The Alaska Department of Fish and Game is responsible for the following:

- Fish passage and habitat permits for activities that divert, obstruct, or change the natural flows of an anadromous fishery
- Determination of instream flows.

City and Borough of Juneau

The City and Borough of Juneau is responsible for issuance of the Large Mine Permit and review for consistency with the Juneau Coastal Management Program.

CHAPTER 2

DESCRIPTION OF ALTERNATIVES, INCLUDING PROPOSED ACTION

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2. DESCRIPTION OF ALTERNATIVES, INCLUDING PROPOSED ACTION

In July 1992, the U.S. Forest Service approved a Plan of Operations (1992 Approved Plan of Operations) for the proposed Kensington Gold Project, located 45 miles north of Juneau, Alaska. The 1992 Approved Plan of Operations included revisions to reflect the Forest Service Record of Decision (ROD) issued for the Final Environmental Impact Statement (1992 FEIS) dated January 29, 1992. The 1992 Approved Plan of Operations reflects the alternative selected by the Forest Service—Alternative F, Water Treatment Option 1. Alternative F consists of underground mining, conventional "wet" tailings disposal, and marine discharge of treated effluent from the proposed operation.

ALTERNATIVES FOR THE KENSINGTON GOLD PROJECT

Alternative A (No Action), 1992 FEIS Alternative F, Option 1—Sherman Creek tailings impoundment, marine discharge of impoundment effluent, onsite cyanidation, liquefied petroleum gas (LPG) for power generation

Alternative B (Proposed Action)—Dry tailings facility (DTF) with paste backfill, offsite processing/no onsite cyanidation, fresh water discharge of mine drainage and DTF effluent, diesel fuel for power generation, conduits

Alternative C (Marine Discharge)—Similar to Proposed Action, except marine discharge of mine drainage and DTF effluent, diesel pipeline

Alternative D (Modified DTF Design)—Similar to Proposed Action, except construction of an engineered structural berm around DTF, tailings pipeline, bridges

During summer 1995, Coeur Alaska, Incorporated, became the sole operator of the Kensington Gold Project. On June 24, 1996, the operator submitted a Revised Plan of Operations (1996 Revised Plan of Operations) and related documentation for the Kensington Gold Project. The most significant revisions to the 1992 Approved Plan of Operations involve ore-processing methods and final disposal of the tailings. Specifically, the 1996 Revised Plan of Operations proposes offsite transport and processing of flotation concentrate, which would eliminate onsite cyanidation. The plan also modified tailings disposal from a conventional wet disposal tailings dam in the Sherman Creek drainage to a "dry" tailings disposal facility located between Sherman and Sweeny Creeks.

This Final Supplemental EIS (SEIS) documents the National Environmental Policy Act (NEPA) process for the 1996 Revised Plan of Operations. Due to publication of the 1992 FEIS and issuance of the Forest Service ROD in 1992 for Alternative F, Water Treatment Option 1, the No Action Alternative for this Final SEIS is equivalent to not approving the 1996 Revised Plan of Operations. The Forest Service's No Action Alternative for this Final SEIS, therefore, comprises the project components of Alternative F, Water Treatment Option 1, as described in the 1992 Approved Plan of Operations, with modifications that address the requirements of the *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994). U.S. Environmental Protection Agency (EPA) Region 10 prepared the TAR for the U.S. Army Corps of Engineers (Corps of Engineers), Alaska District. This Final SEIS refers to the No Action Alternative as Alternative A. Alternative B in this Final SEIS is the Proposed Action. Alternatives C and D in this Final SEIS modify the Proposed Action based on the scoping process, issue identification, and alternative formulation and analysis.

Unlike the Forest Service, EPA and the Corps of Engineers have not issued individual RODs or permits for the 1992 Approved Plan of Operations. For EPA and the Corps of Engineers, therefore, the No Action Alternative is the original Alternative A as described in the 1992 FEIS. Alternative A in the 1992 FEIS would not allow project development but would allow continued mineral exploration. The 1992 FEIS fully considers this alternative and, therefore, this SEIS does not evaluate it further.

The alternatives evaluated in this Final SEIS focus primarily on mineral processing, tailings disposal, wastewater management, the location for effluent discharge, and fuel source selection. After publication of the 1992 FEIS, the operator conducted additional studies on baseline hydrology, water quality, aquatic life, and soil conditions and provided study data to the Forest Service, EPA, and Corps of Engineers to support identification and evaluation of feasible project alternatives and mitigation measures.

Project components, such as power supply, were combined to form a reasonable range of project alternatives. Not all possible combinations were used and, in some cases, individual components can be substituted in other alternatives with similar effects. Chapter 1 notes that the responsible official has the option of selecting an alternative that combines project components of more than one alternative. In the example of power supply, while the component of LPG fuel for power generation is only displayed in Alternative A, it could be combined with any alternative to form the selected alternative in the Forest Service ROD.

This chapter presents the four alternatives for the Kensington Gold Project: Alternative A – No Action (the alternative selected in the 1992 ROD), Alternative B – Proposed Action, Alternative C – Marine Discharge, and Alternative D – Modified DTF (dry tailings facility) Design. Section 2.1 discusses significant issues raised during the scoping process and alternatives development. Section 2.2 provides an overview of each alternative. Section 2.3 discusses the alternatives by project component, and Section 2.4 describes the components not studied in detail. Section 2.5 describes relevant mitigation measures and monitoring. The chapter concludes with Section 2.6, which compares the alternatives.

2.1 ISSUES AND ALTERNATIVES DEVELOPMENT

Formulating alternatives to the Proposed Action is an important component of the NEPA process. By identifying issues during the scoping process and formulating alternatives to the Proposed Action, the lead Federal agency (i.e., Forest Service) can alter or lessen the magnitude of potential environmental impacts associated with the Proposed Action.

The alternatives developed for this Final SEIS reflect the significant issues identified during scoping for the SEIS, including the following:

- Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit meet water quality standards.
- The potential for and effects of failure of the DTF should be considered.

- The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized.
- Use of diesel fuel instead of liquefied petroleum gas (LPG) for power generation may result in increased air emissions.
- The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.

Table 2-1 summarizes the development of alternatives, including the No Action Alternative, in response to issues identified during scoping. Alternative A provides for evaluation of the air quality and spill-related impacts of LPG versus diesel fuel usage for power generation. Alternative A also allows for comparison of visibility-related effects in Lynn Canal. Alternative C describes the potential effects of marine discharge of effluent generated from the facilities included in the 1996 Revised Plan of Operations. Alternative C also addresses spill potential from piping diesel fuel from the beach to the process area rather than truck transport. Alternative D was developed in response to the potential for DTF failure. Alternative D also considers the relative spill and erosion-related impacts of transporting tailings to the DTF via pipeline rather than truck. In addition, Alternative D addresses potential aquatic resource impacts through the use of bridges rather than conduits for road crossings.

2.2 OVERVIEW OF PROJECT ALTERNATIVES

This section introduces the four alternatives for the Kensington Gold Project. Section 2.3 provides a detailed discussion of each alternative by project component. Figures 2-1 through 2-4, provided after Section 2.2, present layouts and summarize Alternatives A through D, respectively.

2.2.1 Alternative A – No Action Alternative

Alternative A assumes that none of the proposed 1996 revisions to the 1992 Approved Plan of Operations would be implemented. This alternative serves as the baseline for estimating the potential effects of the other alternatives and project components. NEPA requires that a No Action Alternative be considered in all environmental impact analyses. In this instance, the No Action Alternative consists of Alternative F as identified in the 1992 FEIS and selected by the Forest Service in the 1992 ROD and modified to address TAR requirements.

Alternative A would include an underground mine, an ore-processing facility, tailings impoundment, office and maintenance complex, onsite employee camp, two heliport/helipads, a marine terminal on Comet Beach, and other ancillary facilities. Other facilities include an access road from the marine terminal to the mine, a fuel storage area, and an explosives magazine.

During full production, the Kensington Gold Project would process about 4,000 tons of ore per day. Ore would be mined by the underground extraction technique of long hole, open stoping. An estimated 400 tons of waste rock per day would be hauled to the surface using a conveyor system and stored in a 15-acre pile at the mill. Approximately 50 percent of the waste

Table 2-1. Development of Alternatives in Response to Scoping Issues

Issues	Alternative A	Alternative B	Alternative C	Alternative D
Potential impacts to water quality	Marine discharge from tailings pond to Lynn Canal	Discharge to Sherman Creek (outfall 001) and Camp Creek (outfall 002); precipitation/filtration of mine drainage and enhanced settling in ponds, truck transport of tailings, conduits	Marine discharge of mine drainage and DTF effluent to Lynn Canal; discharge of process area runoff to upper Sherman Creek	Tailings slurry line and bridges
Potential for and impacts associated with failure of the DTF	No DTF	Engineered drainage system for DTF; contingencies for instability	Same as Alternative B	DTF modified to include engineered structural berm around west, north, and south sides
Potential impacts to visual quality and the effects on tourism, especially cruise ships and ferries	Tailings impoundment	DTF; some backfill of tailings; till borrow area required for construction	Same as Alternative B	Same as Alternative B
Use of diesel for power generation and resulting air emissions, including carbon dioxide	Liquefied petroleum gas (LPG)	Diesel	Diesel	Diesel
Potential impacts to water quality, fisheries, and other resources caused by spills when storing, handling, and transporting diesel fuel	LPG	Truck transport of diesel from intermediate tank to process area	Diesel fuel piped from beach to process area	Same as Alternative B

rock would be used for constructing the tailings embankment, road, and facility foundations. About 920,000 tons of waste rock would require permanent management in the pile.

Ore would be mined and sent to underground jaw crushers. The crushed ore then would be transported to the surface. At the surface, the crushed ore would be ground and passed through a flotation circuit, in which the gold-bearing minerals would be separated from barren rock. Gold would be recovered from the flotation concentrate by tank cyanidation methods to produce gold bullion. Cyanidation tailings would be treated with chloride to destroy cyanide. Both flotation and cyanidation tailings would be pumped to the tailings pond.

Flocculation and baffles would be used to enhance settling in the tailings pond. Tailings water would be recycled from the pond to the maximum extent possible, and excess water would be discharged via a pipeline to Lynn Canal. The marine discharge would be located one-half mile offshore north of Point Sherman. Ophir Creek would be diverted around the tailings impoundment in an open, concrete-lined channel, and avalanche control structures would be constructed in the Ophir Creek drainage. Upper Sherman Creek would be diverted through a culvert.

Reclamation would comprise restoring the site to its pre-mining land use of wildlife habitat and recreation. All buildings, structures, storage tanks, and roads would be removed from the site, except the tailings impoundment. All disturbed areas, including the tailings impoundment, would be regraded to blend with the natural topography to the maximum extent possible. These areas then would be covered with growth media and seeded. Upper Sherman Creek and South Fork Sherman Creek would be routed across the east end of the tailings impoundment into a pond adjacent to the Ophir Creek diversion. The pond would discharge to the Ophir Creek diversion, where the combined flows would fall through a spillway to lower Sherman Creek. All channels would be designed to carry the probable maximum flood.

2.2.2 Alternative B – Proposed Action

Alternative B represents the operator's formal proposal to modify the 1992 Plan of Operations. The modification was proposed to enhance the project's constructability, operability, reclamation, and long-term post-closure monitoring and maintenance, as well as to minimize potential impacts to water quality.

Alternative B involves offsite transport and processing of flotation concentrate, construction of the DTF, and backfilling of tailings. The flotation concentrate would contain the majority of the sulfide component of the ore. The concentrate would be dewatered, filtered, and loaded into specially designed, sealed marine transport containers. Barge shipments would occur weekly, weather permitting, to an existing offsite location for gold recovery operations.

Flotation tailings would be either backfilled in the mine or deposited in the DTF. At least 25 percent of the tailings would be backfilled using paste backfill techniques. The thickened tailings would be pumped to a paste backfill plant in the mine, combined with water and cement, and gravity fed into mined out areas. In addition, waste rock would be backfilled into selected areas within the mine.

Tailings to be deposited in the DTF would be dewatered and transported by truck to the DTF site (i.e., Site B identified in the 1992 FEIS). The DTF would be constructed in three stages or cells. Tailings would be placed in 28-foot high, uncompacted lifts or layers. Each lift would be covered with a 2-foot layer of till and waste rock. The outer slopes and top of the DTF would receive a final cover of till and growth media. Till would be obtained from a borrow area near the mill. Waste rock would be stored temporarily in a 15-acre pile at the 800-foot adit. All waste rock generated during the life of the mine is expected to be used in DTF and process area foundation construction or backfilled.

Mine drainage would undergo precipitation and filtration and then be combined with process area (46 acres) runoff in a settling pond. Discharge from the settling pond would be to upper Sherman Creek. Runoff and seepage from the DTF would be collected in a settling pond and discharged to Camp Creek. Wastewater from the milling process would be recycled. The DTF would require the diversion of a series of unnamed streams that terminate near Comet

Beach. Ophir Creek would be diverted away from the process area and around the sand and gravel borrow area.

The personnel camp (5.7 acres) would be located directly west and adjacent to the process area, farther removed from the main access road than under Alternative A. Haul road stream crossings on upper Sherman Creek and Ivanhoe Creek would be constructed using long-span low-profile bottomless arch conduits. Diesel fuel would be transported by barge to the site and trucked to the generators at the mill site.

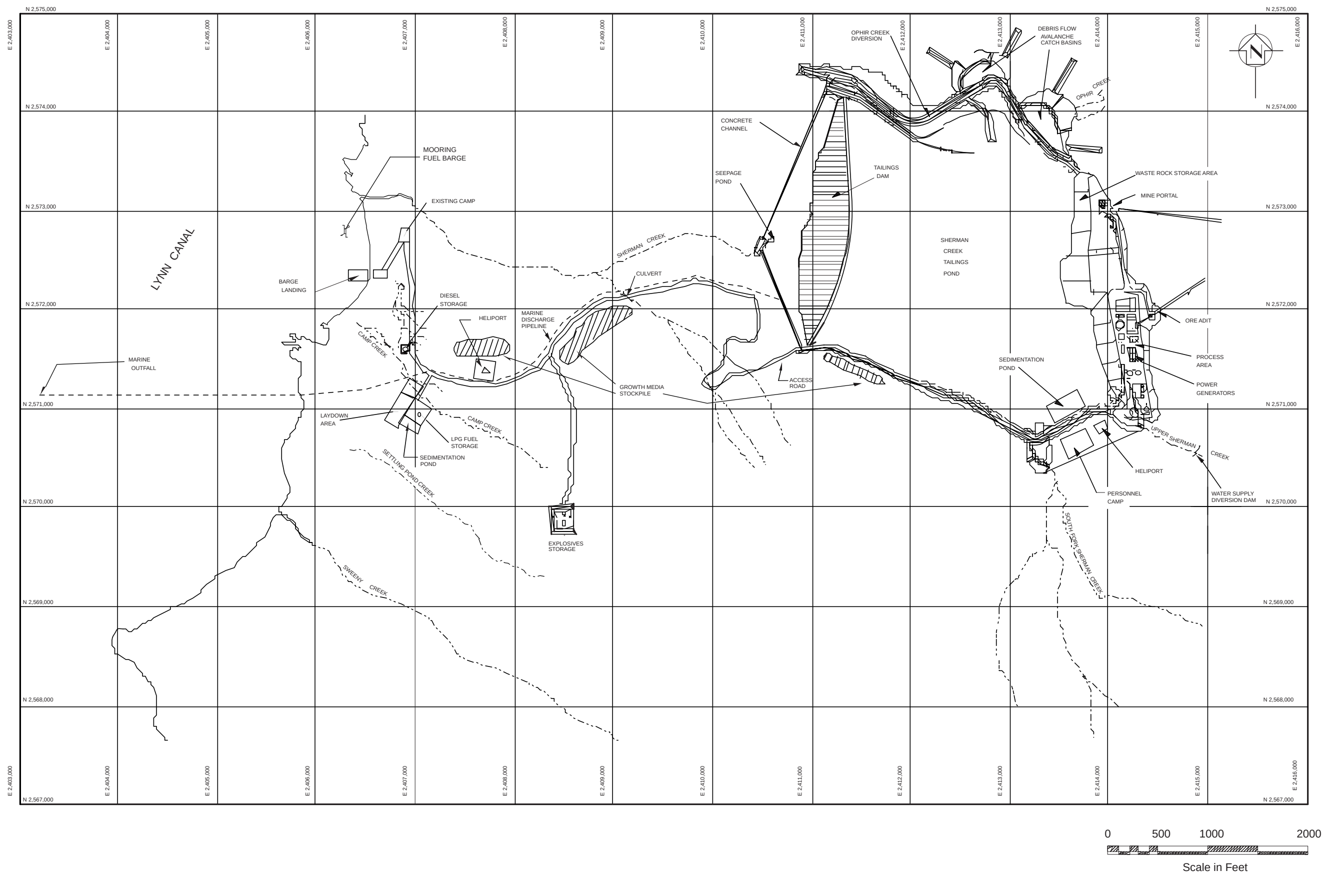
Reclamation would consist of restoring the site to its pre-mining land use of wildlife habitat and recreation. All buildings, structures, and storage tanks would be removed from the site. All disturbed areas, including roads, would be regraded to blend with the natural topography and seeded to the maximum extent possible. The borrow pits would be graded to support the development of wetlands. The settling ponds would be retained as open water. The original channel of Ophir Creek would be restored. The diversion channels around the DTF would remain in place and be redesigned to carry a 500-year, 24-hour storm event. The DTF would undergo concurrent reclamation as cells were developed. This would reduce the extent of disturbance in the project area over the life of the project. Appendix C presents relevant sections of the reclamation plan that were submitted as part of the Proposed Action.

2.2.3 Alternative C – Marine Discharge

Alternative C is similar to Alternative B, except that mine drainage and DTF effluent would be discharged to Lynn Canal, and diesel fuel would be transported from Comet Beach to the process area via a double-walled steel pipeline. Mine drainage would not receive treatment beyond underground settling. Mine drainage would be piped from the process area toward Lynn Canal and be combined with effluent from the DTF settling pond prior to discharge. The operator would need to have an NPDES permit and apply for a mixing zone from the State of Alaska to comply with NPDES permit limits. The effluent pipeline would extend 300 feet into Lynn Canal from Comet Beach. The discharge would be through a diffuser located 30 feet below the low-tide level. Process area runoff would be collected in a settling pond and discharged to upper Sherman Creek. Diesel fuel would be transported by an above-ground, double-walled steel pipeline that would generally parallel the road from Comet Beach to the process area. Reclamation would be similar to Alternative B.

2.2.4 Alternative D – Modified DTF Design

Alternative D is similar to Alternative B, except that the DTF design would be modified. Under Alternative D, the most significant modification is construction of an engineered structural berm around the exterior shell of the DTF. The berm could be constructed of waste rock, tailings, and/or other appropriate material. Alternative D also includes an above-ground tailings slurry pipeline and dewatering facility at the DTF. Reclaimed water would be pumped back to the mill. Under this alternative, bridges would be constructed for haul road stream crossings on upper Sherman Creek and Ivanhoe Creek. Reclamation would be similar to Alternative B.



ALTERNATIVE A COMPONENTS

Waste Rock	400 tons of rock per day, stored in a 15-acre pile at mill site, about 50 percent used in tailings embankment, road, and foundation construction.
Ore Processing	Underground crushing, surface grinding, flotation, and cyanidation.
Tailings Management	Wet tailings disposal in an impoundment in Sherman Creek, no backfill. No haul road.
Diversions	100-year, 24-hour diversions of Ophir and Sherman creeks.
Stream Crossing	Culvert on intermittent Sherman Creek tributary.
Wastewater	Enhanced settling in impoundment, effluent from impoundment piped to marine discharge point 1/2 mile off shore in Lynn Canal north of Point Sherman.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	2 LPG generators at mill, one LPG generator at beach.
Employee Housing	Onsite personnel camp south of Sherman Creek.
Borrow Area	Sand and gravel quarries near the process area (130 acres) within impoundment drainage.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade and revegetate, route streams over tailings impoundment.

Figure 2-1
Kensington Gold Project
Alternative A

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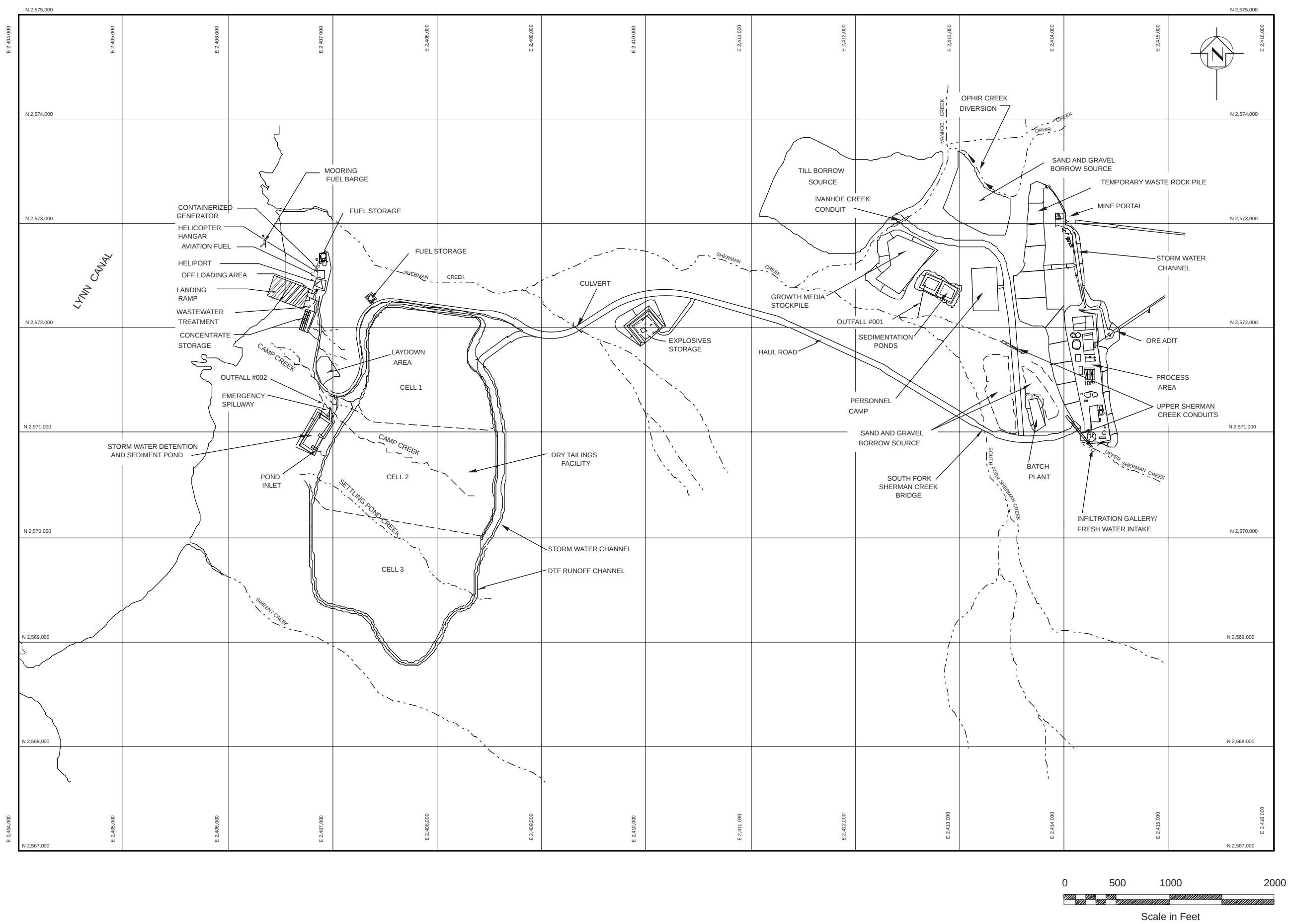
2-7



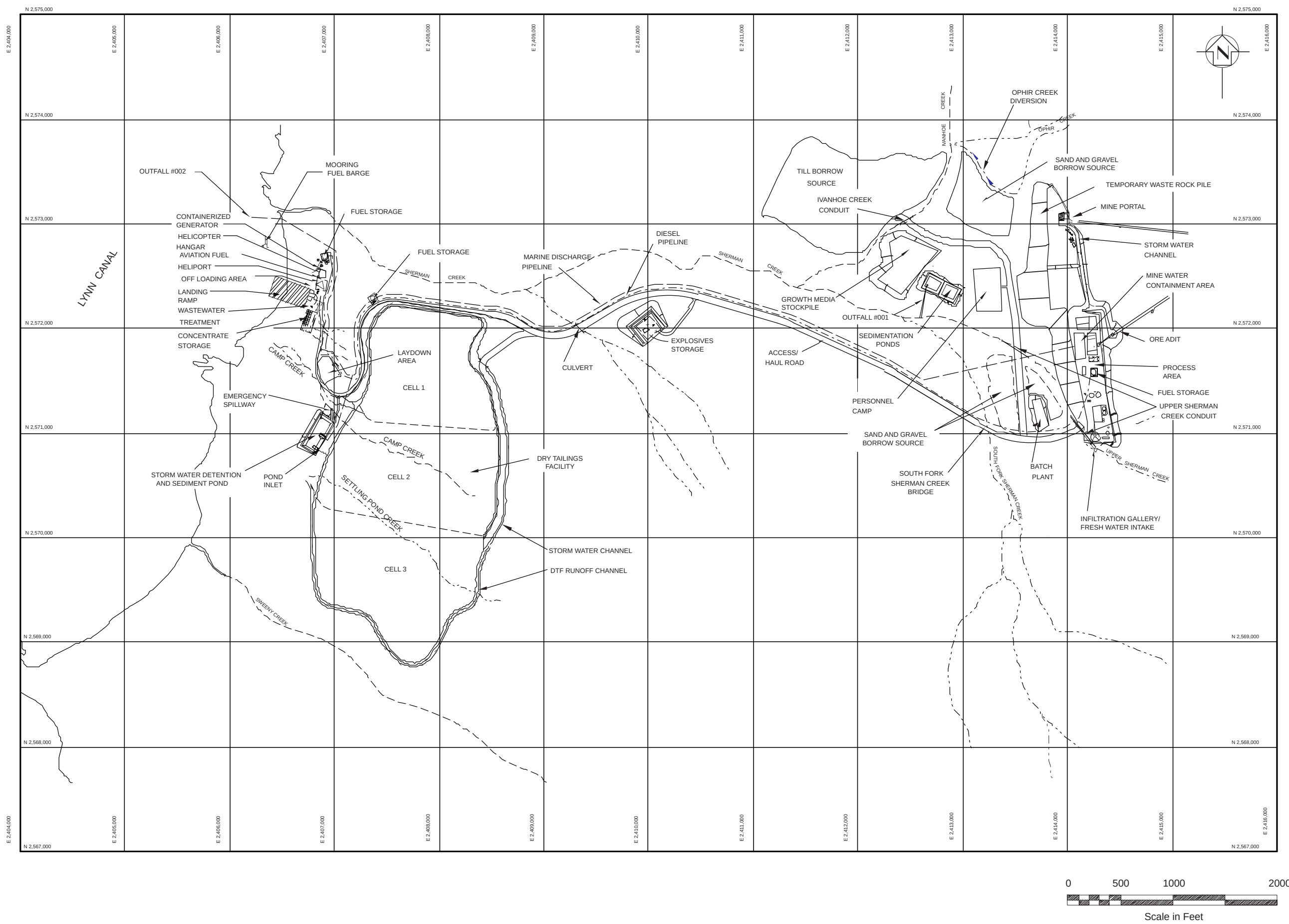
ALTERNATIVE B COMPONENTS

Waste Rock	Temporary 15-acre pile at mine portal, all used in DTF construction and backfill.
Ore Processing	Underground crushing, surface grinding, and flotation, offsite transport of flotation concentrate for further processing.
Tailings Management	Placement of dry tailings in the DTF, engineered drainage system, paste backfill minimum of 25 percent of all tailings, tailings trucked to DTF. 60-foot wide haul road from mill to DTF.
Diversions	100-year, 24-hour diversion above the DTF, 100-year, 24-hour Ophir Creek diversion around mill site.
Stream Crossings	Culvert on Sherman Creek tributary; South Fork Sherman Creek bridge; two bottomless arch conduits on upper Sherman Creek and one on Ivanhoe Creek.
Wastewater	Fresh water discharges to Sherman and Camp Creeks at outfalls 001 (mine water and process area runoff) and 002 (DTF effluent), respectively; enhanced settling in ponds, precipitation/filtration of mine drainage.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	Four diesel generators at mill, one diesel generator at beach, diesel trucked to the process area.
Employee Housing	Onsite personnel camp north of Sherman Creek.
Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the north sand and gravel quarry.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade, and revegetate, maintain diversion above DTF-increase to 500-year, 24-hour capacity.

Figure 2-2
Kensington Gold Project
Alternative B

214D-32

2-8

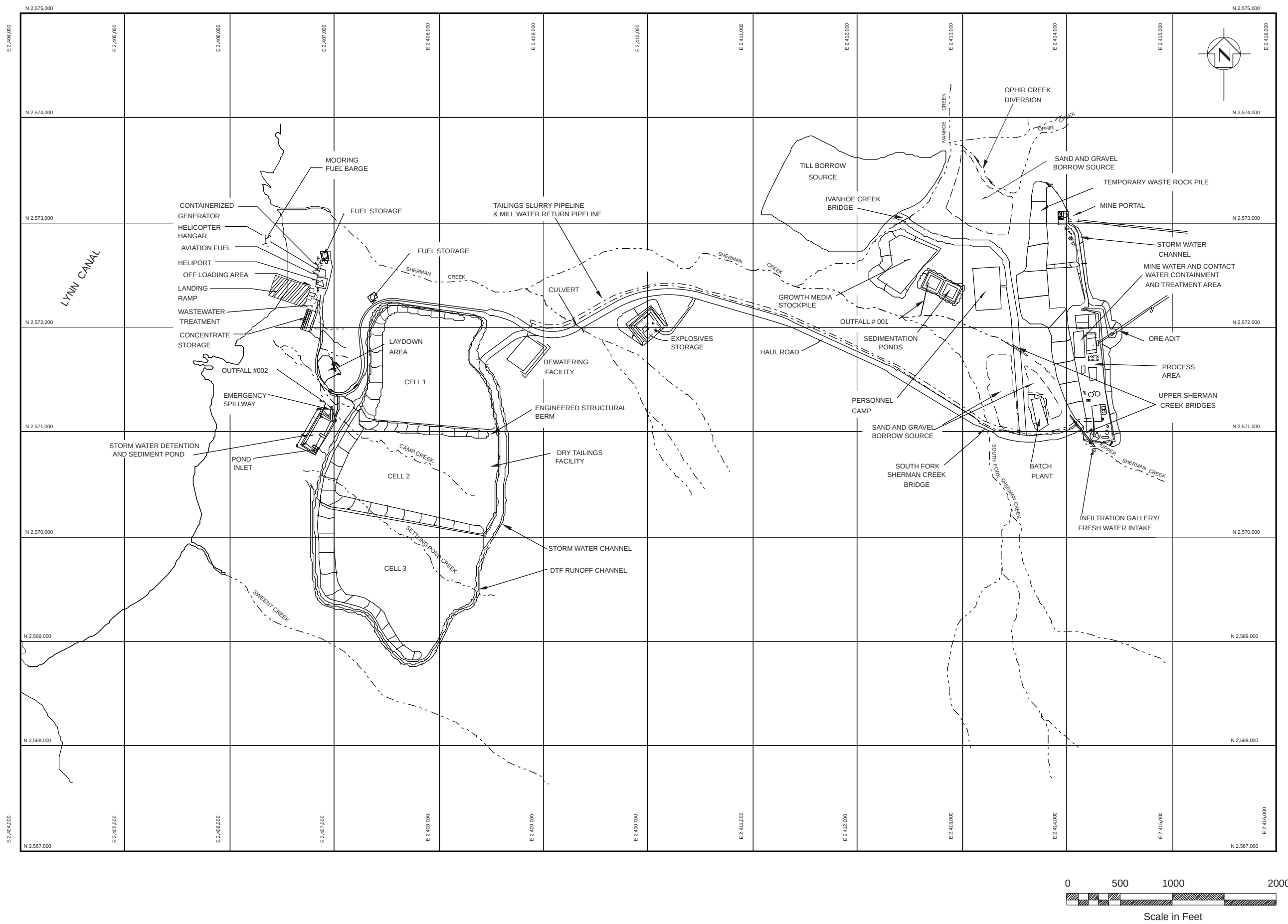


ALTERNATIVE C COMPONENTS

Waste Rock	Temporary 15-acre pile at mine portal, all used in DTF construction and backfill.
Ore Processing	Underground crushing, surface grinding and flotation, offsite transport of flotation concentrate for further processing.
Tailings Management	Placement of dry tailings in the DTF, engineered drainage system, paste backfill minimum of 25 percent of all tailings, tailings trucked to DTF. 60-foot wide haul road from mill to DTF.
Diversions	100-year, 24-hour diversion above the DTF, 100-year, 24-hour Ophir Creek diversion around mill site.
Stream Crossings	Culvert on Sherman Creek tributary; South Fork Sherman Creek bridge; two bottomless arch conduits on upper Sherman Creek and one on Ivanhoe Creek.
Wastewater	Marine discharge of mine drainage and DTF effluent to Lynn Canal 300 feet offshore at outfall 002. Discharge of process area runoff to upper Sherman Creek at outfall 001. Enhanced settling in ponds.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	Four diesel generators at mill, one diesel generator at beach, diesel piped to the process area.
Employee Housing	Onsite personnel camp.
Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the north sand and gravel quarry.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade, and revegetate, maintain diversion above DTF-increase to 500-year, 24-hour capacity.

Figure 2-3
Kensington Gold Project
Alternative C

214D-33



ALTERNATIVE D COMPONENTS

Waste Rock	Temporary 15-acre pile at mine portal, all used in DTF construction and backfill.
Ore Processing	Underground crushing, surface grinding and flotation, offsite transport of flotation concentrate for further processing.
Tailings Management	Placement of dry tailings in the DTF, engineered structural berm around three sides of all cells, paste backfill minimum of 25 percent of all tailings, tailings slurry piped from mill to DTF, 60-foot wide haul road from mill to DTF.
Diversions	100-year, 24-hour diversion above the DTF, 100-year, 24-hour Ophir Creek diversion around the mill site.
Stream Crossings	Culvert on intermittent Sherman Creek tributary; South Fork Sherman Creek bridge; two bridges on upper Sherman Creek and one on Ivanhoe Creek.
Wastewater	Fresh water discharges to Sherman and Camp Creeks at outfalls 001 (mine water and process area runoff) and 002 (DTF effluent), respectively; enhanced settling in ponds; precipitation/filtration of mine drainage.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	Four diesel generators at mill, one diesel generator at beach, diesel trucked to the mill.
Employee Housing	Onsite personnel camp.
Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the north sand and gravel quarry.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade, and revegetate, maintain diversion above DTF-increase to 500-year, 24-hour capacity.

Figure 2-4
Kensington Gold Project
Alternative D

214D-34

2.3 PROJECT COMPONENTS STUDIED IN DETAIL

This section discusses the alternatives by the different project components, including waste rock disposal, ore processing, water management, and tailings disposal.

2.3.1 Project Location

The overall proposed project location is the same as the location identified on page 2-4 of the 1992 FEIS and is shown in Figure 1-1 in Chapter 1 of this Final SEIS.

2.3.2 Mining Methods

The proposed mining methods are similar to those presented in the 1992 Approved Plan of Operations. Pages 2-5 through 2-7 of the 1992 FEIS discuss proposed mining methods. Under Alternatives B through D, paste backfill with cemented tailings would be used to allow further ore recovery. Sections 2.3.3 and 2.3.6 of this Final SEIS discuss the role of paste backfill in mining.

2.3.3 Waste Rock Disposal

Waste rock is rock with a gold content below the economic processing grade that must be removed to develop underground facilities and to access the ore. Waste rock must be disposed of at a stable and suitable site. Under all the alternatives, the operator anticipates the production of approximately 270 cubic yards (400 tons) of waste rock per day, with an annual production of approximately 100,000 cubic yards (150,000 tons). The projected total waste rock for the life of the mine is about 1.2 million cubic yards (1.8 million tons). All alternatives would require that the waste rock be mined and moved to the surface using trucks. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997a) presents the results of chemical characterization studies for the waste rock, as well as ore and tailings.

Under Alternative A, waste rock would be managed in a pile (approximately 15 acres) within the tailings impoundment drainage area near the mine entrance. It would then be used in road, tailings dam, and other embankment construction and for riprap and reclamation activities. Approximately 612,000 cubic yards (920,000 tons) of waste rock would have to be managed permanently in the pile.

Under Alternatives B through D, waste rock also would be stockpiled temporarily near the mine entrance and would be used for process area fill and DTF construction and in selected mine backfill areas. Construction of the DTF and process area foundations and backfilling are expected to use virtually all of the waste rock produced during the life of the mine. Waste rock would be used in DTF base drain construction, as well as placed as drainage layers between lifts. Under Alternative D, waste rock could also be used in construction of the berm around the DTF. The temporary stockpile of waste rock at the mine entrance would be approximately 15 acres; however, the waste rock only would be stockpiled for the first 3 to 4 years of the project. Subsequently, the supply of waste rock would essentially equal the demand, and waste rock only would be stored at the DTF for very short periods. Waste rock would not be used in any site construction activities other than the process area foundations and DTF.

2.3.4 Ore Processing

Once mined, ore must be processed to recover the gold. Ore processing under all alternatives includes underground primary crushing facilities, surface grinding facilities, and a mill flotation process. Pages 2-7 and 2-8 of the 1992 FEIS discuss this process. Treatment of the flotation concentrate differs among the alternatives.

As described on pages 2-8 through 2-10 of the 1992 FEIS, Alternative A includes onsite cyanidation of flotation concentrate using carbon-in-leach (CIL) gold recovery methods. The CIL process would generate approximately 1.2 million tons of tailings (i.e., 4 to 7 percent of the total volume of tailings produced at the site). Residual cyanide in the CIL tailings would be destroyed by alkaline chlorination. Gold recovery would be performed as described in the 1992 FEIS.

Under Alternatives B through D, the underground primary crushing facilities, surface grinding facilities, and the mill flotation process would be the same as Alternative A. The crushed concentrated ore would not be treated using a cyanide CIL process, however, but would be containerized and transported offsite for final processing. Figure 2-5 compares the ore-processing circuits from the Forest Service 1992 ROD (i.e., Alternative A) and the 1996 Revised Plan of Operations (i.e., Alternatives B through D).

The 1992 FEIS evaluates offsite processing of the flotation concentrates, but not in detail. Recent advances in dewatering techniques and the availability of offsite processing capacity have now made offsite processing feasible for the Kensington Gold Project. Under Alternatives B through D, ore concentrate would be dewatered, filtered, and loaded into specially designed $4 \times 8 \times 20$-foot marine transport containers for offsite gold-recovery processing. The sealed containers would be delivered to Comet Beach by truck and stored outside on a storage pad (100 $\times$ 200 feet) adjacent to the barge off loading area (see Figures 2-2 through 2-4, presented previously). On average, one 1,400-ton load would be shipped by barge on a weekly basis.

The types and volumes of chemicals used for grinding and flotation would be the same as those detailed in the 1992 FEIS (see Table 2-2 on page 2-14). Because gold would be recovered offsite, Alternatives B through D would eliminate the use of chemical reagents for cyanidation and cyanide destruction.

2.3.5 Water Management

Under Alternative A, a tailings dam would be constructed across Sherman Creek. All mine drainage and process water from the site would be managed in the Sherman Creek tailings impoundment. The tailings impoundment would capture precipitation that occurs on the impoundment area, as well as contain runoff from the process area. This catchment would be approximately 225 acres.

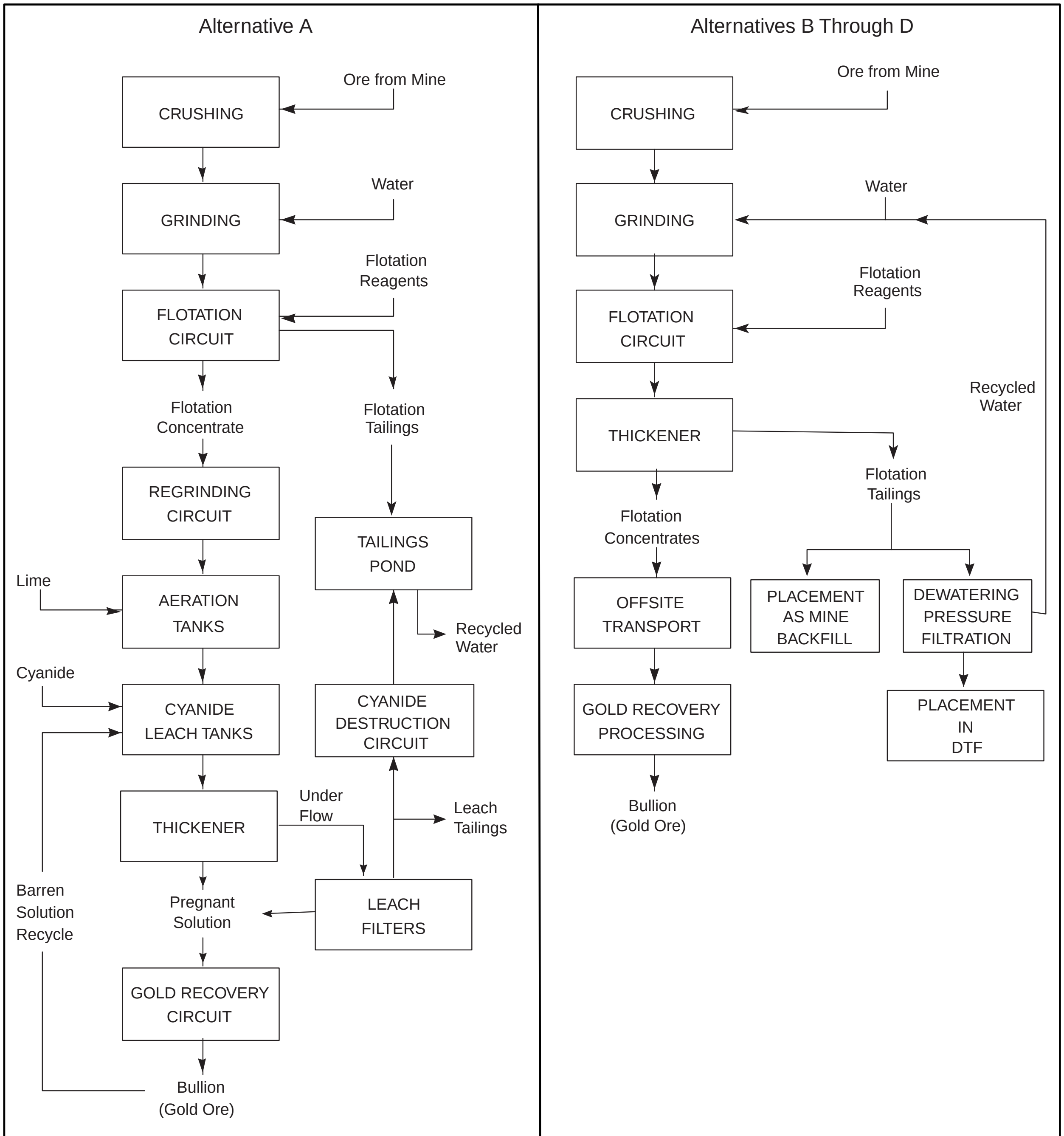


Figure 2-5
Comparison of Ore-Processing Circuits for Alternative A and Alternatives B Through D

214D-24

Flocculation and baffles would be used to enhance settling in the tailings pond. Water would be reclaimed to the maximum extent practicable from the tailings impoundment for reuse in the mill. Excess water in the tailings impoundment would be piped to Lynn Canal for discharge north of Point Sherman. The discharge would require a mixing zone to comply with NPDES permit requirements and Alaska water quality standards, as discussed in Chapter 4 of the 1992 FEIS. Alternative F, Option 1, in the 1992 FEIS includes a marine discharge approximately 300 feet offshore at a depth of 30 feet. After issuance of the TAR, the operator conducted additional studies on circulation patterns in the vicinity of Point Sherman. As discussed in Section 3.9 of this Final SEIS, eddies form near the shore north and south of Point Sherman. These eddies extend to about one-quarter to one-half mile offshore and to a depth of approximately 100 feet. To ensure adequate mixing and dispersion of the plume from the marine outfall, therefore, the discharge under Alternative A would be located about one-half mile offshore at a depth of 300 feet. The discharge would also be outside of the nearshore fishing area. The operator would install a multiport diffuser at the discharge point.

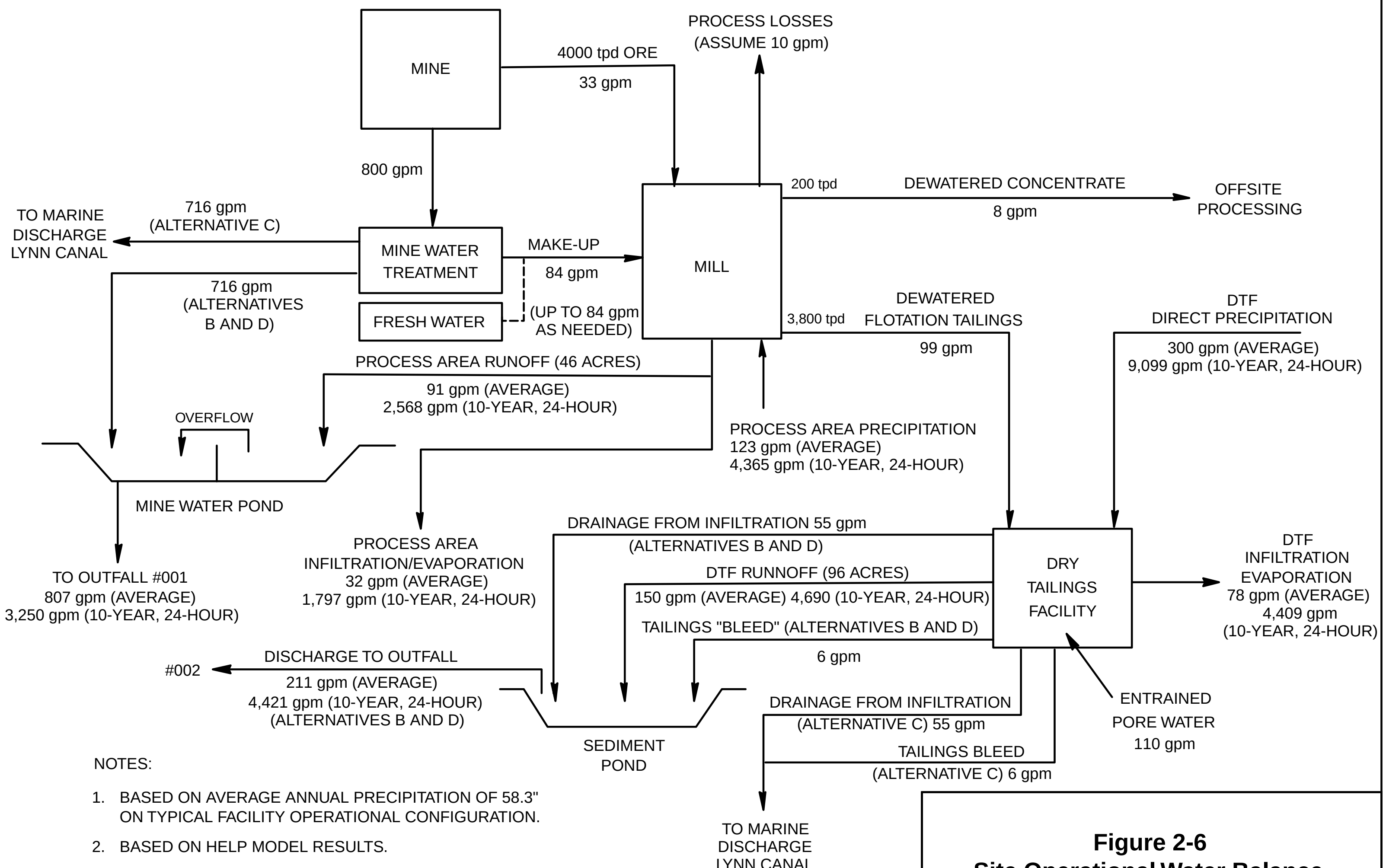
Under Alternative A, approximately 2.1 miles of stream diversion channels would be constructed. Upper Sherman Creek flows, including flows from South Fork Sherman Creek entering Sherman Creek from the southeast, would be diverted from the south side of the tailings impoundment via a buried pipeline. This pipeline would be designed to convey the 25-year, 24-hour storm event. An Ophir Creek diversion would be designed to route flows around the tailings impoundment through a concrete-lined channel. The Ophir Creek diversion would be designed to convey the probable maximum flood. It would return diverted flows to Sherman Creek below the impoundment via a concrete spillway. The Ophir Creek spillway would require a design to ensure proper energy dissipation to avoid scouring or alteration of the channel at the point of entry into Sherman Creek. The operator would construct avalanche control structures in the Ophir Creek drainage upslope from the diversion.

Under Alternative A, a small diversion dam on upper Sherman Creek would primarily supply fresh water for the mill circuit, domestic uses, and power supply. Total water supply demands for the project would average 190 gallons per minute (gpm) (0.42 cfs). As discussed on page 2-24 of the 1992 FEIS, fresh water demands for the mill circuit, domestic use, and power supply and mining operations are estimated at 48 gpm (0.11 cfs), 35 gpm (0.08 cfs), and 107 gpm (0.24 cfs), respectively. To meet these requirements, the operator previously applied to the Alaska Department of Natural Resources (ADNR) for the right to increase water removal from upper Sherman Creek from 0.1 cfs to about 1.1 cfs. This request was never finalized due to the 1996 project modifications. For all alternatives, the operator would be required to meet ADNR permit requirements for maintaining instream flows in Sherman Creek that are protective of aquatic life. Under all alternatives, mine drainage would also be used at the process area for make-up water, including during low-flow periods and for initial startup, after temporary shutdowns, and/or following maintenance activities. The operator has also applied to ADNR to remove up to 1,449 gpm (3.3 cfs) from the mine. The generation of mine drainage is expected to generally range from 600 gpm (1.4 cfs) to 1,000 gpm (2.3 cfs). Under all alternatives, the operator has applied for an ADNR-permitted water withdrawal of 50 gpm (0.125 cfs) from Camp Creek to provide domestic water for Comet Beach facilities.

Under Alternatives B through D, an infiltration gallery upstream of the process area in upper Sherman Creek would primarily supply fresh water. The infiltration gallery would feed a 300,000-gallon fresh water tank. The total water supply demands for the project under Alternatives B through D would average 234 gpm (0.52 cfs). The fresh water demands for the mill circuit, domestic use, and power supply and mining operations are estimated at 84 gpm (0.19 cfs), 50 gpm (0.11 cfs), and 100 gpm (0.22 cfs), respectively. To meet these requirements, the operator recently applied to ADNR for the right to increase water removal from upper Sherman Creek from 0.1 cfs to a maximum of 0.7 cfs. As noted previously, the operator would be required to meet ADNR permit requirements for maintaining instream flows in the upper Sherman Creek drainage that are protective of aquatic life.

Figure 2-6 presents the water balance for Alternatives B through D, including both average monthly flows and extreme storm event conditions. Mine drainage would be collected and settled underground and then pumped to the surface. Under Alternatives B and D, the mine drainage would then undergo precipitation and filtration. Pages 2-12 through 2-15 of the 1992 FEIS describe available wastewater treatment technologies for metals and solids. As discussed in Chapter 4 of this Final SEIS, the proposed precipitation and filtration system would meet NPDES permit limits without a fresh water mixing zone. Figure 2-7 illustrates the proposed treatment system. Under Alternatives B and D, the treated mine drainage would be combined with process area runoff in a settling pond prior to discharge to upper Sherman Creek. Process area runoff includes runoff from five sources: the mill site, temporary waste rock pile, the north sand and gravel borrow area, till borrow access road, and personnel camp. This combined drainage area would equal 46 acres. Runoff would be routed via storm water ditches to the settling pond. The pond would be designed to detain storm water runoff and allow settling of sediment for storms up to the 100-year, 24-hour event. Polymers would be added to the pond to enhance settling. Under Alternative C, mine drainage would be settled underground and piped from the process area toward Lynn Canal. The pipeline would be south of Sherman Creek, as shown in Figure 2-3, presented previously. Under Alternative C, process area runoff would be managed in the settling pond at the mill site and discharged to upper Sherman Creek. Under Alternatives B through D, all water used in the milling process would be recycled completely.

Under Alternatives B through D, seepage and runoff from the DTF would be captured in a storm water channel totaling 8,481 feet (1.6 miles) around the DTF. The runoff would be routed to a settling pond designed to detain storm water runoff and allow settling of sediment for storms up to the 100-year, 24-hour event. Polymers would be added to the pond to enhance settling. Under Alternatives B and D, the DTF settling pond would discharge to Camp Creek. Under Alternative C, DTF effluent would be piped north across the haul road and be combined with the mine drainage pipeline. The combined flow would be discharged to Lynn Canal. All effluent pipelines would be “double pipe” systems for spill prevention. The inner pipe would be constructed of high density polyethylene (HDPE) or steel. Regardless of the material used for the inner pipe, the outer pipe would be cased with HDPE. Assuming that the State granted a mixing zone, the discharge would be through a multiport diffuser located 300 feet from shore at a depth of approximately 30 feet below the low-tide elevation. The pipeline would be buried in a trench surfacing at the diffuser. A location just south of Sherman Creek was selected because the water in this area reaches a depth of 30 feet closest to the shoreline. This would minimize the length of



NOTES:

1. BASED ON AVERAGE ANNUAL PRECIPITATION OF 58.3" ON TYPICAL FACILITY OPERATIONAL CONFIGURATION.
2. BASED ON HELP MODEL RESULTS.
3. MINE WATER VARIES FROM 600 - 1,000 gpm; MINE WATER USED AS MAKE-UP FOR MILL AS NEEDED
4. MINE WATER PRIMARY MAKE-UP FOR MILL; FRESH WATER ONLY USED AS NECESSARY
5. 10-YEAR, 24-HOUR = AVERGAE FLOWS RESULTING FROM 10-YEAR, 24-HOUR STORM EVENT. ASSUMES NO EVAPORATION

Figure 2-6
Site Operational Water Balance
Alternatives B through D

(Modified from SRK, 1996d and SRK, 1997)

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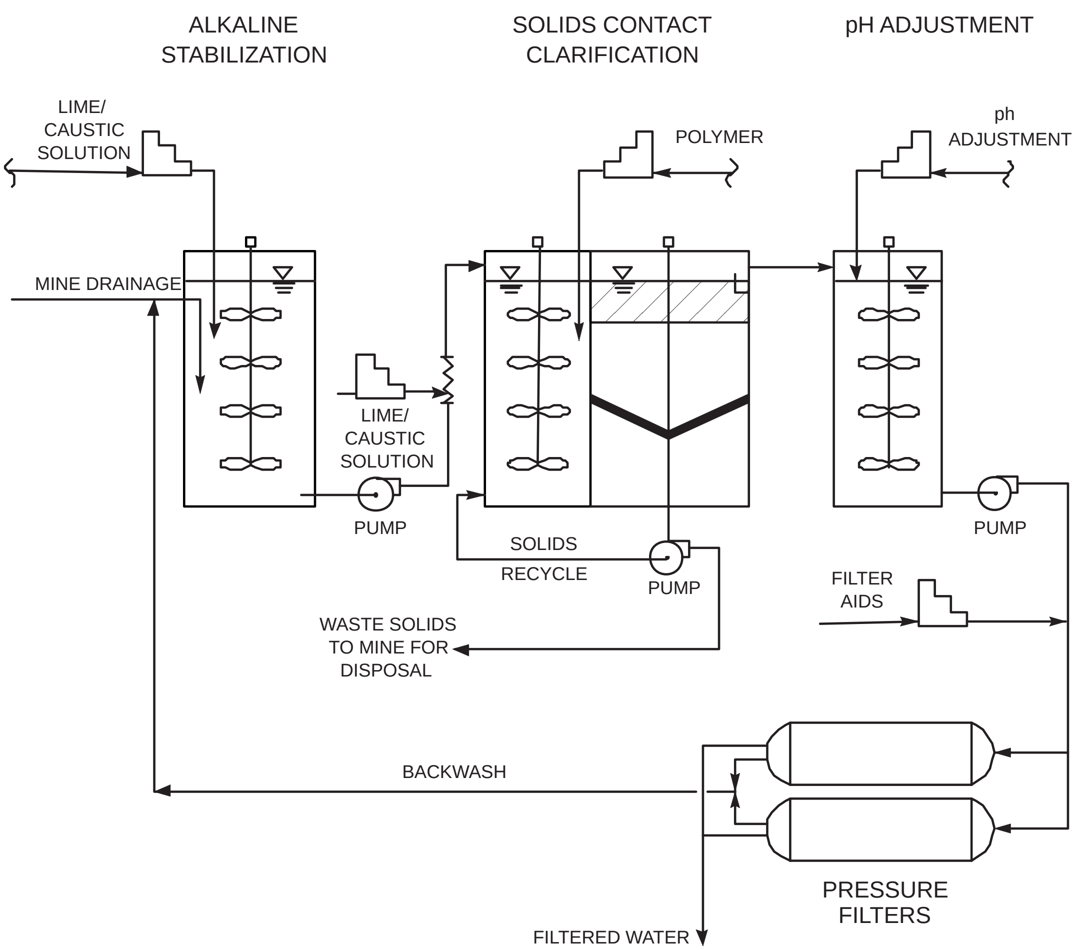


Figure 2-7
Chemical Precipitation Treatment for Alternatives B Through D
(Source: Coeur Alaska, 1996c)

214D-26

the pipeline. The minimum depth of 30 feet below the low-tide elevation was selected to ensure that the discharge would be submerged under all conditions. In addition, the discharge would be beyond the coarse material found near the shore, which could affect diffuser operations. The small size of the marine mixing zone under Alternative C (a cube 9 feet on a side) compared to Alternative A (a cube 24 feet on a side) would allow a nearshore discharge without potential impacts on aquatic life. Sections 4.6.1 and 4.6.4 present detailed discussion on the sizing of the mixing zone for Alternatives A and C. The final location of the outfall and the size of a mixing zone, if any, would be determined by the Alaska Department of Environmental Conservation (ADEC) and EPA under the NPDES permitting process if this alternative is selected. If the State did not grant a mixing zone, additional treatment comparable to the mine drainage treatment system under Alternatives B and D probably would be necessary to meet NPDES permit limits.

Runoff from the till borrow area would be collected in an unlined detention pond within the borrow area. Surface discharges to adjacent wetland areas would only occur during a 100-year, 24-hour event through a spillway. Runoff from haul roads would be managed using best management practices (BMPs) and discharged at NPDES-permitted outfalls to wetland areas. Runoff from the southern sand and gravel borrow area would be contained within the pit and allowed to infiltrate the ground. No discharge would occur from this area.

Under Alternatives B through D, two diversion channels would be constructed in the vicinity of the process area in the Sherman Creek basin. The first channel would be a storm water diversion constructed to catch surface runoff from the watershed east of the process area. The channel would route captured runoff south to join upper Sherman Creek. The storm water diversion would be blasted bedrock or rip-rap channel. The estimated length of the diversion is 2,992 feet (0.5 miles). The second channel would be a stream diversion constructed to divert flows from Ophir Creek around a borrow area, the haul road, and a growth media stockpile. This diversion would route Ophir Creek, as well as runoff generated in the Ophir Creek sub-basin, west to Ivanhoe Creek at approximately the 670-foot elevation. This diversion, which would be similar in design to the first diversion, would be 862 feet (0.2 miles) long. The diversion channels would be designed to route flow from the 100-year, 24-hour storm event during operations. Under Alternatives B through D, the layout of the process area, including borrow sites, would minimize the extent of stream diversions.

In addition, two storm water diversion channels would be constructed above the DTF under Alternatives B through D. The first diversion would provide drainage from an 90-acre sub-basin routing flows north and then west around the embankment before discharging into Camp Creek. This discharge is separate from outfall 002, which also discharges into Camp Creek. This diversion would be a rip-rap or a blasted bedrock design with a length of approximately 4,522 feet (0.9 miles) (SRK, 1996b). The second diversion would provide drainage from a 58-acre sub-watershed and route flows south and then west to Settling Pond Creek. This diversion also would be a rip-rap or a blasted bedrock design with an estimated length of 3,678 feet (0.7 miles). The diversion channels would be designed to route flow from the 100-year, 24-hour storm event during operations.

The haul road would require five stream crossings under Alternatives B through D. As shown in Figures 2-2 through 2-4, culverts would be required where the haul road crosses an intermittent unnamed tributary below the explosives storage area, and a new bridge would be constructed on South Fork Sherman Creek to replace the existing bridge. Alternatives B and C include two crossings on upper Sherman Creek and one on Ivanhoe Creek using low-profile, bottomless arch conduits. These conduits would be 180, 300, and 180 feet in length, respectively, and would be designed to pass flows from a 10-year, 24-hour storm event and maintain the integrity of fish habitat. The *Technical Resource Document for Water Resources (*SAIC, 1997a) and *Kensington Gold Project, Addendum to Report on Construction Activity Related to Creek Crossings and Alterations (*SRK, 1997c) present detailed discussion of the design of these crossings.

Subsequent to publication of the Draft SEIS, comments from the public and other agencies reflected concern over the use of the long-span, low-arch bottomless conduits for haul road crossings on upper Sherman Creek and Ivanhoe Creek. To address these concerns and allow for a comparative analysis of impacts, the Forest Service has incorporated the use of bridges for these crossings into Alternative D. Bridges on these crossings would be designed and constructed to meet Forest Service criteria and construction BMPs. Under these criteria, bridges would be constructed at a minimum height sufficient to pass the peak flow from the 50-year, 24-hour storm event, plus an additional 6 feet to allow clearance for debris.

2.3.6 Tailings Disposal

The operator estimates that the Kensington Gold Project has an ore reserve of about 20 million tons, although the exact size is difficult to predict. If the ore reserve is larger and additional tailings produced, sufficient tailings disposal capacity would be required. Pages 2-15 through 2-20 of the 1992 FEIS consider both wet and dry tailings disposal. The 1992 FEIS analyzes wet tailings disposal at one location in upper Sherman Creek (which was selected in the Forest Service ROD) and two locations in Sweeny Creek. In addition, the 1992 FEIS addresses dry tailings disposal at two locations: Sites “A” and “B.”

Technological innovations during the past 5 years suggest that partial backfilling of tailings and dry tailings disposal at Site B are now feasible alternatives. Dry tailings disposal is now feasible for the following reasons:

- Ore does not have to undergo regrinding prior to gold recovery, thereby producing a coarser material than would be generated with onsite cyanidation.
- Dry tailings disposal has been used successfully worldwide during the past 5 years (Coeur Alaska, 1996a).
- Tailings produced are relatively inert (i.e., no cyanide is added and the sulfide content is low), thereby minimizing wastewater treatment requirements.

Alternative A would use wet tailings disposal, which is consistent with Alternative F in the 1992 FEIS. Alternatives B through D would use dry tailings disposal; the remainder of this section discusses this type of disposal.

Tailings Dewatering and Management

Under Alternatives B through D, flotation tailings would be thickened to approximately 55-percent solids. Under Alternatives B and C, the thickener overflow would discharge to the mill water tank, and underflow would be pumped to two filter feed tanks at the mill site. Plate filters (or design equivalent) would dewater the flotation tailings to filter cake with 15- to 18-percent moisture content (dry weight). The filtrate would be recycled completely as process water. The filter cake would be transferred to covered trucks within the covered loading area and transported to the DTF for placement. The operator would construct a 60-foot wide haul road from the process area to the DTF to meet Mine Safety and Health Administration (MSHA) requirements.

Alternative D includes an 8,000-foot tailings slurry pipeline from the mill to a dewatering facility located near the DTF. Tailings would flow from the thickeners to an agitative tank and then by gravity through the pipeline. The pipeline would parallel the access/haul road in a 10-foot wide right-of-way (see Figure 2-4, presented previously). The tank would have an 8-hour maximum holding capacity. The tailings pipeline would be 14-inch HDPE with a 20-inch casing for spill containment. Flow sensors would be used to detect any blockages or breaks, and an automatic shutdown mechanism would activate as necessary. The dewatering facility would have the same configuration as under Alternatives B and C. The dewatered tailings would be conveyed to a covered transfer area prior to loading into trucks from which the tailings would be placed in the DTF. Reclaimed water would be piped back to the mill through a steel or HDPE pipeline parallel to the slurry pipeline for recycling. Construction of the pipelines would eliminate the 80 haulage trips per day for tailings. The haul road specifications under Alternative D would be the same as for Alternatives B and C, because waste rock and till borrow material would be transported to the DTF site.

Dry Tailings Facility Operation

Under Alternatives B through D, dry tailings would be placed in the DTF. The overall footprint of the DTF under Alternatives B and C would be about 104 acres. The DTF would be constructed in stages (i.e., cells)—cell 1 (33 acres), cell 2 (40 acres), and cell 3 (41 acres). Each cell would have 5 to 7 lifts of tailings. Under Alternative D, construction of an engineered structural berm could increase the area of disturbance by up to 18 acres.

Under Alternatives B through D, the operating scenario for the DTF involves construction of an initial drainage system following clearing, stripping, and stockpiling of surficial materials. As shown in Figure 2-8, the drainage system would be herringbone design with drains spaced at about 100-foot intervals. The drains would be filled with gravel from the construction of the terminal area at Comet Beach. The gravel would be wrapped in geotextile materials to ensure integrity. Prior to initial tailings placement, a minimum of 2 feet of development rock would be placed over the foundation drains. Any areas of the ground that were unsuitable for direct waste rock placement would be covered with geofabric prior to rock placement. Tailings then would be placed in uncompacted lifts approximately 28 feet high. Placement would occur across the entire width of the cell, advancing in an easterly direction. Tailings would not be stored

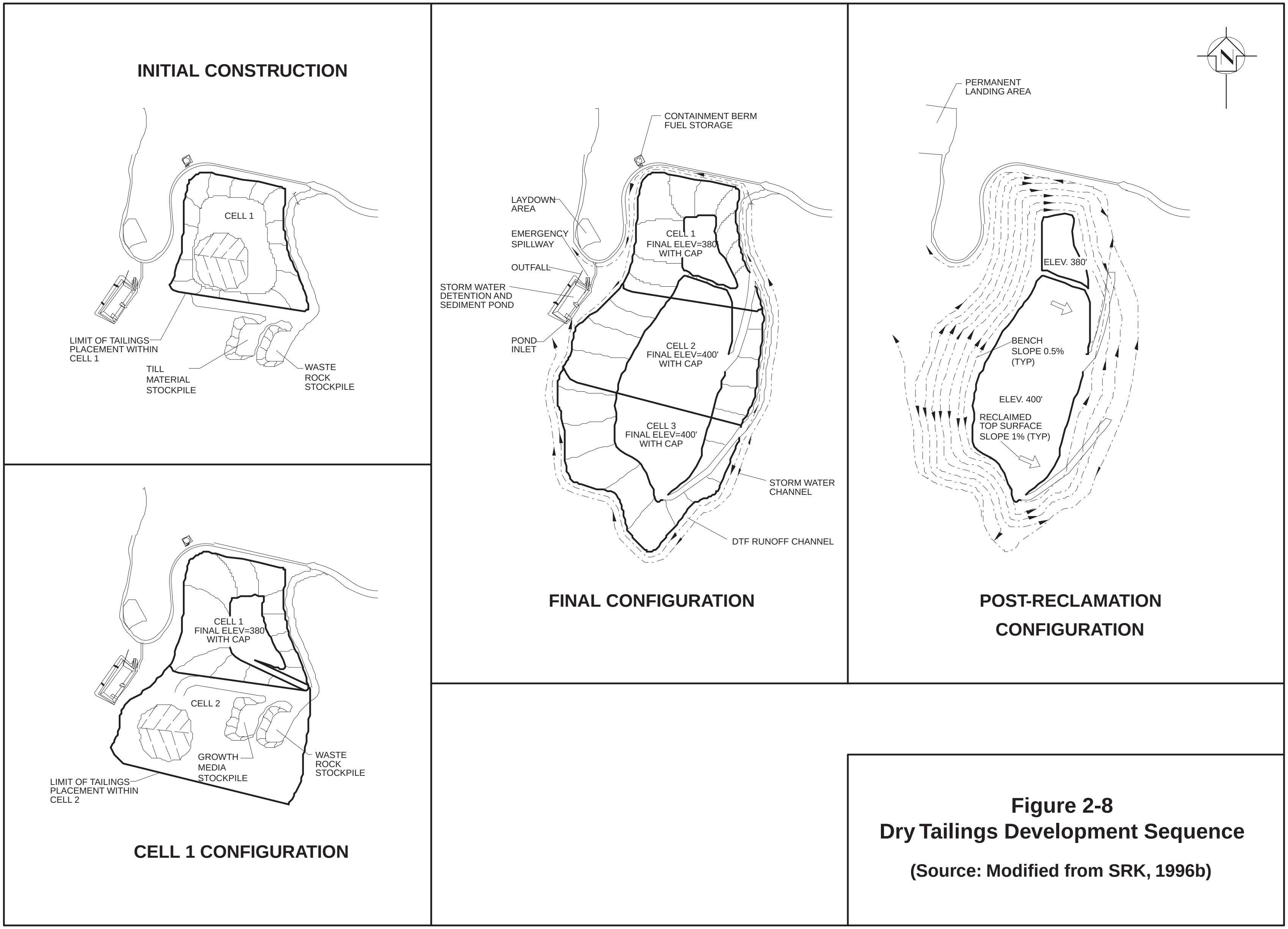


Figure 2-8
Dry Tailings Development Sequence

(Source: Modified from SRK, 1996b)

214D-27a

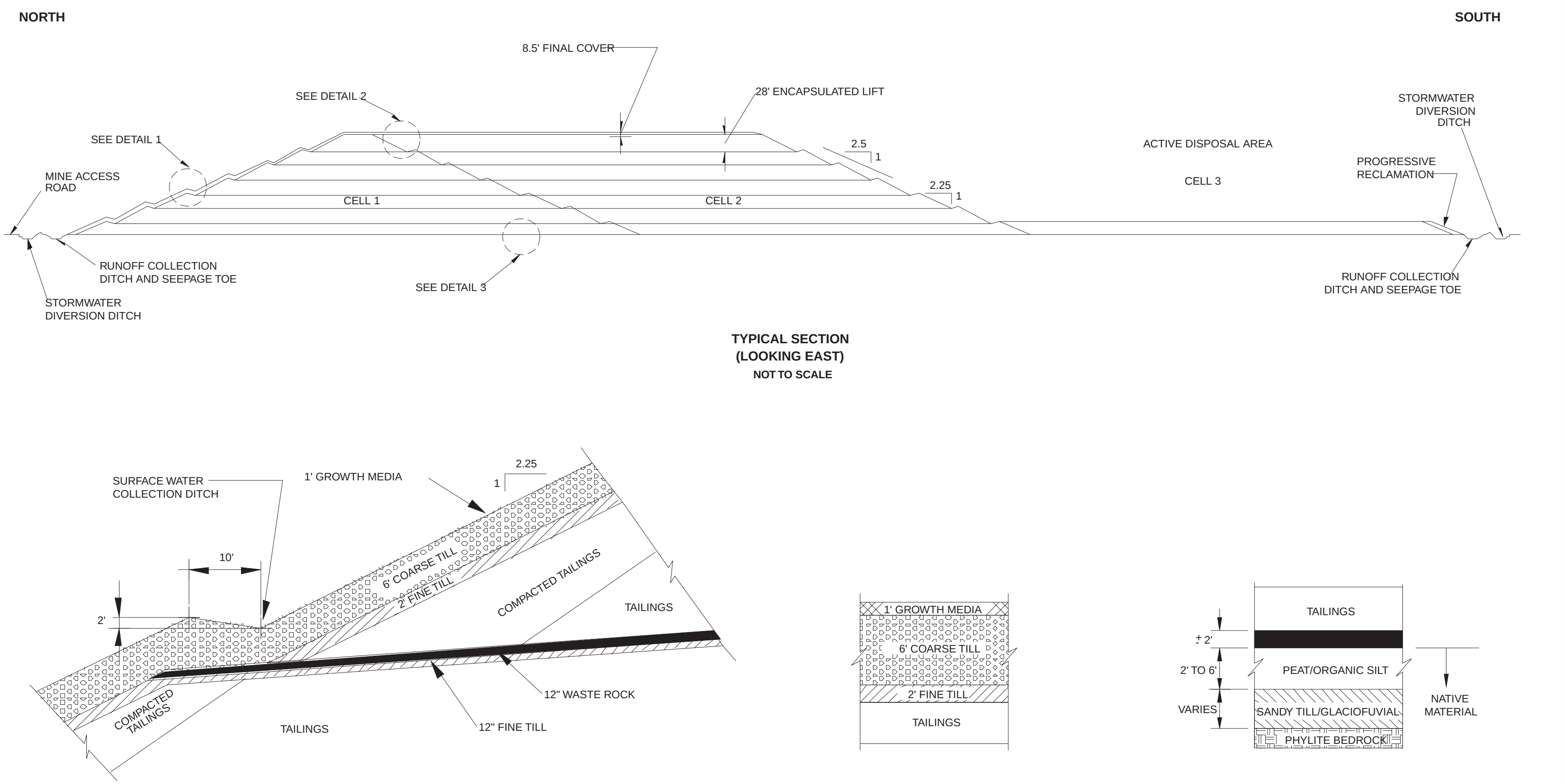
temporarily at the process area or DTF beyond the limited surge capacity in the dewatering system and transfer areas. Therefore, tailings would be either placed directly in the DTF or backfilled (see below) at all times under all weather conditions. Each DTF lift would be covered with a 2-foot layer comprising 1 foot of compacted low permeability fine till material (a barrier) and 1 foot of waste rock to provide immediate cover and a working surface. The waste rock stockpile for each cell would be located in the footprint of the next cell to be constructed. Figure 2-8 shows the development sequence of the DTF, and Figure 2-9 provides typical cross sections and cover details.

As sections of each lift were filled completely, the exposed tailings on the surface of the cell would be covered immediately by the till and waste rock layers, thereby minimizing exposure to precipitation and infiltration. Generally, the tailings area exposed to direct precipitation would be less than 5 acres. Tailings seepage and runoff from the active areas of the cells, as well as runoff from reclaimed areas, would be directed to the DTF settling pond prior to discharge. The pond would be about 350 feet × 150 feet × 14 feet in depth, with a capacity of about 13 acre-feet. The pond would be sized to handle drainage for the entire DTF area of disturbance. As the tailings were placed in each lift, a compacted tailings shell would be constructed around the perimeter of each lift. The thickness of this shell would vary from 35 feet at the base of each cell to 12 feet at the top of each cell. The compacted shell primarily would provide a working surface for capping and reclamation of the outer surfaces of the DTF.

Under Alternatives B through D, the outer slopes and top of the DTF would receive a final cover. The final cover would comprise 6 to 8 feet of fine and coarse till. The underlying fine till layer would serve as a hydraulic barrier, while the overlying coarse till layer would be a drainage layer for infiltration. Growth media would be placed over the coarse till to support revegetation.

Specific operational procedures, quality assurance/quality control requirements, and monitoring plans would be incorporated into the DTF design and final Plan of Operations. Instrumentation, including thermistors, piezometers, and lysimeters, would be used to monitor water levels and potential saturation, which affect geotechnical stability. If monitoring data indicated that widespread saturation were occurring, Alternatives B and C would include a contingency to construct an engineered structural berm around three sides of the DTF using waste rock, compacted tailings, or other suitable material.

Alternative D consists of a modified DTF design similar to Alternatives B and C, with the same infrastructure, construction, operation, and closure as specified in the 1996 Revised Plan of Operations. As mentioned previously, Alternative D would require the construction of an engineered structural berm around the north, south, and west sides of all cells. It would be constructed concurrent with the initial tailings lifts of each cell. The berm might be constructed of impacted tailings, waste rock, or other suitable material. The footprint of the berm of all cells, shown in Figure 2-4, presented previously, could increase the total area disturbed by up to 18 acres. Figure 2-10 provides a cross section at the west toe of the berm. The berm as currently designed would extend to a height of about 100 feet along the west slope and about 50 feet on the north and south slopes.



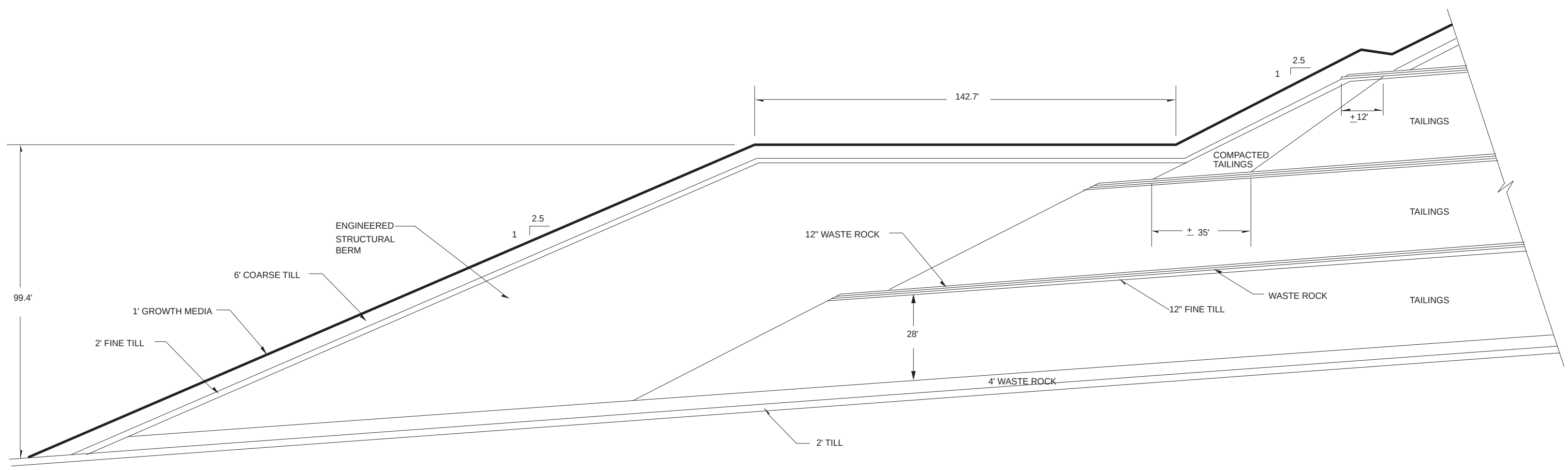
DETAIL 1
TYPICAL EXTERNAL SLOPE DETAIL
(ALL RECLAIMED EXTERIOR SLOPES)
NOT TO SCALE

DETAIL 2
FINAL COVER PROFILE
NOT TO SCALE

DETAIL 3
TYPICAL FOUNDATION PROFILE
NOT TO SCALE

Figure 2-9
Dry Tailings Facility
Typical Section and Cover Details
(Source: SRK, 1996b)

214D-22



ENGINEERED STRUCTURAL BERM DETAIL

(NOT TO SCALE)

Figure 2-10
Cross Section of Engineered Structural Berm (West Toe) - Alternative D

(Modified from SRK, 1996e)

214D-50

214D-50

Backfill

The 1992 FEIS eliminates partial backfilling of tailings from consideration because of potential instability in the underground workings. New paste backfilling techniques have evolved during the past 5 years that would allow the operator to backfill while maintaining stability within the mine workings. The 1992 FEIS also indicates that backfilling of CIL tailings might cause acid drainage. Alternatives B through D include offsite processing and, therefore, CIL tailings would not be produced onsite. The operator performed additional acid-base accounting studies that show that flotation tailings have a low acid-generating potential.

Under Alternatives B through D, the operator would transport at least 25 percent of the tailings to a paste backfill plant. Thickened tailings would be pumped to the backfill plant at 55-percent solids through a 6-inch diameter HDPE or steel pipeline. The pipeline would extend 1,500 feet from the thickeners to the 800-foot portal and adit. The pipeline then would extend down the 800-foot adit to the middle of the ore body. At this point, the pipeline would rise through a borehole to the paste backfill plant at the 2,050-foot level. A catchment would be provided underground to contain the total volume of tailings slurry flowing underground. At the portal, the pipeline would have a safety valve to prevent backflush to the surface. On the surface, the pipeline would be sited in a containment ditch that would provide secondary containment for any ruptures and spills. The return water line from the paste backfill plant to the mill would parallel the tailings line with the same containment measures.

At the paste backfill plant, the tailings would be mixed with water and cement and piped by gravity into open stopes within the mine. Testing completed by the operator shows that paste material could be placed efficiently and would remain stable. Backfilling selected open stopes would allow areas to be mined that otherwise could not be excavated due to stability concerns.

Due to swelling and mixing with water and cement, the operator theoretically could paste backfill all of the open stopes in the mine with only about 60 percent of the tailings volume produced at the Kensington Gold Project. Since paste backfill is difficult to pump, the volume of backfill would generally be limited to areas that could be accessed from the backfill plant by gravity feed. In addition, certain areas along the outer edges of the ore body would not be economical to paste backfill. These areas would either be backfilled with waste rock or remain open. The operator's estimate of 25-percent backfill was based on these considerations. In the 1996 Plan of Operations, the operator committed to increasing backfill to more than 25 percent to the extent feasible.

2.3.7 Employee Housing and Transportation

Except for the location of the permanent personnel camp, employee housing and transportation would be the same as discussed on pages 2-20 through 2-24 of the 1992 FEIS. Under Alternatives B through D, the proposed camp would be located directly west and adjacent to the process area, which is north of upper Sherman Creek (see Figures 2-1 through 2-4, presented previously).

2.3.8 Power Supply

To supply power under Alternative A, five 3.5-megawatt (MW) turbine generators fueled by liquefied petroleum gas (LPG) would be located at the site with three units operating at a time (see page 2-25 of the 1992 FEIS). Under Alternatives B through D, diesel-powered reciprocating generators would be used. Four 3.33-MW diesel generators would be located at the process area, and a 275-kilowatt (kW) "containerized" unit would be located near Comet Beach. These generators would supply the estimated annual 68,400,000 kW site demand. Alternative D would not require installation of an additional generator at the DTF. Underground lines would be used to supply power from the process area generators to the dewatering facilities at the DTF.

For diesel-fired generators, a selective catalytic reduction system or similar best available control technology would be used to control emissions of nitrogen oxides as required by ADEC. Under all alternatives, the power supply would be operated and emission sources controlled according to ADEC air quality permit requirements.

2.3.9 Fuel Use and Storage

Under all alternatives, a shore-based platform raft with secondary containment systems would be used to transfer fuel from the barges, as discussed on pages 2-25 and 2-26 of the 1992 FEIS. The barge would be moored to buoys, and fuel transfer lines would be attached from the barge to the platform to the shore. Diesel fuel would be stored onsite in above-ground tanks with berms and liners for secondary containment.

Under Alternative A, LPG fuel would be stored in a 76-foot diameter metal sphere near Comet Beach. Alternative A would use 2 million gallons of diesel fuel per year. Alternative A would include two primary diesel fuel storage areas: a 150,000-gallon tank at the marine terminal and a 20,000-gallon tank at the process area. Diesel fuel would be trucked to the tank at the process area.

Under Alternatives B through D, an estimated 6.5 million gallons of diesel fuel would be used annually. One 300,000-gallon tank would be located near Comet Beach, and one 300,000-gallon tank would be located at the laydown area. At the process area, two 20,000-gallon tanks would be located at the 800-foot portal and two 300,000-gallon tanks would be located adjacent to the generators.

Under Alternatives B and D, 5,000-gallon trucks would transport fuel from the laydown area to the mill site. Under Alternative C, an above-ground, 8,000-foot double-walled steel pipeline would be constructed to convey fuel from the fuel tanks near Comet Beach to the power plant and other facilities at the process area. The pipeline would parallel the access/haul road.

Under Alternative A, helicopter fuel would be stored at the heliport in a 10,000- to 15,000-gallon facility. Under Alternatives B through D, helicopter fuel would be stored in 5,000-gallon ISO containers at Comet Beach within the secondary containment area for the 300,000-gallon diesel tank.

2.3.10 Handling and Storage of Hazardous Materials and Chemicals

Under all alternatives, the chemicals and reagents required for the project would be handled and stored as detailed on page 2-26 of the 1992 FEIS. Alternatives B through D would not require sodium cyanide because of offsite processing. Chlorine would not be needed for cyanide destruction, although limited volumes would be used for potable water treatment. Under Alternatives B through D, wastewater treatment would use sodium hydroxide or lime, a polymer additive, and possibly ferric chloride for chemical precipitation. In addition, polymer would be used to enhance filtration, and hydrogen sulfide would be used for pH adjustment. Under all alternatives, the operator would be required to operate under the requirements presented in the Hazardous Material Handling Plan and spill contingency programs in Chapter VII of the 1996 Revised Plan of Operations.

Under all alternatives, explosives and cap sensitive primers, including ammonium nitrate and fuel oil, used in underground mining would be stored at a central surface explosives magazine. The explosives magazine would be located at a site separate from the marine terminal facility and process area. Figures 2-1 through 2-4, presented previously, show the location of the explosives magazine for Alternatives A through D, respectively. The storage and use of the blasting materials would meet all pertinent Federal, State, and local regulations. The storage of explosives would specifically comply with applicable Bureau of Alcohol Tobacco and Firearms and MSHA regulations.

2.3.11 Non-Process Waste Disposal

Refuse

The Forest Service controls refuse disposal on National Forest lands. The disposal methods detailed in the 1992 FEIS meet current Forest Service and ADEC waste disposal policies. As approved in the Forest Service ROD, an incinerator would burn non-process refuse at the site. Under Alternative A, ashes from the incinerator would be disposed of in the tailings impoundment. Under Alternatives B through D, ashes from the incinerator would be disposed of in privately owned areas of the mine according to ADEC solid waste permit requirements. Construction and demolition wastes would be salvaged as appropriate. Some construction and demolition wastes also would be managed in privately owned areas of the mine workings according to ADEC solid waste permit requirements.

Tailings from hardrock mines are subject to Alaska solid waste regulations. At its discretion, ADEC would incorporate applicable provisions of these regulations into the facility’s solid waste disposal permit to address tailings management for the Kensington Gold Project.

Hazardous Waste

As discussed on page 2-27 of the 1992 FEIS, over the expected 12-year operating period, the project would be considered a small quantity generator (i.e., less than 2,200 pounds per month) of hazardous waste and would be regulated under the Resource Conservation and Recovery Act. All hazardous waste generated at the mine site would be stored temporarily onsite, in accordance with an approved hazardous material handling plan. The hazardous waste would be transported to a permitted hazardous waste treatment, storage, and disposal facility operating in accordance with all Federal, State, and local requirements.

Sanitary Wastewater

Under all alternatives, sanitary wastewater generated at the marine terminal complex would be collected and routed to a new onsite secondary sanitary wastewater treatment plant that would require a permit issued by EPA in consultation with ADEC. The treated effluent from this plant would be discharged to Lynn Canal through an existing sanitary wastewater pipeline. This pipeline would extend from the current sanitary plant to the discharge location, which is 300-feet offshore from the low-tide point. The sludge from the sanitary plant would be managed offsite. Under Alternative A, sanitary wastewater from the process area and camp facilities would go to the tailings impoundment. Under Alternatives B through D, sanitary wastewater from these areas would be collected and managed at an ADEC-permitted leach field at the process area.

2.3.12 Borrow Areas

Alternative A would include the development of several borrow areas (approximately 130 acres) to serve as a material source for both construction activities and long-term operational needs. All borrow areas would be located within the footprint of the tailings impoundment. Page 2-27 of the 1992 FEIS discusses these borrow areas. Alternatives B through D would involve the development of three sand and gravel borrow areas (16 acres) and a till borrow area (27 acres), which are shown in Figures 2-2 through 2-4, presented previously.

Under all alternatives, sand and gravel would be used for fill; facility foundations; plant, warehouse, and support facilities; and other construction needs. Under Alternatives B through D, approximately 1.5 million cubic yards (2.25 million tons) of till would be used for construction of the DTF. Coarse till would be used to provide a 2-foot-thick drainage layer along the outer surfaces of the DTF. Underlying glacial (fine) till would be needed to establish a hydraulic barrier between the DTF lifts and the DTF outer slopes. Based on soils studies performed by the operator, the proposed site is the only readily accessible area of the site with sufficient material to meet till requirements under Alternatives B through D.

Discharges of runoff from all borrow areas would be regulated through an NPDES permit. Under all alternatives, the proposed borrow sites would be reclaimed concurrent with their development. Reclamation would involve grading, recontouring, and placement of growth media and seeding.

2.3.13 Reclamation and Closure

This section presents an overview of the reclamation process anticipated for activities associated with the Kensington Gold Project. Appendix C provides relevant sections of the reclamation plan submitted in support of the Proposed Action. Although the reclamation plan presents details specific to Alternative B, the processes and goals described would be similar for each alternative. Under all alternatives, the project is consistent with the designation of Minerals

Management during operations and Modified Landscape after closure under the revised Tongass Land and Resource Management Plan (USFS, 1997b).

Reclamation for the project site would focus on stabilizing disturbances and would ensure that all lands disturbed by exploration, construction, and operation of the mine and its related facilities would be returned to a suitable land use following mining activities. Reclamation activities would begin with stripping and stockpiling growth media prior to initial construction activities. Growth media piles would be seeded as part of an interim reclamation program, which would focus on reducing soil loss through erosion. Interim reclamation measures would include selective seeding, contouring, fertilizing, and mulching in accordance with Forest Service BMPs included in the *Soil and Water Conservation Handbook* (USFS, 1996b). Appendix D includes the applicable BMPs from the current handbook. These BMPs are subject to change over time. These measures would be employed in peripheral areas disturbed during exploration, construction, and operation and would minimize the amount of time during which land disturbances exist prior to temporary or permanent reclamation.

The initial stages of final reclamation would involve decommissioning facilities not necessary for the conduct of reclamation activities. This would include the removal or neutralization and proper disposal of chemicals and reagents, the removal of chemical and fuel storage tanks, and the salvage or demolition of buildings in the process area. Following the removal of facilities, the areas would be regraded to blend with the natural topography. Roads not required for long-term monitoring site access also would be reclaimed. Road closure activities would include removing or burying culverts, ripping the road surface, and contouring the cut and fill slopes to blend in with the surrounding terrain. The final contouring activities would restore normal surface drainage across the reclaimed roads. Stream crossings would be restored to their original conditions and bridges removed if they were determined not to be necessary for post-closure monitoring access.

Later stages of reclamation would include the removal of drainage controls as necessary from stabilized areas and the progressive removal, regrading, and revegetation of additional facilities corresponding to the reduced demand for ongoing activities at the site. Final stages would include the removal of the structures and stabilization of the remaining disturbances. The mine portal would be sealed to prevent access. The design would include a low permeable material that would allow drainage.

Growth media would be applied over the regraded areas to a depth of at least 1 foot, followed by seeding. The selected seed mixtures would be applied to a prepared seedbed via broadcast seeding or other appropriate methods. The depth of growth media, plant species, and seed mixtures, as well as the use of fertilizer and amendments (e.g., lime and/or gypsum), would be directed by the outcome of the test plot programs conducted during the life of the operation. The use of mulch and other BMPs would minimize erosion until vegetation became established, and a monitoring program would be implemented to track the success of reclamation efforts.

Under Alternative A, closure would involve routing upper Sherman Creek and its unnamed tributary across the east end of the tailings impoundment into a pond adjacent to the Ophir Creek diversion. The pond would discharge to the Ophir Creek diversion, where the combined flows would fall through a spillway to lower Sherman Creek. All channels would be designed to carry the probable maximum flood.

Under Alternatives B through D, closure would include restoring the original channel of Ophir Creek. The diversion above the process area would be removed. The diversion channels around the DTF would remain in place and be redesigned to carry a 500-year, 24-hour storm event. The DTF would undergo concurrent reclamation as cells were developed. This would reduce the extent of disturbance in the project area over the life of the project. The process area and DTF settling ponds would be left as open water.

2.4 PROJECT COMPONENTS NOT STUDIED IN DETAIL

Pages 2-28 through 2-45 of the 1992 FEIS discuss project components that were eliminated from detailed study based on technical, environmental, legal, and regulatory criteria. Except for submarine tailings disposal (STD) and DTF design, analyses of project components not considered in detail in the 1992 FEIS remain applicable and are not repeated in this Final SEIS.

2.4.1 Submarine Tailings Disposal

The 1992 FEIS discusses the potential for STD for the Kensington Gold Project. This component was eliminated from detailed consideration in the 1992 FEIS because the new source performance standards (40 CFR 440, Subpart J) for NPDES permits in this industry prohibit this disposal method. EPA recently proposed a change to these regulations to allow consideration of STD for the formerly proposed Alaska-Juneau (A-J) Mine Project. EPA proposed the regulatory change because the extreme topography and climatic conditions at the A-J Mine Project site appeared to make the use of a tailings impoundment impractical. EPA would not have finalized the proposed STD allowance if a feasible alternative to STD had been identified.

The circumstances associated with the Kensington Gold Project are different substantively from those of the A-J Mine Project. Although the A-J Mine Project might not have had feasible alternatives to STD, all of the alternatives identified for the Kensington Gold Project appear feasible, including alternatives that incorporate the use of a DTF. The prohibition on STD, therefore, continues to apply to the Kensington Gold Project.

2.4.2 DTF Construction

During analysis for this Final SEIS, two options for tailings management and construction of the DTF were identified but not considered in detail. Each option would increase stability of the DTF. The first option involves compacting all tailings. However, this option would be costly, and compaction might be difficult during high precipitation and/or freezing and thawing conditions. The second option would involve adding 3-percent cement to the tailings in a pug mill prior to transport and placement. This option also would be significantly more costly than DTF construction under Alternatives B through D. Primarily because these two options are more costly and would provide similar geotechnical stability as Alternative D, they were eliminated from detailed consideration.

2.5 MITIGATION AND MONITORING

The potential impacts associated with the alternatives depend in part on the mitigation and monitoring programs proposed for the project.

2.5.1 Mitigation

CEQ defines mitigation at 40 CFR 1508.20 as including avoidance, minimization, and reduction of impacts and compensation for unavoidable impacts. Table 2-2 summarizes the mitigation and control measures by resource for the Kensington Gold Project alternatives. These mitigation and control measures generally address the significant issues identified during scoping. Under Alternatives B through D, for example, effects on fisheries identified in the 1992 ROD are avoided and minimized through 1) reduction in length of diversion, 2) water treatment, 3) BMPs, 4) instream flow requirements and monitoring, 5) the use of bridges (Alternative D), and 6) offsite processing of sulfide concentrate. Many of the mitigation measures identified in the table have already been incorporated into the 1996 Revised Plan of Operations and/or will be permit requirements. The following paragraphs describe additional mitigation measures required by the Forest Service ROD. Note that reclamation included in the Plan of Operations is considered mitigation by EPA. Section 2.3.13 summarizes reclamation for each alternative, and Appendix C provides relevant sections of the Reclamation Plan.

Water Resources

Additional treatment of DTF effluent beyond enhanced settling is a contingency under Alternatives B through D. The same wastewater treatment options would be available for the DTF effluent as described for mine drainage (see pages 2-12 through 2-15 of the 1992 FEIS). These include precipitation and filtration for metals and solids. The chemistry of influent to the DTF pond, the existing tailings characterization data, and projected effluent composition (see Section 4.4 of this Final SEIS) currently suggest that no additional treatment would be needed to meet NPDES permit limits. If actual monitoring data indicated higher than anticipated metals in the DTF pond effluent, EPA could require the operator to provide treatment to ensure compliance with NPDES permit limits.

In developing the final design for the road under Alternative D, the operator would use bridges for the two crossings of Sherman Creek and one crossing of Ivanhoe Creek rather than bottomless conduits. The use of riprap to armor at least 300 feet of streambank immediately downstream of the diversion along Ivanhoe Creek would be required. Large woody debris would be incorporated with the riprap to enhance the development and improvement of aquatic habitat.

Moreover, the Forest Service requires BMPs for nonpoint source and construction-related discharges to surface water resources. The purpose of BMPs is to protect water quality and abate or mitigate water quality impacts. There are three types of BMPs: administrative, preventive, and corrective. Administrative BMPs are implemented as organizational controls (e.g., scheduling construction to avoid the highest precipitation periods). Preventive BMPs are used to minimize the effects of an activity on water quality (e.g., spreading grass seed on exposed soil). Corrective BMPs are applied in the field to address a problem (e.g., installing riprap to address streambank erosion).

Table 2-2. Summary of Mitigation and Control Measures

Resource	Mitigation and Control Measure	Authority
Air Quality	Use selective catalytic reduction to control emissions from generators (Alternatives B through D only)	ADEC – Final Air Quality Permit
	Use water sprays and baghouses on crushing, screening, and transfer facilities	ADEC – Final Air Quality Permit
	Use a baghouse on cement and lime silos	ADEC – Final Air Quality Permit
	Cover and reclaim dry tailings as soon as possible (Alternatives B through D)	USFS – Final Plan of Operations
Water Quality and Hydrology	Construct mine water treatment facility (precipitation and filtration) (Alternatives B through D)	EPA/ADEC – Final NPDES Permit
	Have DTF effluent treatment similar to mine water treatment available as a contingency if necessary to meet water quality standards, see discussion in text (Alternatives B and D)	EPA/ADEC – Final NPDES Permit
	Implement blasting BMP for ammonia and nitrate control	EPA/ADEC – Final NPDES Permit
	Design sediment ponds for 100-year, 24-hour storm event and construct polymer addition systems for high-flow events (Alternatives B through D)	EPA/ADEC – Final NPDES Permit
	Install temporary covers and conduct concurrent reclamation of DTF to minimize infiltration/ contact with tailings (Alternatives B through D)	USFS – Final Plan of Operations
	Provide secondary treatment of sanitary wastewater from beach area	EPA/ADEC – Final NPDES Permit
	Process sulfide concentrate offsite (Alternatives B through D)	USFS – Final Plan of Operations
	Follow Forest Service BMPs for construction and nonpoint source pollution (BMPs 14.9, 14.15, 14.17, 14.18, 14.20), see Section 2.5.1 and Appendix C	USFS – Final Plan of Operations
	Develop BMP plan for point source storm water only discharges, see discussion in text	EPA/ADEC – Final NPDES Permit
	Develop erosion control plan for construction and operations	USFS – Final Plan of Operations
	Divert upland runoff around mill site and DTF in 100-year, 24-hour diversions; expand DTF diversion to 500-year, 24-hour diversion at closure	USFS – Final Plan of Operations
	Regrade run-on diversion behind mill to establish natural drainage	USFS – Final Plan of Operations

Table 2-2. Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority
Water Resources (Marine)	Locate marine process water outfall one-half mile offshore outside of primary fishing zone and nearshore eddies (Alternative A); locate marine outfall as necessary to meet EPA/ADEC permitting requirements (Alternative C)	EPA/ADEC – Final NPDES Permit
	Develop Spill Prevention, Containment, and Countermeasure (SPCC) Plan, Facility Response Plan (FRP), and Oil Discharge Prevention and Contingency (C-) Plan to address worst-case spill event	EPA – FRP/SPCC Plan, ADEC/Coast Guard – C-Plan
	Avoid fuel deliveries during fish openings and seas greater than 3 feet, whenever practicable	ADEC/Coast Guard – C-Plan
	Develop Spill Prevention Control and Countermeasures Plan to address worst condition	ADEC/Coast Guard – C-Plan
	Have deployment boat with attached booms at beach during all transfers	ADEC/Coast Guard – C-Plan
	Provide annual inspections and pre-delivery checks of transfer equipment	ADEC/Coast Guard – C-Plan
	Station personnel at both ends of fuel lines; provide fuel line check valve	ADEC/Coast Guard – C-Plan
	Transport sulfide ore offsite in ISO containers	USFS – Final Plan of Operations
Water Resources (Fresh Water)	Provide secondary containment around all tanks and transfer points	EPA-FRP; ADEC – C-Plan
	Provide for double-walled tailings pipeline with safety valve from mill to paste backfill plant (Alternatives B through D); provide for double-walled tailings slurry and diesel fuel pipelines with check valves (Alternative C–diesel pipeline, Alternative D–tailings pipeline)	EPA-FRP; ADEC – C-Plan
	Provide for oil-water separation for runoff collected within secondary containment areas	EPA-FRP; ADEC – C-Plan
	Store spill cleanup equipment at beach, process area, and middle of road	EPA-FRP; ADEC – C-Plan
	Provide bottomless arch type conduits to allow for fish passage (Alternatives B and C)	USFS – Final Plan of Operations
	Use bridges instead of culverts to minimize instream disturbance and allow for fish passage (Alternative D)	USFS – Final Plan of Operations
	Time in-water construction activities to avoid critical times for anadromous fish	USFS – Final Plan of Operations; ADF&G – Habitat Permit
	Provide 300 feet of armoring incorporating the use of large woody debris for banks below Ophir Creek diversion (Alternatives B through D)	USFS – Final Plan of Operations; ADF&G – Habitat Permit

Table 2-2. Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority
Water Resources (Fresh Water) (continued)	Meet instream flow requirements in upper Sherman Creek and monitor in lower Sherman Creek; limit intake as necessary and use mine water/ground water as primary water supply, when feasible	ADNA – Water Rights Permits
	Re-establish Ophir channel at closure and re-populate with Dolly Varden, remove diversion upstream of process area (Alternatives B through D)	ADF&G – Plan of Operations
Geotechnical	Construct 2 avalanche control structures in Ophir Creek basin (Alternative A)	USFS – Final Plan of Operations
	Provide cleanup equipment onsite with response plan for avalanche control (Alternatives B through D)	USFS – Final Plan of Operations
	Perform routine inspections and monitoring of tailings dam stability (Alternative A)	USFS – Final Plan of Operations
	Maximize backfill of tailings	USFS – Final Plan of Operations
	Monitor geotechnical stability throughout DTF, install temporary and permanent covers as quickly as feasible to minimize infiltration (Alternatives B through D)	USFS – Final Plan of Operations
	Provide for pre-designed contingency berm around DTF and establish monitoring triggers for berm construction (Alternatives B and C)	USFS – Final Plan of Operations
	Construct structural berm around the north, south, and west sides of the DTF to prevent against most probable failure scenario (Alternative D)	USFS – Final Plan of Operations
Wildlife	Implement an employee education program in wildlife management	USFS – Final Plan of Operations
	Prohibit employees from hunting, trapping, and harassing wildlife in project area	USFS – Final Plan of Operations
	Implement a disciplinary program for employees violating fish and game regulations	USFS – Final Plan of Operations
	Establish buffer zones around bald eagle nests in consultation with Forest Service	USFS – Final Plan of Operations
	Restore mountain goat herd (by re-introduction after mine closure) if monitoring indicated that the goat population significantly declined during mine operations	USFS – Final Plan of Operations
	Implement garbage management plan (to limit bear access)	USFS – Final Plan of Operations
	Utilize helicopter flight paths that would avoid bald eagle nest sites and mountain goat habitat when weather and safety permit	USFS – Final Plan of Operations
	Develop flight guidelines for helicopter use near sensitive mountain goat habitat	USFS – Final Plan of Operations

Table 2-2. Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority
Wildlife (continued)	Implement nesting season timing restrictions for helicopter use and blasting near bald eagle sites	USFS – Final Plan of Operations
	Establish revegetation test plots to evaluate the most effective means of reclaiming wildlife habitat after project closure	USFS – Final Plan of Operations
	Develop long-term revegetation measures to improve wildlife habitat, such as thinning of second-growth forest in reclaimed areas	USFS – Final Plan of Operations
	Insulate power plant building and orient cooling towers on west side of building to minimize noise impacts to mountain goat habitat (all alternatives); orient turbine air inlets to minimize impacts (Alternative A)	USFS – Final Plan of Operations
Soils, Vegetation, and Wetlands	Prohibit the collection of plants or plant parts except by permit issued by the Forest Service for scientific or educational purposes	USFS – Final Plan of Operations
	Use plants native to the area and originating near the project area for reclamation to the extent possible; prohibit the use of herbicides within 100 feet of any known sensitive plant	USFS – Final Plan of Operations
	Maintain drainage patterns, water quality, and water quantity to the extent possible to support aquatic plant populations and habitats	USFS – Final Plan of Operations
	Maintain sediment ponds as open water at closure and retain any shallow water remaining in borrow areas as open water wetlands (Alternatives B and D)	USCOE – Final 404 Permit
	Remove fill material from roads and process area and reclaim to natural conditions	USCOE – Final 404 Permit
	Replace topsoil to a minimum depth of 1 foot.	USFS – Final Plan of Operations
	Reclaim vegetative cover to 75 percent.	USFS – Final Plan of Operations
Socioeconomics	Provide employment information to city and borough of Juneau and city of Haines	USFS – Final Plan of Operations; CBJ – Mine Permit
	Maximize hiring within Southeast Alaska, as practicable	USFS – Final Plan of Operations; CBJ – Mine Permit
Visual Resources	Locate roads to minimize visual impacts from the Alaska Marine Highway and tour ship travel routes in Lynn Canal	USFS – Final Plan of Operations
	Use full bench cuts and end-hauled material when slopes are too steep to hold material and/or where residual trees do not provide enough screen to permit the road to meet visual quality objectives	USFS – Final Plan of Operations

Table 2-2. Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority
Visual Resources (continued)	Minimize right-of-way clearing as cut and fill slopes permit	USFS – Final Plan of Operations
	Mitigate the effects of sidecast slash within 30 feet of road shoulders by the most appropriate method: 1) end haul slash to a central approved area or 2) pile slash in non-impacting areas; slash should be consolidated as much as practical, covered with soil, and shaped into natural contour	USFS – Final Plan of Operations
	Locate and design tree plantings where necessary to meet the visual quality objectives	USFS – Final Plan of Operations
	Use earth-tone colors on all building exteriors to blend with the surrounding natural landscape	USFS – Final Plan of Operations
	Revegetate the external tailings slopes and borrow areas as soon as practicable	USFS – Final Plan of Operations
	Direct exterior lighting inward, where possible, to reduce glare and visual impacts	USFS – Final Plan of Operations
	Conduct concurrent reclamation of DTF (Alternatives B through D)	USFS – Final Plan of Operations
Cultural Resources	Develop a plan for monitoring and, as necessary, mitigation of potential effects of ground disturbance at elevations below 100 feet	USFS – Final Plan of Operations
	Develop and implement mitigation plan if existing structures at 2,050-foot adit are to be removed and are determined to be eligible for National Register of Historic Places listing	USFS – Final Plan of Operations
	Provide for employee education on avoiding indirect impacts and procedures for inadvertent discoveries	USFS – Final Plan of Operations

The *Soil and Water Conservation Handbook* presents Forest Service BMP requirements (USFS, 1996b). Appendix D provides the relevant sections of the handbook and the applicability of the BMPs to hardrock mining operations. The handbook requirements and anticipated NPDES permit requirements for point source discharges formed the basis for the BMPs included in the 1996 Revised Plan of Operations. The Forest Service is responsible for ensuring adherence to the Plan of Operations, including identified BMPs, and determining BMP effectiveness in controlling nonpoint source and construction-related pollution. The Forest Service also would require the following specific BMPs as mitigation measures (see Appendix D):

- Avoid instream construction activities in Sherman Creek and its tributaries during critical life stages of anadromous fish (BMP 14.6). In general, this would range from adult entry into lower Sherman Creek until fry left the watershed. The Forest Service and the Alaska Department of Fish and Game (ADF&G) would determine the specific timing by evaluating species-specific periodicity and life stage information.

- Include in the final Plan of Operations an erosion control plan for construction and maintenance of roads and borrow areas. The plan would specifically address BMPs 14.9, 14.15, 14.17, 14.18, and 14.20.

- Incorporate oil-water separation into the process area runoff management system.

- Include in the spill prevention control and countermeasures plan specific provisions for cleanup of a worst-case diesel fuel spill along the road (Alternatives A, B, and D), pipeline (Alternative C), and fuel transfer and storage areas (all alternatives).

Under the NPDES permit for any alternative, EPA could require additional BMPs for point source discharges. For combined process and storm water point source discharges, BMPs would be required, as necessary, to meet effluent limitations for sediment and toxic pollutant loadings to surface water. For storm water only point source discharges, BMPs would be developed and implemented as part of the facility's BMP plan required by the NPDES permit.

Soils, Vegetation, and Wetlands

The following mitigation measures would be implemented under any alternative selected to address sensitive species:

- Prohibit the collection of plants or plant parts except by permit issued by the Forest Supervisor for scientific or educational purposes.

- Use plants native to the area and originating near the project area for reclamation to the extent possible, and prohibit the use of herbicides within 100 feet of any known sensitive plant.

- Close the area to off-road vehicle use.

- Maintain drainage patterns, water quality, and water quantity to the extent possible to support aquatic plant populations and habitats.

The closure criteria submitted by the operator in the Reclamation Plan (Appendix C) would be modified prior to approval in the final Plan of Operations to reflect that reclamation objectives and bond release would be met by establishing 75 percent live vegetation cover on reclaimed areas, and water quality criteria would be met.

The discussion of growth media placement and grading in the Reclamation Plan would be modified prior to approval in the final Plan of Operations to indicate that growth media would be placed at a depth of at least 1 foot over all disturbed areas, excluding rock faces, riprap, and other locations where placement of growth material would be impractical.

Cultural Resources

Prior to initial ground disturbance (e.g., vegetation removal or grading) for each cell of the DTF and any other areas below 100 feet of elevation, the operator would be required to prepare a cultural resources monitoring plan. The plan would be approved by the Forest Service and Alaska State Historic Preservation office and be circulated for comment to the Chilkat and Chilkoot Indian Associations, whose comments must be addressed in the plan. The plan would incorporate provisions for notifying the Forest Archaeologist 30 days prior to initial ground disturbance and monitoring ground disturbances by an archaeologist approved by the Forest Service and contracted by the operator. The plan would also establish procedures for evaluating and mitigating potential effects to historic archaeological resources in the event of unexpected discoveries. This would include consultation with Native Alaskans.

Prior to removal of the two existing structures at the 2,050-foot adit, a qualified historian must document and evaluate the structures in terms of their potential eligibility for listing on the National Register of Historic Places. If determined to be eligible, a mitigation plan for data recovery would be developed and implemented prior to removal of the structures. Documentation, evaluation, and mitigation, as necessary, would be contracted by the operator and approved by the Forest Service in consultation with the Alaska State Historic Preservation Office.

The operator's Final Plan of Operations would provide for education of project personnel to reduce the potential for secondary effects of increased visitation on cultural resources sites. This training would also address the steps to be followed in the event of inadvertent discovery of cultural resources. These provisions would be subject to approval by the Forest Archaeologist. In addition, Native Alaskans would be provided the opportunity to comment on these provisions. These provisions would be subject to revision to protect any significant cultural resources that might be discovered during project construction, operation, and reclamation. Revisions would be initiated and proposed by the Forest Archaeologist or the Alaska State Historic Preservation Office and finalized in cooperation with the operator.

Visual Resources

The following mitigation measures would be implemented under any alternative selected to address visual resources:

- Locate roads to minimize visual impacts from the Alaska Marine Highway and tour ship travel routes in Lynn Canal.
- Use full bench cuts and end-hauled material when slopes are too steep to hold material and/or where residual trees do not provide enough screen to permit the road to meet visual quality objectives.
- Minimize right-of-way clearing as cut and fill slopes permit.
- Mitigate the effects of sidecast slash within 30 feet of road shoulders by the most appropriate method: 1) end haul slash to a central approved area or 2) pile slash in non-impacting areas. Slash should be consolidated as much as practical, covered with soil, and shaped into a natural contour.
- Apply seed and fertilizer (as necessary) to all disturbed areas to be reclaimed, including cut/fill embankments and roadways. Typical seed mixtures should reflect vegetation and growth characteristics of Southeast Alaska. Appropriate grasses, for example, would include Alyeska Polargrass (*Arctagrostics latifolia*), Actared Red Fescue (*Festuca rubra*), Norcoast Bering Hairgrass (*Dechampsia beringensis*), and Gruening Alpine Bluegrass (*Poa alpina*).
- Locate and design borrow pits to minimize visual impacts and retain screen trees where necessary to meet the visual quality objective.
- Use earth-tone colors on all building exteriors to blend with the surrounding natural landscape.
- Design structures to repeat forms, lines, and textures that occur frequently in the surrounding landscape.
- Direct exterior lighting inward wherever possible.

2.5.2 Monitoring

The purpose of monitoring is to collect data of known quality to verify projected impacts, evaluate the effectiveness of mitigation measures, and determine the effectiveness of reclamation efforts. Regulatory agencies and the operator would review the results of all monitoring activities. If environmental changes varied from those predicted, the regulatory agencies would determine what actions, if any, the operator would need to implement to reduce or eliminate project-related effects. Table 2-3 lists monitoring activities identified for selected resources. When the Forest Service is the responsible agency for specific monitoring, detailed monitoring programs will be included in the final Plan of Operations. For example, the following subsection describes the components of the Forest Service's water quality monitoring plan.

Table 2-3. Summary of Monitoring Activities for Selected Resource Objectives

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Construction, Operation, and Reclamation Specifications						
Construction, operation, and reclamation according to Plan of Operations and permit requirements.	Documentation, reporting, and inspections	Ongoing	Non-conformance with approved design specifications	To be determined by individual agencies	Forest Service ROD, final Plan of Operations, NPDES permit, Section 404 permit	Forest Service, EPA, and Corps of Engineers
Water Quality/Hydrology						
Effluent treatment measures	Inspect implementation of design and mitigation measures outlined in final Plan of Operations and Final SEIS	Ongoing	Operability of measures at all times	Cannot discharge effluent to receiving waters until measures implemented	Forest Service ROD, SPCC, NPDES permit	Coeur Alaska with Forest Service, ADEC, and EPA review
Implementation of best management practices (BMPs) to control pollution from sediment, petroleum products, and hazardous or toxic wastes (including metals) during construction and operation	Review site-specific BMP plans and inspect implementation of plans	During construction - ongoing During operation - monthly	Evidence that BMPs are not designed and implemented correctly	Require additional or improved pollution control measures	Forest Service ROD, final Plan of Operations, NPDES permit	Forest Service, ADEC, EPA, and Coeur Alaska
Effluent compliance with NPDES permit	Implement methods according to NPDES permit	Frequency indicated in NPDES permit	Thresholds at NPDES permit limits	Notify as required by NPDES permit and final Plan of Operations; implement additional measures to correct the noncompliance	NPDES permit	Coeur Alaska with EPA review
Surface water quality	Implement methods according to NPDES permit	Frequency indicated in NPDES permit	Trend showing effects on water quality	Per NPDES permit	NPDES permit	Coeur Alaska with EPA review
Effectiveness of BMPs in controlling nonpoint source pollution during construction and operation	Collect and evaluate data on relevant water quality constituents from sites located above and below mine activity	During construction and operation - varies from weekly to quarterly depending on the site and the year after construction or agency	Evidence that nonpoint source pollution control measures are not installed correctly, maintained operationally, or effective; compliance with water quality criteria or change in water quality trends	Require additional or improved pollution control measures	Forest Service ROD, final Plan of Operations	Coeur Alaska with Forest Service review

Table 2-3. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Effectiveness of impoundment and seepage control structures in maintaining or improving the water quality in fish-bearing streams below impoundment (Alternative A only)	Sample ground water, seepage pond, and stream below impoundment for standard aquatic water quality parameters and biomonitoring	Monthly to quarterly	Flow quantities exceeding the amounts predicted in the SEIS; quality exceeds background levels in streams.	Take action to intercept seepage around or under tailings pond	Forest Service ROD, final Plan of Operations, NPDES permit	Coeur Alaska with Forest Service and EPA review
Ground water quality effects of DTF (Alternatives B-D)	Sample ground water upgradient and downgradient of DTF	According to solid waste permit	Per solid waste permit	Per solid waste permit	Solid waste permit	Coeur Alaska with ADEC review
Maintenance of instream flows in Sherman Creek	Monitor stream flows below diversion (Alternative A) and below intake (Alternatives B-D)	As established by Alaska Department of Natural Resources (ADNR) instream flow permit	Instream flow levels set by ADNR permit	Limit water withdrawal to levels established by ADNR permit	Forest Service ROD, ADNR water rights permit	Coeur Alaska with Forest Service and ADNR review
Compliance with storm water regulations	Sample and inspect according to NPDES permit	According to NPDES permit	Per NPDES permit	Per NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Effectiveness of reclamation measures in maintaining water quality at the mine site	Monitor above and below the impoundment (Alternative A) and mill and DTF sites (Alternatives B-D)	Vary with time after reclamation	Background levels and trends, including seasonal influences	Implement additional reclamation efforts	Forest Service ROD, final Plan of Operations	Coeur Alaska with Forest Service review
Effectiveness of reclamation in maintaining stable, self maintaining stream channels	Monitor reclaimed channels for stability	Vary with time after reclamation	Self maintaining, productive channels	Implement additional reclamation efforts	Forest Service ROD, final Plan of Operations	Coeur Alaska with Forest Service review
Impacts of spills and effects of response measures	See C-Plan for marine and fresh water and SPCC Plan for fresh water	Post spill as required in C-Plan and SPCC Plan	Per C-Plan and SPCC Plan	Per C-Plan and SPCC Plan	C-Plan and SPCC Plan	Coeur Alaska with ADEC (marine and fresh water) and EPA (fresh water) review

Table 2-3. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Aquatic Resources						
Discharge effect on aquatic organisms	Perform bioassays of discharges to surface water, fish surveys above and below discharges	Per NPDES permit	Per NPDES permit	Per NPDES permit	NPDES permit	Coeur Alaska with ADEC and EPA review
Spawning salmon escapement survey	Conduct pink, chum, and coho spawner counts in intertidal zone and 30-meter sections of Sherman Creek from mouth to fish barrier with same methods used by Konopacky in 1995	Yearly survey; weekly counts during spawning period	When results of this monitoring, in addition to other information, indicate habitat capabilities are changing as a result of mine activities	Meet with Forest Service to discuss potential problem; could result in change in construction or operating practices and mitigation in nearby streams	Final Plan of Operations	Coeur Alaska with Forest Service and ADF&G review
Benthic macroinvertebrate community composition	Sample from known sites using established procedures	Yearly	Trend showing effects on benthic community composition	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Spawning gravel composition and embryo survival	Sample using established procedures	Yearly	Trend showing effects on gravel composition and embryo survival	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA review
Water temperature	Sample using established procedures	Yearly	Trend showing effects on water temperature	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Sediment quality (metals toxicity and other characteristics)	Sample using established procedures	Annual	Trend showing increased toxicity and/or metals levels	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Aquatic habitat characteristics	Visual observation and photos of habitat type (e.g., riffle, pool), substrate size and vegetation/woody debris; similar to previous Konopacky surveys	Yearly in both Sherman Creek and Sweeny Creek (control)	Trends showing habitat change from baseline	Meet with Forest Service to discuss potential sources of impacts; could result in change in construction or operation practices and mitigation in nearby streams	Final Plan of Operations	Coeur Alaska with Forest Service review

Table 2-3. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Wildlife						
Eagle nest management	Visit nest sites	Years 1 and 2 of project development, every month May - August; after second year, annually	A change (an occupied nest is no longer occupied) due to mining-related activity	Consult with U.S. Fish and Wildlife Service, Forest Service, and Coeur Alaska to modify activity if deemed to be influencing the observed change (nest abandonment)	Eagle Protection Act, final Plan of Operations	Forest Service and U.S. Fish and Wildlife Service
Stellar sea lions, marine mammals (seals)	Observe known haulout sites	Annually while activities are occurring; during times when haulouts occupied	Evidence of harassment of marine mammals as direct result of mining-related activities	Enforce Marine Mammal Protection Act	Marine Mammal Protection Act, Endangered Species Act	National Marine Fisheries Service
Mountain goat monitoring	Conduct population surveys, track radio-collared goats	Several flights per year	Evidence of extreme adverse reaction to mining-related activities causing abandonment of habitat	Consult to minimize disturbance; if disturbance cannot be minimized causing loss of mountain goat population, mitigation could involve reintroduction	Agreement with Coeur Alaska	ADF&G and Forest Service
Vegetation						
Compliance with timber sale contract provisions (sale administration)	Conduct onsite inspections	Before, during, and after harvest activities	Compliance with contract clauses	Return to compliance	36 CFR Part 223	Forest Service
Visual Resources						
Operations monitoring: compliance with visual quality objective	Conduct field observation and document with photos taken from established viewpoints	After construction, during operations, and after project completion	Determine if visual impacts exceed anticipated impacts	Consider additional mitigation	FSH 2309.22	Forest Service
Reclamation monitoring: compliance with visual quality objective	Conduct field observation and document with photos taken from established viewpoints	Once every 5 years for 15 years after reclamation	Determine if visual impacts exceed anticipated impacts	Photos would be used as reference in determining impacts and achieving VQOs in future planning	FSH 2309.22	Forest Service

Table 2-3. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Geotechnical Stability						
Tailings structure: construction materials	Conduct visual inspection and gradation testing of coarse and fine till, drain rock, and waste rock	Continuous	Per design documents	Remove non-conforming material	Final Plan of Operations	Coeur Alaska and Forest Service
Tailings structure: construction methods	Perform compaction and moisture tests along with other standard engineering practices	As dictated by selected design needs	Per design documents	Remove non-conforming material or apply additional effort to installation	Final Plan of Operations	Coeur Alaska with Forest Service review
Tailings structure: ongoing performance	Perform visual inspections, measure saturation and movement with grid network of 100 piezometers and settlement gauges	At minimum monthly, more frequent as dictated by selected design; after large earthquakes or other natural events	Per design documents, including specific trigger levels for piezometers as identified in the final Plan of Operations	Per analysis of variance	Final Plan of Operations	Coeur Alaska with Forest Service review
Waste rock pile stability	Perform visual inspection	Annually	Visible movement	As dictated by findings	Final Plan of Operations	Coeur Alaska with Forest Service review
Cultural Resources						
Ground Disturbance below 100-foot elevation	Monitoring of ground disturbance for discovery of cultural resources by qualified archaeologist according to plan approved by Forest Service and State Historic Preservation Office and made available for comment by Native Alaskans	As appropriate	Detection of buried archaeological remains	Implement mitigation measures as described in plan	Final Plan of Operations	Coeur Alaska with Forest Service review

0Water Quality

EPA, ADEC, ADNR, and the Forest Service require monitoring of water quality and quantity. Individual permits for the project would include more detailed monitoring requirements for specific resources. A detailed monitoring plan for nonpoint source quality would be developed by the operator in cooperation with the Forest Service specifically for surface water quality as part of the final Plan of Operations. This monitoring plan would combine the following elements:

- Purpose, information goals, and monitoring objectives
- Network design
  - Station location
  - Constituent selection
  - Sampling frequency
  - Sample collection, handling, and shipping procedures
- Field sampling
  - Training
  - Protocols
  - Field quality control and samples
  - Constituents
- Laboratory procedures
  - Analysis techniques
  - Quality control and assurance procedures
  - Data recording standards
  - Required lab quality control sample and frequency
- Data handling
  - Data verification and validation
  - Data base maintenance
  - Data reporting and distribution
  - Filing procedures and security
- Data analysis needs
  - Graphical and/or statistical requirements
  - Compliance with State criteria
  - Trend analysis
  - Quality control interpretation
  - BMP effectiveness

- Program modification and updates
  - Annual review of information needs
  - Annual analysis of data
  - Adjustment of monitoring requirements to meet changing information needs
  - Evaluation of BMP effectiveness and adaptation of BMPs as needed.

Data from monitoring that was initiated as a result of the 1992 FEIS led the Forest Service and Alaska Department of Fish and Game (ADF&G) to reevaluate parts of the wildlife monitoring plan described in the 1992 FEIS. The remainder of this section discusses the reevaluation.

Black Bears

Results from radio telemetry work indicate that the project area has a high density of black bears and that denning occurs within the project area. Additional telemetry work, as described in the monitoring section of the 1992 FEIS, would not yield more useful information. Rather than continuing telemetry work through the construction phase and into the operation phase of the mine, it would be better to concentrate on mitigating the potential problems that could occur as a result of the mine development. The operator would work closely with the Forest Service and ADF&G in the final design and implementation stages of the mine development to reduce impacts to the area's black bear population. Special attention would be focused on plans for food handling and garbage disposal. Wet garbage would be specifically collected on a daily basis from each area of the site and taken to the well-fenced incinerator.

Mountain Goats

The original monitoring goals for construction and operation of the mine were to determine if the activities associated with mine development would result in disturbance or displacement of the mountain goats that use the habitat adjacent to the mine. The level of monitoring identified in the 1992 FEIS would not likely provide enough information to determine cause-and-effect relationships between mountain goat movement patterns and mineral development.

Results from the pre-construction monitoring have shown that a more intensive effort would be required to determine the cause and effect relationships in the original monitoring goal. A monitoring effort of this magnitude would require more mountain goats to be radio-collared and more crews stationed in the field gathering data. These activities would have their own impact on the mountain goat population. There would also be increased costs for a study of this nature. The Forest Service and ADF&G reevaluated the costs and effects of the proposed monitoring in the 1992 FEIS and developed an alternative monitoring goal. The revised monitoring plan will have less effects on the mountain goats, provide sufficient information to allow the operator to respond to a need to change activities that are displacing the herd, and be more cost-effective. For these reasons, the Forest Service and ADF&G monitoring goal will be to obtain yearly population estimates, gather herd composition information, and determine areas of high use. This goal will enable the Forest Service and ADF&G to determine population trends over the life of the mine. The goal can be reached by conducting survey flights several times each year. ADF&G is working with the operator on a cooperative agreement to conduct this monitoring.

Body Tissue Monitoring

In the monitoring plan identified in the 1992 FEIS, mink were to be collected from the Sherman Creek drainage in order to determine the levels of various metals in tissues. This would indicate whether metals could be bioaccumulating in animals that use the habitats that are potentially impacted by the project. Because the data collected to date are highly variable, many more samples would be required to determine any trends or cause-and-effect relationships between levels of metals in tissue samples and mine development. Removing more animals from the drainage on a yearly basis would likely result in a temporary depletion of the mink population. New mink would quickly move into the area; however, tissue samples taken from their bodies could add a bias to the data because they would not have spent much time in the impacted area. Because of these potential problems, mammal tissue sampling has been eliminated from the monitoring plan.

2.5.3 Implementation of Mitigation and Monitoring

If the No Action Alternative (Alternative A) is selected, mitigation and monitoring would be implemented as specified by the 1992 ROD and the 1992 Approved Plan of Operations. If one of the action alternatives—B, C, or D—is selected, mitigation and monitoring would be implemented as documented in the Final SEIS and ROD. Individual permits probably would contain specific management, mitigation, and monitoring requirements for the project. The agencies issuing the permits then would be responsible for enforcing these measures. Elements of different agencies' monitoring plans for the same resources could vary depending on individual agency goals and requirements.

2.6 COMPARISON OF ALTERNATIVES

The alternatives for the Kensington Gold Project were developed and evaluated by project component based on the issues identified as part of the public scoping process. Table 2-4 summarizes and compares the alternatives according to the project components discussed in Section 2.3. The Forest Service, EPA, and Corps of Engineers reviewed all of the issues for significance. Significant issues were used to develop alternatives and to compare the potential effects of all project alternatives. Table 2-5 summarizes the potential impacts of each alternative according to the significant issues. Table 2-6 summarizes the potential impacts of each alternative by resource.

Table 2-4. Comparison of Alternatives by Project Component

Project Component	Alternative A	Alternative B	Alternative C	Alternative D
Project Location	Sherman Creek Drainage Basin	Sherman Creek Drainage Basin; Terrace Area Drainage Basin	Same as Alternative B	Same as Alternative B
Mining Methods	Long-hole, open stoping	Similar to Alternative A, except paste backfill for greater recovery	Same as Alternative B	Same as Alternative B
Waste Rock Disposal	About 50 percent consumed in roads and tailings dam, 50 percent remains in 15-acre permanent stockpile at mine entrance	Used in DTF construction and foundation benches in facilities area and mine portal, and some backfill; 15-acre temporary pile at mill	Same as Alternative B	Same as Alternative B
Ore Processing	Onsite flotation and cyanidation	Onsite flotation, concentrate transported offsite by barge for further processing	Same as Alternative B	Same as Alternative B
Water Management	Alkaline chlorination for cyanide process water destruction; enhanced pond settling (mine drainage), discharge to Lynn Canal .25 to .50 miles offshore north of Point Sherman Effluent pipeline 2.7 miles Ophir and Sherman creeks diverted, total habitat loss - 6,000 ft	Discharge of mine drainage and mill site runoff into Sherman Creek (outfall 001), discharge of DTF effluent into Camp Creek (outfall 002), recycle mill process water; enhanced settling in ponds, precipitation/ filtration of mine drainage No effluent pipeline Ophir Creek diverted, temporary habitat loss of 2,450 ft, haul road crossings on upper Sherman and Ivanhoe Creeks using long-span bottomless conduits	Marine discharge of mine drainage and DTF effluent 300 feet offshore north of Point Sherman, process area runoff to upper Sherman Creek, enhanced settling in ponds, application for marine mixing zone Effluent pipeline 2.2 miles Ophir Creek diverted, temporary habitat loss of 2,450 ft	Same as Alternative B, except bridges constructed for haul road crossings on upper Sherman and Ivanhoe Creeks
Tailings Transportation and Disposal	Cross valley dam in Sherman Creek Negligible tailings pipeline	Dry disposal at Site B in 220 ft high unit, constructed with engineered drainage system, backfill maximum feasible volume of tailings (at least 25 percent) Tailings trucked (80 trips per day)	Same as Alternative B	Dry disposal at Site B in 220 ft high unit, engineered structural berm around three sides, backfill maximum feasible volume of tailings (at least 25 percent) 8,000-ft tailings pipeline
Employee Housing and Transportation	Onsite camp at mill site; employees transported by helicopter to site	Onsite camp at mill site, north of the FEIS site; employees transported by helicopter to site	Same as Alternative B	Same as Alternative B

Table 2-4. Comparison of Alternatives by Project Component (continued)

Project Component	Alternative A	Alternative B	Alternative C	Alternative D
Power Supply	Two LPG-fired generators at beach	Four diesel generators at the mill and one generator at Comet Beach	Same as Alternative B	Same as Alternative B
Fuel Use and Storage	LPG stored in 300,000-gallon tank near Comet Beach, piped to 20,000-gallon tank at process area; diesel fuel stored in 150,000-gallon tank near Comet Beach and 20,000-gallon tank near process area Diesel trucked from Comet Beach to process area	Diesel fuel stored in 1) 300,000-gallon tank near Comet Beach, 2) 300,000-gallon tank near laydown area, and 3) two 300,000-gallon and two 20,000-gallon tanks near process area Fuel trucked from laydown area to process area	Same as Alternative B, except fuel piped 8,000 ft from laydown area to process area	Same as Alternative B
Handling, Storage, and Disposal of Hazardous Materials and Chemicals	Storage of reagents and solvents consistent with hazardous material handling plan and disposal under small quantity generator permit; sodium cyanide shipped to site in ISO containers	Storage of reagents and solvents consistent with hazardous material handling plan and disposal under small quantity generator permit; no sodium cyanide	Same as Alternative B	Same as Alternative B
Non-Process Waste Disposal	Combustibles incinerated; ash to impoundment; any noncombustibles generally shipped to Juneau for disposal in approved facility; some construction waste to mine	Same as Alternative A, except ash to mine	Same as Alternative B	Same as Alternative B
Borrow Areas	Sand gravel areas within impoundment drainage (total 130 acres)	Three sand and gravel quarries near the process area (total 16 acres); till borrow area (27 acres) northwest of the rock quarry	Same as Alternative B	Same as Alternative B
Reclamation and Closure	All structures removed except impoundment, surfaces regraded and revegetated, Sherman Creek routed to pond at east end of impoundment	All structures removed, except diversions upgradient of DTF and settling ponds; settling ponds retained as wetlands; surfaces regraded and revegetated; Ophir Creek restored to natural drainage	Same as Alternative B	Same as Alternative B
Total Disturbance	282 acres	250 acres	Same as Alternative B	Same as Alternative B

Table 2-5. Summary of Potential Impacts of Each Alternative by Significant Issues

Alternative	Summary of Potential Impact
Water Quality (from discharges)	
Alternative A - No Action	Marine – Levels of cyanide, metals, and total suspended solids in effluent discharge could meet water quality standards with a mixing zone. No impacts to fisheries expected. Sediment accumulation is expected in the vicinity of the outfall. Some heavy metal accumulation could occur only in sedentary, bottom-dwelling organisms (e.g., tubified worms and polychaetes) near the outfall. Fresh water – Construction of the tailings impoundment and diversions initially would increase sediment loads along a 1,000-foot downstream portion of pink salmon spawning habitat in Sherman Creek. Sediment loadings at closure would depend on reclamation success and geotechnical impacts.
Alternative B - Proposed Action	Marine – No direct marine discharge of process water. Fresh water discharges ultimately would reach Lynn Canal, but compliance with all standards would minimize any marine impacts. Fresh water – Discharges would comply with all technology- and water quality-based permit limits without a mixing zone. Accomplished through mitigation for water quality impacts, including mine water treatment, offsite processing of sulfide concentrate, and blasting BMP. Construction of the DTF and other facilities and runoff during active operations could increase sediment loads to Sherman Creek and the unnamed creeks in the Terrace Area. Any sediment impacts mitigated by polymer added settling ponds, BMPs during construction and operation, and complete reclamation.
Alternative C - Marine Discharge	Marine – Levels of metals and total suspended solids in effluent discharge would meet water quality standards with mixing zone. No impacts to fisheries expected. Sediment accumulation expected in the vicinity of the outfall. Some heavy metal accumulation could occur only in sedentary, bottom-dwelling organisms (e.g., tubified worms and polychaetes) near the outfall. Fresh water – Similar to Alternative B, except no discharge of mine drainage or DTF effluent to fresh water. Water quality impacts mitigated by offsite processing, blasting BMP, and sediment control.
Alternative D - Modified DTF Design	Same as Alternative B.
Air Quality (increased emissions, including CO_2)	
Alternative A - No Action	Air quality impacts would be well below allowable Federal and Alaska ambient air quality standards.
Alternative B - Proposed Action	Air emissions of NO_X, SO_2, CO, and total suspended particulates would be greater than Alternative A but still below air quality standards. NO_X emissions mitigated by SCR, particulates by baghouses and water sprays. CO_2 emissions slightly higher than Alternative A.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Similar to Alternative B, except that vehicle emissions would be slightly reduced, along with less fugitive dust from the road.

Table 2-5. Summary of Potential Impacts of Each Alternative by Significant Issues (continued)

Alternative	Summary of Potential Impact
Geotechnical Considerations (potential failure of tailings unit)	
Alternative A - No Action	Tailings dam would be constructed using a modified centerline technique and would be designed to withstand maximum probable storm event and seismic event for the region. Ongoing monitoring during operation. Avalanche control features.
Alternative B - Proposed Action	DTF would be designed to maintain unsaturated tailings through engineered drainage system and temporary and permanent barriers. Design would account for maximum credible seismic event. Intensive ongoing monitoring during operations; pre-designed contingencies, including berm, depend on monitoring results.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Modified DTF design would include engineered structural berm. Berm would mitigate potential effects of instability in DTF.
Spill Potential From Increased Use of Diesel Fuel	
Alternative A - No Action	Limited use of diesel fuel.
Alternative B - Proposed Action	Increased risk of spill due to increased diesel usage primarily for power generation. Diesel would be transported, handled, and stored according to SPCC Plan, C-Plan, and FRP requirements. Any impacts limited by transfer timing restrictions, equipment design, and prompt spill response capability. Diesel transport from Comet Beach to mill by truck.
Alternative C - Marine Discharge	Similar to Alternative B, except double-walled pipe used to transport diesel from laydown area to mill.
Alternative D - Modified DTF Design	Similar to Alternative B.
Visual Impacts	
Alternative A - No Action	Primary visual impact would involve Sherman Creek tailings dam (270 ft high × 2,400 ft long).
Alternative B - Proposed Action	At full construction, DTF (220 ft high x 5,000 ft long) would average about 150 feet above treeline. Downslope would be reclaimed upon completion, and individual cells would be reclaimed fully immediately after completion. Borrow pits, roads, and facilities hidden by the tailings impoundment under Alternative A would be visible to marine traffic. Increased road width and traffic compared to Alternative A. DTF height limited by maximizing backfill. Alternative B includes measures to limit visual effects of DTF, borrow areas, and roads. Dust control and concurrent reclamation would be used to minimize emissions.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Same as Alternative B.

Table 2-6. Summary of Potential Impacts of Each Alternative by Resource*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Air Quality and Climate	Air Quality	Predicted pollutant emissions less than State and Federal standards.	Predicted emissions higher than Alternative A but less than State and Federal standards.	Same as Alternative B.	Same as Alternative B.
Topography	See 1992 FEIS	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Geology	See 1992 FEIS	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Geotechnical Considerations	Probability of Tailings Facility Failure	Negligible.	Low to moderate potential of saturation during operations. Probability of failure low because of intensive monitoring and pre-designed contingencies.	Same as Alternative B.	Very low due to berm.
Surface Water Hydrology	Water Withdrawals	190 gpm (0.42 cfs), impoundment of upper Sherman Creek.	234 gpm (0.52 cfs), infiltration gallery on upper Sherman Creek	Same as Alternative B.	Same as Alternative B.
	Stream Diversions	2 diversions, totaling 2.1 miles; impacts on streams remain at closure.	4 diversions, totaling 2.3 miles. Only Ophir Creek diversion directly affects stream flow. All diversions except above DTF removed at closure. Potential impact to Ivanhoe Creek because of increased flows from Ophir Creek Diversion.	Same as Alternative B.	Same as Alternative B.
	Stream Flow	Potential impact to instream flows during critical flow periods. Marine discharge of mine drainage would reduce average stream flow 0.8 cfs in Sherman Creek.	Potential impact to instream flows during critical flow periods in Sherman Creek between withdrawal and discharge point. Under all alternatives, effects of water withdrawals on stream flow mitigated by State requirements for maintaining instream flows necessary for maintenance of fish habitat. Mine drainage provides alternative water supply. Discharge of mine drainage to Sherman Creek, increasing average stream flow 1.3 cfs.	Similar to Alternative A, except process area runoff discharged to Sherman Creek.	Same as Alternative B.
Surface Water Quality	Sedimentation	Highest potential for sediment loading to Sherman Creek would be during construction (282 acres of disturbance). Sediment controlled through settling in impoundment and BMPs. One culvert on intermittent Sherman Creek tributary.	Highest potential for sediment loading to Sherman Creek would be during construction (250 acres of disturbance). Sediment controlled through polymer added sediment ponds and BMPs. With proper construction and maintenance, sediment loadings should be consistent with natural conditions. Two bottomless arch conduits on upper Sherman Creek and one on Ivanhoe Creek could cause channelization, streambed erosion, and sedimentation.	Highest potential for sediment loading to Sherman Creek would be during construction (253 acres of disturbance, including disturbance of 2.7 acres due to pipelines). Sediment controlled through polymer added sediment ponds and BMPs. With proper construction and maintenance, sediment loadings should be consistent with natural conditions. Same conduits as Alternative B.	Highest potential for sediment loading to Sherman Creek would be during construction (270 acres of disturbance, including disturbance of 1.8 acres due to tailings slurry and reclaim pipelines) and up to 18 acres for DTF berm. Sediment controlled through polymer added sediment ponds and BMPs. With proper construction and maintenance, sediment loadings should be consistent with natural conditions. Potential effects of crossings reduced by use of bridges instead of conduits.

*Chapter 4 presents a detailed discussion of potential impacts.

Table 2-6. Summary of Potential Impacts of Each Alternative by Resource (continued)*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Surface Water Quality (continued)	Effluent Quality	No process water discharge to fresh water; see Aquatic Resources, Marine.	No impacts; effluent would comply with water quality-based NPDES permit limits at discharge point. Negligible onsite acid generation potential.	No process water discharge to fresh water, except process area runoff. Discharge of process area runoff would meet water quality-based permit limits at discharge point.	Same as Alternative B.
	Spills	Seepage from or failure of the tailings dam, or leakage or rupture of the effluent pipeline, could discharge effluent into Sherman Creek (maximum pipeline volume 17,000 gallons).	Potential for accidental release during transportation of 5 tons of lead nitrate, 5,000 gallons of diesel fuel, or 50 tons of tailings into Sherman Creek. Risk of diesel spill about 1 in 67 over life of mine; risk of tailings spill 1 in 6. Potential impacts mitigated by distance to creek (except at crossings), location of spill response equipment along road, and plan for prompt response.	Potential for accidental release during transportation of 5 tons of lead nitrate or 50 tons of tailings into Sherman Creek. Same risk of tailings spill as Alternative B. Rupture of the diesel pipeline could release 17,000 gallons of fuel into Sherman Creek. Rupture of the effluent pipeline could release 17,000 gallons of mine drainage and DTF effluent into Sherman Creek. Risk of diesel spill 1 in 37 over life of mine; risk of effluent 1 in 36. Mitigated by double-walled pipe and check valves and automatic pressure sensors on both pipes.	Potential for rupture of tailings pipeline could result in the release of up to 270,000 gallons of tailings to Sherman Creek. Risk of tailings spill 1 in 50 over life of mine; impacts mitigated by double-walled pipe with check valves and pressure sensors. Potential for accidental release during transportation of 5 tons of lead nitrate or 5,000 gallons of diesel fuel. Risks similar to Alternative B.
Ground Water Hydrology	Ground Water Flow	Underground mine drainage would create a localized cone of depression. Minimal impacts on overall sitewide hydrology and hydrogeology.	Similar to Alternative A. DTF would have limited effects in Terrace Area.	Same as Alternative B.	Same as Alternative B.
	Ground Water Quality	No effects from mine workings. Seepage from tailings impoundment collected and returned to impoundment; monitored to determine any need for mitigation after closure.	No effects from mine workings. Infiltration through waste rock and DTF consistent with background surface and ground water quality. Negligible acid generation potential.	Same as Alternative B.	Same as Alternative B.

*Chapter 4 presents a detailed discussion of potential impacts.

Table 2-6. Summary of Potential Impacts of Each Alternative by Resource (continued)*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Aquatic Resources, Marine	Water Quality	Mixing zone required for cyanide, lead, copper, and mercury. Cyanide requires largest dilution (31:1) to meet water quality-based permit limits. Discharge location moved to ½ mile offshore away from nearshore eddies and commercial fishing area. 1 in 3 risk of diesel fuel spill from transfer (maximum 880 gallons). Low spill risk from LPG, cyanide, and chlorine transport.	No impacts from effluent discharges. Probability of 1 to 2 diesel fuel spills from transfer (maximum 880 gallons). Under all alternatives, effects of diesel spill during marine transfer mitigated by timing restrictions, equipment maintenance and inspection, and location of containment booms on beach ready for deployment. No use of LPG or cyanide. Very limited use of chlorine for water supply treatment.	5:1 mixing zone required for copper only. Discharge 300 feet offshore. Same as Alternative B for spills.	Same as Alternative B.
	Sedimentation	Negligible.	Negligible.	Negligible.	Negligible.
	Habitat Loss	Negligible.	Negligible.	Negligible.	Negligible.
Aquatic Resources, Fresh Water	Habitat Loss through Diversions (linear feet)	6,000 (Ophir and Sherman Creeks, permanent)	2,450 (Ophir Creek only, temporary, channel restored during closure)	Same as Alternative B.	Same as Alternative B.
	Haul Road/Stream Crossings	See 1992 FEIS.	Potential channelization, erosion of bed material, and sedimentation; potential effects to fish passage	Same as Alternative B.	Same as Alternative B, except potential effects reduced by use of bridges rather than conduits.
	Fish Mortality	400–500	Up to 125–170	Same as Alternative B.	Same as Alternative B.
	Water Withdrawal (cfs)	0.42 Under all alternatives, water withdrawal impacts mitigated by instream flow requirements.	0.52–0.70 Under all alternatives, water withdrawal impacts mitigated by instream flow requirements.	Same as Alternative B.	Same as Alternative B.
Soils	See 1992 FEIS	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Vegetation	Total Vegetation Disturbance (acres)	282 Under all alternatives, no effects on region-wide survival of sensitive plants found at site; mitigation to minimize disturbance of sensitive species.	250 Under all alternatives, no effects on region-wide survival of sensitive plants found at site; mitigation to minimize disturbance of sensitive species.	253 Under all alternatives, no effects on region-wide survival of sensitive plants found at site; mitigation to minimize disturbance of sensitive species.	270 Under all alternatives, no effects on region-wide survival of sensitive plants found at site; mitigation to minimize disturbance of sensitive species.
	Timber Removed (mmbf)	3.3	2.7	Same as Alternative B.	Same as Alternative B.
	Acres of Old Growth Forest Removed	86.5	71.6	72.7	73.2

*Chapter 4 presents a detailed discussion of potential impacts.

Table 2-6. Summary of Potential Impacts of Each Alternative by Resource (continued)*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Wetlands	Acres of Wetland Loss (short term)	271	243	246	262
	Acres of Wetland Loss (long term)	51	147 Ponds retained as open water wetlands.	Same as Alternative B.	164
	Type of Wetland Loss (majority)	Palustrine forested.	Palustrine scrub-shrub.	Same as Alternative B.	Same as Alternative B.
	Permanent Loss of Functions and Values	Temporary or permanent loss of surface hydrologic control (moderate to high values), sediment retention (low to high values), wildlife diversity (moderate values), and riparian support (moderate to high values).	Temporary or permanent loss of surface hydrologic control (moderate to high values), sediment retention (low to high values), and riparian support (moderate to high values).	Same as Alternative B.	Same as Alternative B.
Socioeconomic Resources	Direct Employment and Payroll Effects	Increase of 289 and 286 workers during first and second years of operation, respectively, and average of 344 during operations.	Increase of 164 and 338 workers during first and second years of construction, respectively, and average of 253 during operations.	Same as Alternative B.	Same as Alternative B.
	Housing Effects	Total housing requirement would increase to between 96 and 143 units during first 2 years of construction and between 217 to 292 units during operations.	Total housing requirement would increase to between 36 and 126 units during first 2 years of construction and 217 units during operations.	Same as Alternative B.	Same as Alternative B.
	Effects on CBJ Revenues and Expenditures	Increase in property tax revenues. Increase in sales tax revenues. Increase in revenues from State sources. Possible increase in work load and related costs for CBJ.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
	Employment and Payroll Effects (City of Haines, Borough of Haines, and City of Skagway)	Negligible.	$2.58 million in additional annual earnings by Haines residents. Negligible increase in total employment for Skagway residents.	Same as Alternative B.	Same as Alternative B.
	Population-Related Effects (City of Haines, Borough of Haines, and City of Skagway)	Negligible.	Slight increase in present Haines population, but minor compared to seasonal population growth. Only a minor increase in Skagway population due to high unemployment.	Same as Alternative B.	Same as Alternative B.

*Chapter 4 presents a detailed discussion of potential impacts.

Table 2-6. Summary of Potential Impacts of Each Alternative by Resource (continued)*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Wildlife	See 1992 FEIS	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Recreation	See 1992 FEIS	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Cultural Resources	Impacts on Historic Properties or Culturally Significant Sites	No impacts on sites eligible for NHPA designation or culturally significant to Native Americans.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Visual Resources	Disturbance	Primarily tailings impoundment. See FEIS.	Borrow pits, DTF, roads, and structures. Probably would not meet VQO during operations. Measures to minimize effects, including maximizing backfill, would likely meet VQO after reclamation.	Same as Alternative B.	Same as Alternative B.
Subsistence	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Land Use	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Noise	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.

*Chapter 4 presents a detailed discussion of potential impacts.

CHAPTER 3

AFFECTED ENVIRONMENT

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3. AFFECTED ENVIRONMENT

Chapter 3 of the *Kensington Gold Project, Final Environmental Impact Statement* (1992 FEIS) (USFS, 1992) discusses the environmental resources in the vicinity of the Kensington Gold Project. The extent of the area analyzed and discussed in this Final Supplemental Environmental Impact Statement (SEIS) is the same as the 1992 FEIS. The terms "study area" and "project area" are defined in the 1992 FEIS, and their usage is carried through this document. The project area is the specific area within which all surface disturbance and development activities would occur. The study area is a larger peripheral zone around the project area within which most potential direct and indirect effects to a specific resource would be expected to occur. It should be noted that the study area is different for each resource, depending on the extent of influence the project could have on it (e.g., the study area for socioeconomics is larger than the study area for vegetation). This chapter supplements information presented in the 1992 FEIS by summarizing the results of studies completed since its publication in 1992.

Since publication of the 1992 FEIS, Coeur Alaska, Incorporated, completed studies that further characterize natural resources in the region of the Kensington Gold Project. The additional studies, conducted to address proposed project modifications and public and regulatory concerns, focused on water quality characterization and the Terrace Area proposed for the potential dry tailings facility (DTF), which is described in Chapter 2 of this Final SEIS. The U.S. Forest Service Planning Record documents reports detailing all studies conducted for this project.

This chapter only revises sections of the 1992 FEIS if new descriptions were necessary or if more recent characterization efforts changed the discussion regarding the affected environment. If a section of the 1992 FEIS was not revised, the Final SEIS references relevant page numbers of the 1992 FEIS. This Final SEIS revises the following sections in Chapter 3 of the 1992 FEIS:

- Geology, specifically geochemical characterization of the ore deposit
- Geotechnical considerations
- Surface water hydrology
- Surface water quality
- Ground water hydrology
- Ground water quality
- Aquatic resources
- Soils, vegetation, and wetlands
- Cultural resources
- Socioeconomic environment.

3.1 AIR QUALITY AND CLIMATE

The discussion of air quality and climate has not been revised. Pages 3-1 through 3-3 of the 1992 FEIS present a complete discussion.

3.2 TOPOGRAPHY

The discussion of topography has not been revised. Page 3-3 of the 1992 FEIS presents a complete discussion.

3.3 GEOLOGY

In general, the description of geology presented in the 1992 FEIS has not been revised. Pages 3-4 and 3-5 of the 1992 FEIS present a complete description of site geology. The *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994) indicates that the geochemical characterization of the ore body presented in the 1992 FEIS was not representative of the entire geologic deposit, however. Consequently, Coeur Alaska conducted additional chemical analyses that relate the characteristics of the ore to be mined to the potential for water quality impacts. This section summarizes the results of the new analyses. Appendix D provides additional details. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997a) discusses the geochemical characteristics of tailings generated by processing and the geochemical characteristics of the waste rock produced during mining.

Ore characterization studies used 591 drill core samples collected from 39 boreholes that intersected the width of the ore zone and four bulk samples either excavated from the mid-section of the ore body or synthesized by blending previously mined samples and drill cuttings. Bulk samples varied from 1.5 to 5 tons. Geochemical tests of ore materials included acid-base accounting analyses, trace metals analyses, static leach tests, and kinetic humidity cell leach tests.

Additional bulk ore testing data were collected since publication of the 1992 FEIS to address issues of data completeness and sample representativeness raised in the *Technical Assistance Report* (EPA, 1994). Data from drill core samples are presented in Geochemica and Kensington Venture (1994) and are summarized in Appendix E.

Static acid-base accounting tests indicate that the net acid-generating potential of the ore is variable. Acid neutralization will occur as acid generated by the oxidation of sulfide minerals reacts with carbonate and feldspar minerals. Both neutralizing mineral types are present throughout the ore body. The average total sulfur content of the ore body is 1.32 percent, but locally ranges from 0.24 to 2.95 percent, as determined from 39 length-weighted drill core intercepts of the ore body (average values across the ore zone) and five bulk samples (SRK, 1996a). The drill core intercepts have NP:MPA (neutralization potential:maximum potential acidity) ratios ranging from 1.2:1 to 25.0:1, with a median value of 3.9:1, which indicates that most are net neutralizing. Thirteen of the 39 intercepts have ratios less than 3, but none have ratios less than 1.

Significant evidence suggests that the Kensington ore materials will not produce acidification of meteoric waters, even though static acid-base accounting tests of drill core samples indicate that some ore intercepts had NP:MPA ratios between 1 and 3. This includes 1) the consistently neutral pH values measured during routine monitoring of mine water drainage water samples collected from within the adits and 2) the neutral pH values of leachate produced during 20-week long kinetic humidity cell tests of ore material. In addition, the sulfide mineralization would generally be removed from the mine for flotation and offsite processing. The *Technical Resource Document for Water Resources* (SAIC, 1997a) and Appendices E and F provide additional information on the potential for acid generation.

Trace metals analyses were conducted on drill core and bulk samples to define the compositional variability of the ore body. The major constituents of most ore samples are aluminum, calcium, iron, magnesium, manganese, phosphorous, and sodium. Despite variability among samples, most length-weighted drill core composites have chromium, copper, cobalt, and zinc contents exceeding 10 parts per million (ppm) and cadmium, lead, molybdenum, and tellurium contents exceeding 1 ppm (Coeur, 1996b). Median values for mercury and selenium are 88 parts per billion (ppb) and 400 ppb, respectively (Coeur, 1996b). Antimony, arsenic, beryllium, bismuth, lanthanum, tin, and tungsten are typically below minimum detection limits in most drill core composites. Bulk ore samples tend to have higher contents of antimony, arsenic, and nickel and lower cadmium than the drill core composites, but otherwise have similar compositions (Coeur, 1996b; SRK, 1996a).

Kinetic humidity cell tests conducted on a 3.8-ton bulk ore sample were used to determine the potential for the ore to contribute metals to surface and ground waters. Results show that leachates remained neutral to slightly alkaline for the 20-week test period, with pH values ranging from 6.9 to 8.9 (Lakefield Research, 1995). Acidity was not detected in any samples. Sulfate concentrations generally ranged between 10 mg/L and 50 mg/L, with all sample concentrations measured below 150 mg/L. Most analyte concentrations remained comparatively constant following the initial flush (week 0), and no analyte concentrations increased with time. The concentrations of most transition metals and arsenic, beryllium, phosphorous, antimony, selenium, and tellurium occurred at or below analytical detection levels in most samples.

3.4 GEOTECHNICAL CONSIDERATIONS

Pages 3-5 through 3-9 of the 1992 FEIS identify faults and describe seismic activity within the Kensington Gold Project area. The 1992 FEIS indicates that the maximum credible earthquake would have a magnitude of 6.5 to 7.0 on the Richter Scale. This would result in a peak ground acceleration of 0.5 to 0.6 gravity.

Pages 3-7 and 3-8 of the 1992 FEIS also describe the local terrain and its potential to generate landslides, avalanches, and other mass movements. Because steep slopes characterize much of the area surrounding the Kensington Gold Project, additional studies of avalanche chutes were conducted to facilitate project design and layout and to address issues identified in the TAR. The study results are summarized below. Pages 3-7 to 3-8 of the 1992 FEIS outline avalanche- and landslide-prone areas in the region bounded by Lions Head Mountain to the north, Berners Bay to the south, and Lynn Canal to the west. Areas with evidence of landslide and avalanche activity were located by examining aerial photos for places devoid of heavy spruce and hemlock forest, regions with steep (greater than 30 percent) slope angles, and areas with snow accumulation and avalanche paths.

Since publication of the 1992 FEIS, the snow avalanche potential within the Sherman Creek drainage was studied in detail (Fesler and Fredston, 1994). The study involved field investigations, including analysis of tree size (age and age variation), tree species, and evidence of avalanche-induced damage. Vertical aerial photography, oblique aerial photography, and historical records, including accounts and photographs, were used to help determine run out limits and event frequency.

Figure 3-1 depicts the distribution of avalanche hazard potential. The zones include "high potential hazard," "moderate potential hazard," "low potential hazard," and "no hazard." A high potential hazard is characterized as having return periods of 3 to 30 years and/or a horizontal impact pressure normal to flow of 600 pounds per square foot. Moderate potential hazard zones have return periods of 30 to 300 years and/or horizontal impact pressure normal to flow of less than 600 pounds per square foot. Low potential hazard zones have forested slopes of 30 to 55 degrees and/or open slopes of 25 to 30 degrees. Avalanches are not typical in these areas, but could occur as a result of deforestation or surface disturbances caused by construction. Areas having gentle slopes are classified as no hazard, although the potential for small rock falls and avalanches exists.

3.5 SURFACE WATER HYDROLOGY

Studies describing the flow of surface water in the project area have been refined since publication of the 1992 FEIS. Refined models better define the baseline hydrology of the area and have helped to improve the design of hydrologic control structures. Other refinements were based on an analysis of precipitation data from three stations near the site: Eldred Rock (period of record 1941, 1943-1973), the Jualin Project (period of record 1928-1929), and the Juneau Airport (period of record 1949 to present).

Estimated temperature variations and evapotranspiration rates at the project site were not revised from the previous estimates described on pages 3-2 and 3-10 of the 1992 FEIS.

The Kensington Gold Project, as proposed, would be located in the Sherman Creek watershed. The watershed, situated at the western foot of Lions Head Mountain in the Kakuhan Range of the Coast Mountains, is typical of other drainages in this region of Southeast Alaska. Slopes are typically very steep with surface cover varying from exposed bedrock at higher elevations to muskeg forests and meadows in lower regions. The main stem of Sherman Creek flows from the base of Horrible Hill and discharges into Lynn Canal at Comet Beach.

The hydrologic regime of a watershed such as Sherman Creek is determined by regional climate and physical characteristics that include geomorphologic and other parameters, including soil type and depth, basin aspect, vegetative cover, and stream channel geometry and gradient. This section reviews and discusses these characteristics and the responses they produce in the project area.

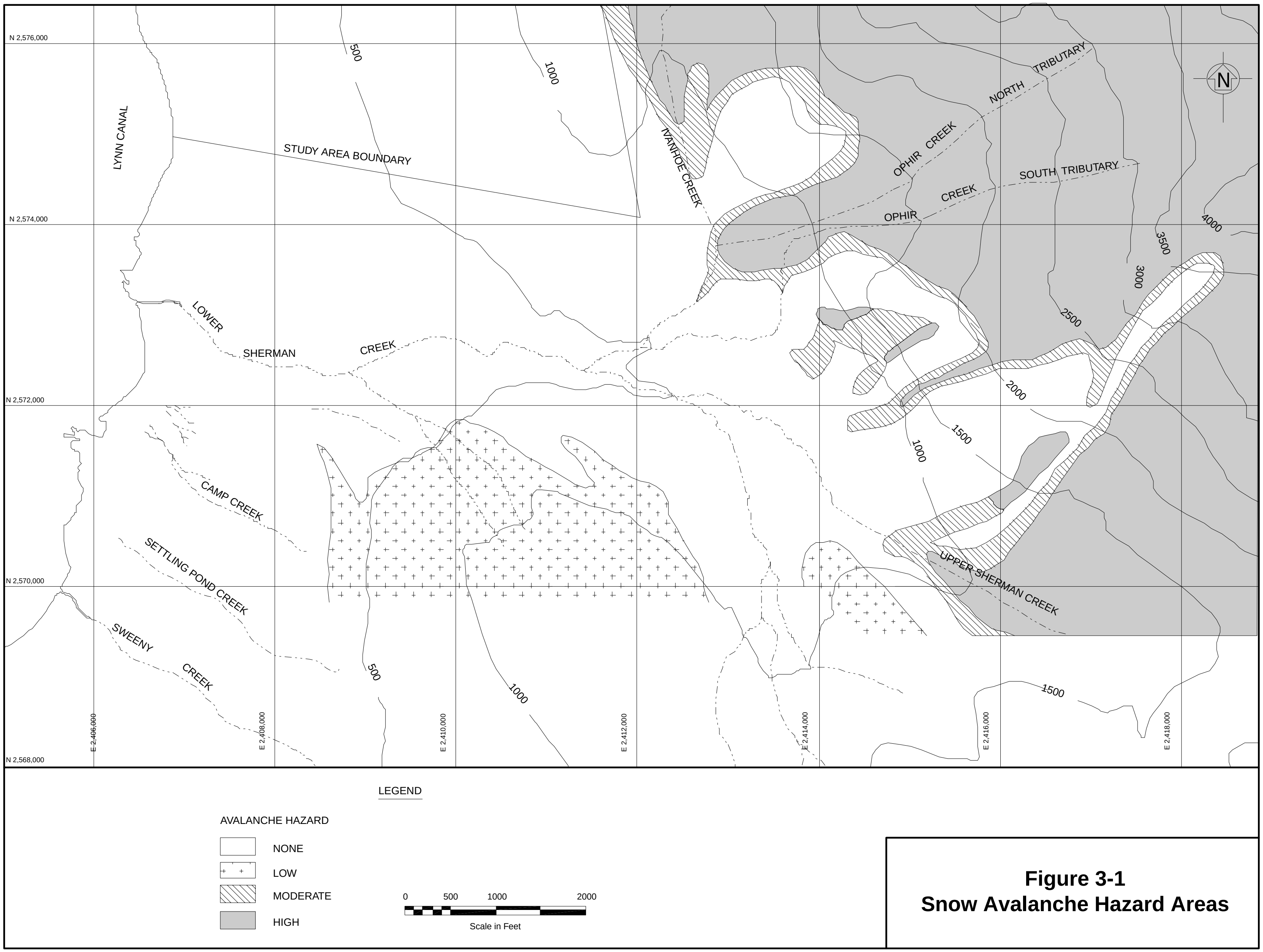

Figure 3-1
Snow Avalanche Hazard Areas

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3.5.1 Climatic Conditions

The regional maritime climate produces high annual precipitation as a result of the onshore, up-slope movement of moist air. Snowfall contributes a significant portion of the total annual precipitation in the watershed, with contributions increasing with elevation. There are no glaciers or lakes within the basin; however, a large snow pack can exist throughout the summer at the higher elevations (Knight Piesold, 1996).

The Eldred Rock weather station, located on Lynn Canal approximately 7.5 miles north of Comet Beach, is the closest long-term weather station to the project site. The Juneau Airport station is the only other long-term weather station in the region, but it is located approximately 40 miles south of the site. Eldred Rock receives approximately 16 percent less rainfall than the Juneau Airport, based on a study comparing 15 years of concurrent data (Knight Piesold, 1996). Both the Eldred Rock station and the Juneau Airport station are at or near sea level.

Precipitation data from the Eldred Rock station have been used to estimate precipitation at the project site. To account for increasing precipitation with increasing elevation (orographic effects), conservative assumptions were applied to the Eldred Rock data to obtain precipitation estimates at various elevations in the Sherman Creek watershed. Average annual precipitation at the mouth of Sherman Creek (sea level) is assumed to be approximately 47 inches, which is the value recorded at the Eldred Rock station. Based on this value, estimated average annual precipitation is 58 inches at 800-feet elevation (where proposed mine operations would be located) and 200 inches at 5,000-feet elevation (Knight Piesold, 1996). Precipitation at the proposed DTF site, the western margin of which is at an elevation of approximately 250 feet, is expected to be slightly higher, but not significantly greater, than that estimated for Eldred Rock. Estimates of the mean monthly precipitation at 800-feet elevation, presented in Table 3-1, were derived by increasing the monthly averages at Eldred Rock by 25 percent to account for orographic effects.

The value for the 24-hour probable maximum precipitation (PMP) event at the site was revised in response to regulatory and public concerns. This value is not measured, but is a conservative estimate that reflects a theoretical maximum amount of precipitation that could occur at a given location. Previous estimates for PMP were reevaluated to account for the severe orographic effects at the project site (Knight Piesold, 1996; USDOC, 1983). After further analysis, the PMP value for this Final SEIS was revised to 17.26 inches from 15.8 inches, as indicated in the 1992 FEIS.

Table 3-1. Average Monthly and Average Annual Precipitation at the 800-Foot Level

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Precipitation (inches)*	11.0	6.8	5.4	4.1	4.8	3.3	2.6	3.0	2.2	3.1	4.5	7.5	58.3
Percentage of Annual	18.9	11.7	9.2	6.9	8.3	5.7	4.5	5.2	3.8	5.3	7.8	12.8	100.0

*Data are estimated by increasing data from Eldred Rock Station (1941; 1943-73) by 25 percent to account for orographic effects.

3.5.2 Watershed Characteristics

The 1992 FEIS describes three watershed areas in the project area defined by the Sherman Creek, Sweeny Creek, and Slate Creek drainage basins. The Sweeny Creek and Slate Creek basins are not discussed in this Final SEIS because proposed operations would not occur in these basins. Pages 3-12 and 3-13 of the 1992 FEIS describe these basins. A fourth watershed area has subsequently been identified as the proposed location for the DTF. This small region, which lies between Sherman Creek and Sweeny Creek basins, is referred to as the Terrace Area drainage basin.

Sherman Creek Drainage Basin

The Sherman Creek basin has an area of 2,681 acres (4.19 sq. miles) and ranges in elevation from sea level to 5,000 feet. The watershed contains four sub-basins, which flow into the main channel of Sherman Creek at an elevation of approximately 500 feet. The sub-basins, which contain the drainages of Ivanhoe Creek, Ophir Creek, upper Sherman Creek, and South Fork Sherman Creek, are characterized by high channel densities and numerous unnamed (and unmapped) secondary channels that intermittently flow to the main channels. Upper Sherman Creek is that portion of the creek that occurs upstream of the confluence with Ophir Creek. Lower Sherman Creek refers to the creek below the confluence with Ophir Creek. Figure 3-2 shows the stream channels within the Sherman Creek basin.

The Ivanhoe Creek sub-basin has an area of approximately 658 acres (1.03 sq. miles) and ranges in elevation from 700 to 5,000 feet. Much of the watershed lies above timberline with many actively eroding bedrock slopes. Snowpack can persist throughout the summer in the upper portion of the sub-basin, which can be heavily affected by avalanches and rock slides. Vegetation in the lower portion of the sub-basin consists of sparse coniferous trees and shrubs (see page 3-44 of the 1992 FEIS). Ivanhoe Creek is a short, steep-gradient mountain channel (WEST, 1996).

The Ophir Creek sub-basin comprises approximately 499 acres (0.78 sq. miles) and ranges in elevation from 500 to 5,000 feet. The sub-basin is similar to the Ivanhoe Creek sub-basin insofar as a large portion occurs above timberline and has a sparse vegetative cover. Snowpack can persist throughout the summer in a small area of the upper sub-basin. The Ophir Creek sub-basin contains two subparallel tributaries: a southern tributary that forms the main stem of Ophir Creek and a northern tributary. These channels are rocky, have steep gradients, and are sparsely vegetated.

The upper Sherman Creek sub-basin has an area of approximately 518 acres (0.81 sq. miles) and ranges in elevation from 500 to 4,000 feet. Approximately 20 percent of the area occurs above timberline. Below timberline, the vegetative cover consists mostly of coniferous trees. The upper reaches of the Sherman Creek channel are deeply incised with steep gradients.

The South Fork Sherman Creek sub-basin has an area of approximately 180 acres (0.28 square miles) and ranges in elevation from approximately 500 to 1,800 feet. Most of this sub-

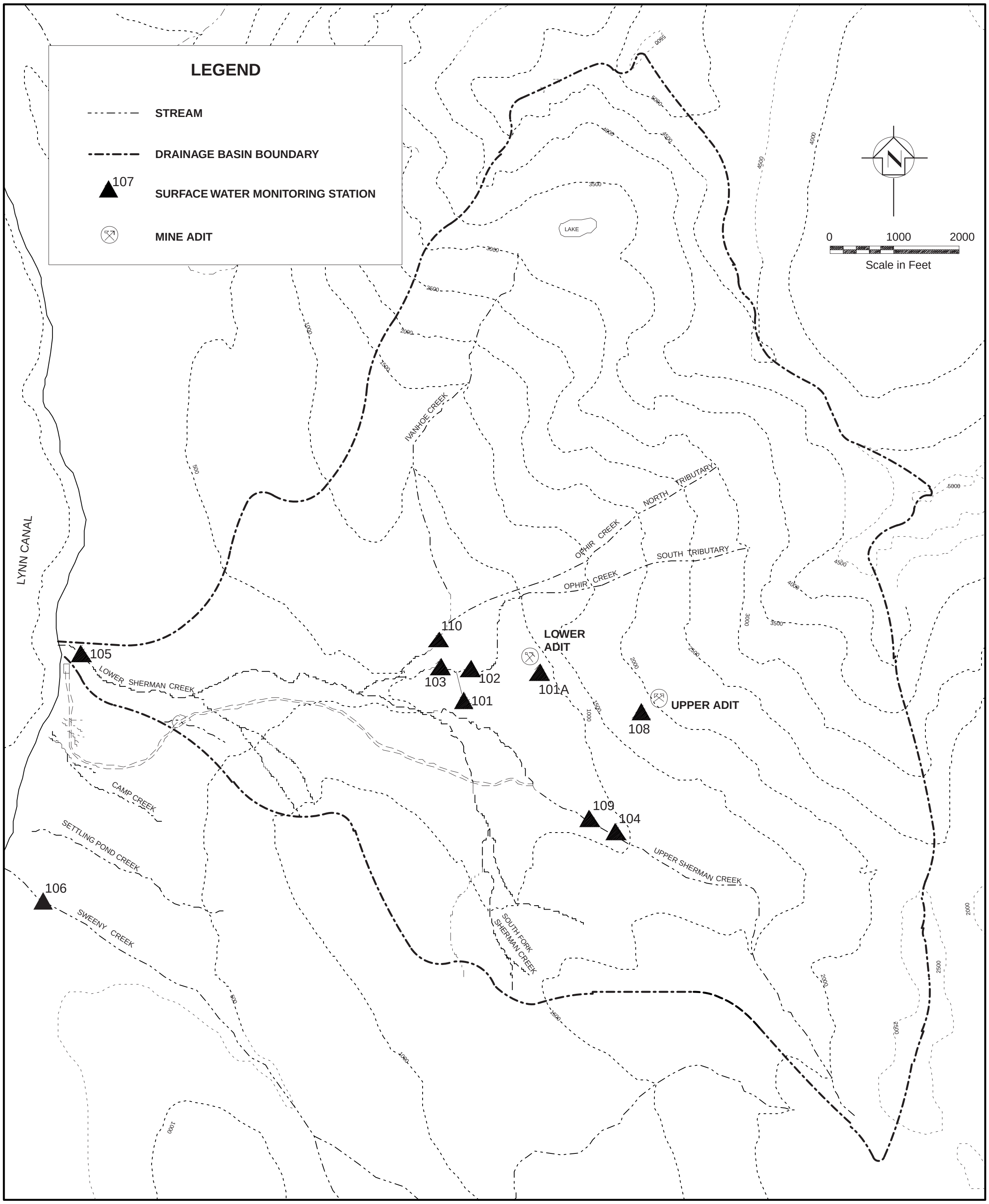

Figure 3-2. Sherman Creek Drainage and Surface Water Monitoring Stations (Source: Adapted from Montgomery Watson, 1996a and SRK, 1996d)

basin is below timberline, and vegetation consists of coniferous trees. South Fork Sherman Creek is a tributary of upper Sherman Creek. The channel is moderately to deeply incised and is characterized by moderate to steep gradients.

The lower Sherman Creek contributing area ranges in elevation from sea level to 500 feet and covers an area of approximately 826 acres (1.29 sq. miles) between Lynn Canal and the confluence of Ophir Creek and upper Sherman Creek. The moderately to deeply incised channel has a low gradient. Vegetation covers most of the lower portions of the basin.

As described on page 3-10 of the 1992 FEIS, the Sherman Creek basin contains soils that have moderate infiltration rates when thoroughly wetted. The soils have a thick, permeable peat layer that overlies clean sands and gravels derived from the underlying fine-grained till deposits. Shallow ground water locally occurs where permitted by soil thickness and slope gradient.

Terrace Area Drainage Basin

The site proposed for the DTF is situated in a small terrace area that consists of its own watershed between the lower main channel of Sherman Creek and the lower main channel of Sweeny Creek (Figure 3-3). Although the watershed area ranges from sea level to 1,400 feet, more than 50 percent occurs at elevations less than 250 feet. The basin has a catchment area of 330 acres (0.51 sq. miles), most of which drains internally through a series of small stream systems to Comet Beach. Runoff from the basin does not flow into Sweeny Creek or Sherman Creek.

A May 1996 field study conducted to characterize the basin identified 18 separate stream channels that combine to form 6 small stream systems in the area above and east of the proposed DTF site (Konopacky Environmental, 1996b). Four of these stream systems drain westward into Lynn Canal, supplying drainage to the non-contributing sub-basin. The headwaters or drainage areas for these four stream systems initiate in or slightly above and to the east of the proposed DTF site. At the time the field study was conducted, flow from these four streams was not observed to outfall into Lynn Canal via surface flow. Rather, observable flow terminated at Comet Beach. The final drainage to Lynn Canal was assumed to occur through the subsurface.

Headwaters and drainage areas for the two remaining stream systems initiate above and to the north-east of the proposed DTF footprint. These streams join Sherman Creek slightly upstream of the fish passage barrier, which is located approximately 1,200 feet upstream of Lynn Canal. Although these small stream systems and their associated drainage areas contribute runoff to lower Sherman Creek, they do not drain the part of the watershed that would host the proposed DTF.

3.5.3 Stream Flow

Figure 3-2, presented previously, depicts the location of surface water monitoring stations in the Sherman Creek and Sweeny Creek drainages. Monitoring stream flow at most stations is

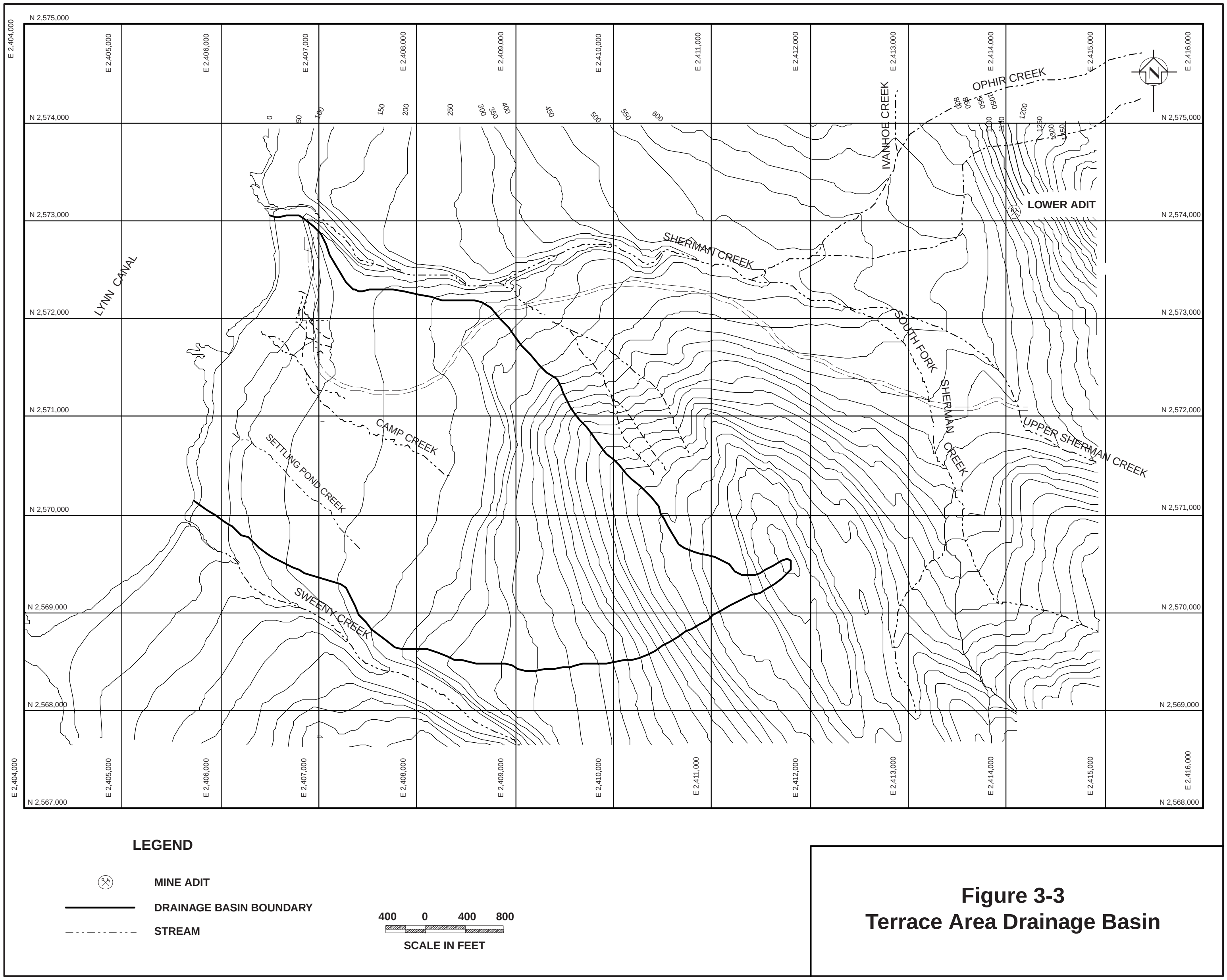

Figure 3-3
Terrace Area Drainage Basin

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difficult because of the severe climate and steep topography (Montgomery Watson, 1996a). In addition, stream courses have been noted to change abruptly or to migrate over time in some of the measured reaches. Many creeks exhibit intermittent flow. Dynamic conditions such as these are common in high mountain, steep-gradient channels, and accurate and consistent stream flow measurements are difficult to obtain. Data collected from the site area are of limited use for establishing an accurate, long-term record of stream flow. Consequently, flow data from the upper stations have been used primarily to characterize the relationship of high and low flow conditions to water quality. In some cases, flow measurements have not been reported because extremely low flows have precluded accurate measurement. Table 3-2 summarizes observed high and low stream flow measurements from the monitoring stations where flows were recorded. The *Technical Resource Document for Water Resources* (SAIC, 1997a) provides a detailed description of these data. Figures 3-4 through 3-6 outline flow duration curves for annual stream flows at stations 110, 109, and 105, respectively. These curves outline the percentage of time that specific flows are expected to be exceeded at these stations. The *Technical Resource Document for Water Resources* (SAIC, 1997a) presents flow duration curves developed for each month. These data often are used in determining minimum instream flow requirements and in permitting withdrawals from streams.

Flows in the four Terrace Area basin streams that discharge into Lynn Canal were measured during a field characterization study of the area of the proposed DTF (Konopacky Environmental, 1996b). Measured flow rates were low in the four stream channels, with the maximum observed flows ranging from 0.004 to 0.06 cubic feet per second (cfs) (2 to 25 gallons per minute [gpm]) and the minimum measured flows ranging from 0.002 to 0.01 cfs (1 to 5 gpm).

Table 3-2. Observed Stream Flows Within the Sherman Creek Drainage

	Low Flow		High Flow	
Station	**Cubic Feet/Second**	**Date**	**Cubic Feet/Second**	**Date**
101	0.2	March 1990	1.7	November 1991
103	0.2	March 1991	32.8	October 1991
104	Replaced with Station 109			
105	0.6	January 1995	105	November 1988
109	1.1	January 1991	32.7	June 1992
110	0.3	January 1995	26.8	July 1992

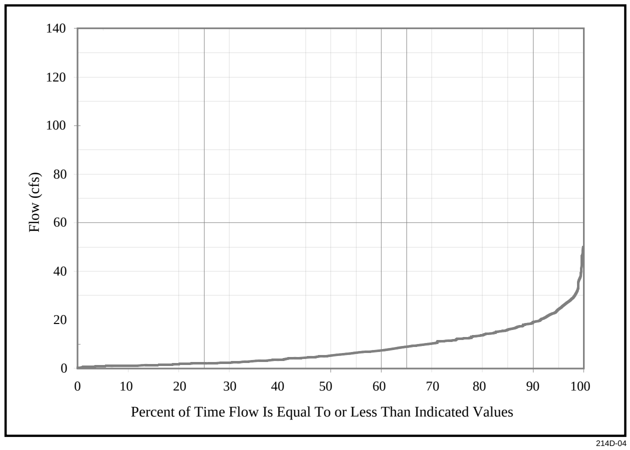


Figure 3-4. Flow Duration Curve for Station 110

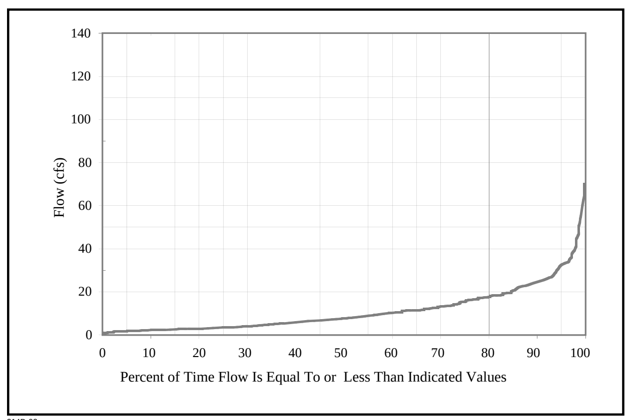


Figure 3-5. Flow Duration Curve for Station 109

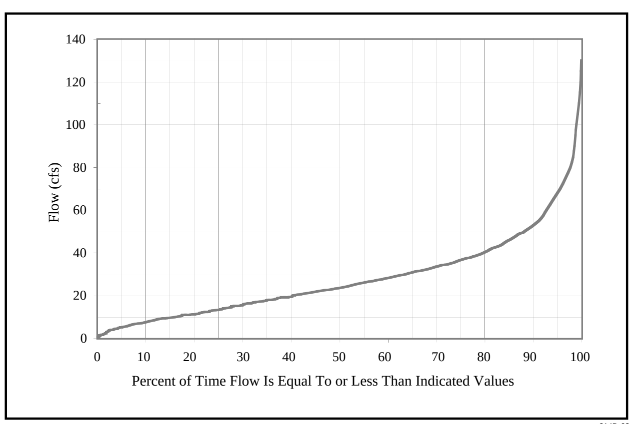


Figure 3-6. Flow Duration Curve for Station 105

Stream Flow Modeling

A long-term data base has not been established for stream flow in Sherman Creek and its tributaries. Consequently, a regional analysis procedure was used to estimate the characteristic monthly and annual variations in stream flow. Regional analysis is a statistical procedure based on the assumption that streams and rivers in watersheds in the same geographical region will respond to precipitation events in a hydrologically similar manner. The procedure allows stream flow in ungauged streams to be estimated from records collected from gauged streams. In conducting the analysis, 36 similar drainage basins with long-term flow records were initially evaluated in Southeast Alaska and British Columbia (Knight Piesold, 1994). Seven of these drainage basins were determined to have characteristics similar to the Sherman Creek watershed. Data from the seven drainage basins were combined with the information available from the Sherman Creek basin to perform the regional analysis (Knight Piesold, 1994). Table 3-3 outlines the general characteristics of the drainage basins.

The FLOOD computer model was used to perform the regional analysis and provide estimates of characteristic flows for Sherman Creek and its main tributaries (Knight Piesold, 1994). Table 3-4 shows the estimated average monthly flows for Sherman Creek derived from the analysis. The program also calculates estimates for peak daily flows and peak instantaneous flows, as well as 7- and 30-day annual low flows for each tributary and for a range of return periods. Peak daily and peak instantaneous flows often are used for design purposes. Low flows are important in conducting water quality evaluations and determining instream flow requirements for fisheries. Tables 3-5 and 3-6 present the estimated most probable peak daily flow and most probable peak instantaneous flow by return period, respectively. Table 3-7 provides the estimated most probable 7-day annual instream flows for important return periods.

Table 3-3. Basin Characteristics of Stream Flow Stations Selected for Regional Analysis

Station Name	Years of Data	Basin Area (sq. miles)	Max Basin Elevation* (feet)	Proximity to Site (miles)	Basin Orientation
Sheep Creek near Juneau	31	4.57	4,200+	51	SE to NW
Montana Creek near Auke Bay	16	15.50	4,000+	38	NW to SE
Lake Creek at Auke Bay	10	2.50	2,000	39	NW to SE
Auke Creek at Auke Bay	16	3.96	2,000	40	NW to SE
Greens Creek near Juneau	11	22.80	4,600+	55	E to W
Lawson Creek at Douglas	5	2.98	3,300	48	SW to NE
Fish Creek near Auke Bay	20	13.60	3,400+	42	SE to NW
Sherman Creek at Comet Beach	2	3.65	4,000+	NA	E to W

*Values estimated from USGS 1:250,000 map of Juneau.
NA = Not applicable.
Source: Adapted from Knight Piesold, 1994.

Table 3-4. Estimated Average Monthly Stream Flow for Sherman Creek at Comet Beach*

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Stream Flow (cfs)	36.7	21.4	10.2	9.1	8.4	9.4	15.8	44.0	45.1	30.9	31.6	34.9	NA
Percentage of Annual	12.5	7.1	3.4	3.1	2.7	3.3	5.2	15.0	14.8	10.5	10.8	11.6	100.0

*Sherman Creek distribution calculated as an average of seven regional stations and historic Sherman Creek data.
NA = Not applicable.

Table 3-5. Estimated Most Probable Peak Daily Flow by Return Period

Sub-Basin	Peak Daily Stream Flow (cfs)					
	Average Annual	**2-year**	**10-year**	**25-year**	**100-year**	**200-year**
Upper Sherman Creek	56	63	103	124	154	169
Ophir Creek	42	46	77	92	114	125
Ivanhoe Creek	55	61	101	121	151	166
South Fork Sherman Creek	15	15	24	29	36	40
Sherman Creek at Comet Beach	194	221	364	436	543	596

Source: Adapted from Knight Piesold, 1994.

Table 3-6. Estimated Most Probable Peak Instantaneous Flow by Return Period

Sub-Basin	Peak Instantaneous Flow (cfs)				
	2-year	**10-year**	**25-year**	**100-year**	**200-year**
Upper Sherman Creek	146	293	367	476	530
Ophir Creek	109	217	272	353	394
Ivanhoe Creek	143	287	360	467	520
South Fork Sherman Creek	34	69	86	112	125
Sherman Creek at Comet Beach	515	1,033	1,294	1,679	1,870

Source: Adapted from Knight Piesold, 1994.

Table 3-7. Estimated Most Probable 7-Day Annual Low Flows by Return Period

Sub-Basin	7-Day Annual Low Flow (cfs)	
	2-year	**10-year**
Upper Sherman Creek	0.45	0.22
Ophir Creek	0.32	0.16
Ivanhoe Creek	0.42	0.21
South Fork Sherman Creek	0.11	0.06
Sherman Creek at Comet Beach	1.55	0.75

Source: Adapted from Knight Piesold, 1994.

3.6 SURFACE WATER QUALITY

The surface water monitoring stations discussed previously have been used to monitor the surface water quality and the existing mine drainage discharge. Monitoring stations include the 800-foot lower adit (station 101A), the discharge from the existing mine drainage settling ponds (station 101), the south tributary of Ophir Creek (stations 102 and 103), lower Sherman Creek (station 105), upper Sherman Creek (stations 104 and 109), the historical Kensington upper adit at the 2,050 foot level (station 108), and the main stem of Ophir Creek (station 110). Water quality monitoring was initiated in 1987 at stations 101A, 103, 104, and 105. The remaining stations were added between 1988 and 1991. In addition, water quality monitoring was conducted in the adjacent Sweeny Creek basin (Station 106) between 1987 and 1994. This station was established to provide comparative water quality data from a nearby, undisturbed drainage basin. Page 3-13 of the 1992 FEIS presents data from these sites. The following discussion includes these data and monitoring data collected from these sites since publication of the 1992 FEIS. Table 3-8 presents data on parameters of potential concern in evaluating potential water quality impacts of project alternatives, and Appendix F summarizes data for

Table 3-8. Summary of Surface Water Data (August 1987 – October 1995)

Station[a, b, c, d]		As (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Pb (µg/L)	Hg (µg/L)	Ni (µg/L)	Se (µg/L)	Ag (µg/L)	Zn (µg/L)	NO_3-N (µg/L)	NH_4-N (µg/L)	pH (s.u.)	TDS (mg/L)	TSS (mg/L)
Station 101	Mean	1.9	NA	NA	9.0	1.3	NA	NA	NA	0.12	11	2,775	1,793	--	539	12
	Min	0.7	*<0.2*	*<10*	2.7	1	*<0.05*	*<10*	*<5*	0.1	10	10	10	6.8	70	1
	Max	5.6	*<2*	*<50*	150	20	*<1*	*<20*	*<5*	1	60	39,100	22,600	8.3	1,268	140
	Detects	19	0	0	21	17	0	1	0	17	30	78	60	89	86	63
	Non-detects	55	74	74	53	57	74	73	74	57	44	10	24	0	0	24
Station 101A	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	93	NA
	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*<200*	*<10*	6.7	74	NA
	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*200*	*<50*	7.6	140	NA
	Detects	0	0	0	0	0	0	0	0	0	0	1	0	5	5	0
	Non-detects	0	0	0	0	0	0	0	0	0	0	4	5	0	0	0
Station 102	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	637	NA	--	28	NA
	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	*<10*	7.0	22	0
	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,510	*57*	7.6	41	13
	Detects	0	0	0	0	0	0	0	0	0	0	6	1	6	4	2
	Non-detects	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Station 103	Mean	1.8	NA	NA	4.1	4.4	NA	NA	NA	0.17	12	3,169	718	--	243	3.6
	Min	0.59	*<0.2*	*<10*	2.1	1	*<0.05*	*<10*	*<5*	0.1	10	90	20	5.7	31	1
	Max	50	*<2*	*<50*	50	217	*<1*	*<20*	*<5*	1.1	60	36,000	9,590	8.0	996	33
	Detects	11	1	0	15	17	0	3	0	14	30	84	59	93	90	50
	Non-detects	60	70	71	56	54	71	68	71	57	41	8	29	0	0	34
Station 105	Mean	0.47	NA	NA	3.1	1.1	NA	NA	NA	0.09	7.7	774	54	--	71	4.2
	Min	0.55	*<0.2*	*<10*	2.3	1	*<0.05*	*<10*	*<5*	0.1	10	10	6	6.0	22	1
	Max	0.81	*<2*	*<50*	30	36	*<1*	*<20*	*<5*	1.1	50	19,200	350	8.0	194	120
	Detects	6	0	1	13	12	0	2	0	10	19	81	50	92	88	47
	Non-detects	64	70	69	57	58	70	68	70	60	51	10	37	0	2	36
Station 106	Mean	NA	NA	NA	5.3	5.4	NA	NA	NA	0.13	7.5	419	65	--	65	4.6
	Min	*<0.5*	*<0.5*	*<10*	5	1	*<0.05*	*<10*	*<5*	0.1	10	15	10	6.3	20	1
	Max	*5*	*<2*	*<50*	25	256	*<1*	*<20*	*<5*	1.1	40	14,200	1,120	8.1	130	85
	Detects	5	2	0	14	15	0	5	0	12	17	71	45	82	79	47
	Non-Detects	55	58	60	46	45	60	56	60	48	43	11	37	0	0	25
Station 108	Mean	NA	NA	NA	6.4	0.74	NA	NA	NA	0.19	8.3	122	39	--	57	5.7
	Min	*<5*	*<0.5*	*<10*	5	1	*<0.1*	*<10*	*<5*	0.1	10	10	40	7.0	26	1
	Max	*<5*	*3.4*	*<10*	19	4	*<0.1*	*<10*	*<5*	0.7	20	310	120	7.9	102	28
	Detects	0	1	0	7	3	0	0	0	7	5	16	6	17	14	12
	Non-detects	11	10	11	4	8	11	11	11	4	6	1	11	0	0	3
Station 109	Mean	1.2	NA	NA	4.3	0.76	NA	NA	NA	0.11	7.0	459	60	--	54	3.4
	Min	0.5	*<0.5*	*<10*	5	1	*<0.05*	*<10*	*<5*	0.1	10	10	10	5.7	16	1
	Max	2.8	*<2*	*<50*	30	3	*<1*	*20*	*<5*	1.3	30	15,500	1,380	7.85	110	73
	Detects	13	1	0	11	13	0	4	0	10	16	77	36	78	78	52
	Non-detects	47	59	60	49	47	60	56	60	50	44	1	42	0	0	19
Station 110	Mean	NA	NA	NA	4.3	3.9	NA	NA	NA	0.1	10	214	55	--	31	1.7
	Min	*<0.5*	*<0.2*	*<10*	2	1	*<0.05*	*<10*	*<5*	0.1	10	30	20	6.7	8	1
	Max	*<5*	*<2*	*<50*	41	186.5	*<1*	*<20*	*<5*	1.7	150	535	670	7.7	80	8
	Detects	1	1	0	13	10	0	1	0	9	14	45	24	54	48	24
	Non-detects	53	53	54	41	44	54	53	54	45	40	8	25	0	6	30

a. Minimum and maximum detected values are shown for sets with sufficient data for robust statistical analysis. Italics indicate overall minimum and maximum values (considering non-detects) for sets with insufficient data for robust statistical analysis.

b. NA—"No Data Available for Analysis" indicates no analyses were conducted for constituent.

c. All metals are total recoverable.

d. Where sufficient data were available to perform statistical analyses, the minimum value represents the **lowest detected value** for each parameter. In these cases, there are also non-detected values. Mean values were determined using both detected and non-detected values (see the *Technical Resource Document for Water Resources* for statistical methods and treatment of non-detect values [SAIC, 1997a]).

Source: Montgomery Watson, 1996a.

all parameters. In general, water quality monitoring results are consistent with those anticipated for a mineralized area, with various metals detected intermittently at most monitoring stations.

3.6.1 Sherman Creek Drainage Basin

Based on water quality analyses, surface water within the Sherman Creek watershed is classified into two types. Stations 101 and 103, which are influenced by water discharging from the 800-foot adit, have calcium sulfate-type water. The remaining monitoring stations have calcium bicarbonate-type water.

Water quality data were evaluated in light of stream flow records to determine whether correlations exist between discharge and water quality parameters. Because stream flow records for the upper monitoring stations are temporally inconsistent, statistically robust correlations could not be established for individual monitoring stations. Consequently, evaluations compared each station's water quality data to the stream flow record from lower Sherman Creek (station 105), which offers the longest, most consistent record in the basin and is located along a stream reach with a relatively stable streambed.

Statistical analyses do not reveal strong correlations between 41 measured water quality parameters and stream flow at station 105. However, potential weak to moderate correlations are noted for 14 measured water quality parameters that include conductivity (related to salinity) as measured both in the field and in the laboratory, dissolved copper, dissolved lead, nitrite, sodium, calcium, sulfate, carbonate, bicarbonate, total alkalinity, hardness, total dissolved solids (TDS), and sodium adsorption ratio. All of these parameters, with the exception of nitrite concentration, have inverse correlations with stream flow. An inverse correlation is one in which the measured parameter increases as stream flow decreases. Nitrite showed increasing measured concentrations with increasing stream flow.

Monitoring station 101 (settling ponds) was established to monitor discharge water quality from the settling ponds used to treat mine drainage from the 800-foot adit. Concentrations of total aluminum, total iron, and total manganese were reported above their minimum detection limits for some samples collected between 1989 and 1993; other metals were not detected or occasionally measured at concentrations near their minimum detection limits in these samples. Table F-3 presents detections and summary data for metals and other constituents not presented in Table 3-8. Samples with higher metal concentrations were generally collected during periods of exploratory drilling and adit work within the mine

Monitoring station 101A (mine drainage from the 800-foot adit) was sampled on five dates between 1987 and 1989. Dissolved iron was measured at concentrations above its minimum detection limit of 10 parts per billion (ppb) in four of the five samples. The average iron concentration of the four samples was 282 ppb, although the data vary from 20 ppb to 1,200 ppb (Montgomery Watson, 1996a). Other metals typically were not detected. This site has not been monitored since publication of the 1992 FEIS.

Monitoring stations 102 (south Ophir Creek tributary) and 110 (north Ophir Creek tributary) establish baseline water quality conditions above exploratory operations on Ophir Creek (Montgomery Watson, 1996a). Data from station 102 are limited and cannot be statistically analyzed; however, they suggest that water is generally low in dissolved constituents and turbidity. Data from station 110 show few detections of metals with concentrations typically measured near the minimum detection limit. Although lead commonly was not detected, concentrations of total lead (186.5 ppb) and dissolved lead (57 ppb) were recorded in January 1992 (Montgomery Watson, 1996a).

Monitoring station 103 (south Ophir Creek tributary) is located downstream of the discharge point from the settling ponds used to treat mine drainage from the 800-foot adit (station 101). The water at station 103, which is characterized as calcium sulfate-type, has a chemistry that more closely resembles ground water than surface waters from other sites (except station 101). This indicates that water quality at station 103 is strongly affected by the mine drainage discharge. Low concentrations of total lead have been recorded occasionally at levels near the minimum detection limit, with measured concentrations of 1 to 2 ppb, ranging up to 10 ppb, in March and October 1992. Samples collected in January 1992 contained 217 ppb of total lead and 62 ppb of dissolved lead (Montgomery Watson, 1996a). These data are higher by more than 2 orders of magnitude than the lead concentrations measured on any other sampling date. Other metals typically were not detected or were occasionally measured at concentrations near their minimum detection limits.

Monitoring station 105 (lower Sherman Creek) provides an overall characterization of water quality in the Sherman Creek watershed. Concentrations of total iron and total manganese have been measured above their minimum detection limits with relatively higher concentrations being reported occasionally. Other metals are typically undetected or, in the case of lead, occasionally measured at concentrations near their minimum detection limits.

Monitoring station 109 (upper Sherman Creek) also provides background data above exploratory operations. Metals typically were not detected or were measured at concentrations near their minimum detection limits in these samples. This station was established to replace station 104, which was located in an unstable stream reach.

Elevated concentrations of nitrate, ammonia, and orthophosphate were detected in several samples collected from stations 101 and 103 between 1988 and 1990. These detections coincide with the period when explosives were used during exploration of the upper and lower adits. The presence of cyanide also has been reported at these two stations in correspondence with the elevated concentrations of nitrate and ammonia. Cyanide is not known to have been used at the site and is not expected to occur naturally. It should be noted, however, that cyanide can be falsely detected when high concentrations of nitrate are present if specific laboratory procedures are not applied. Section 3.8 discusses cyanide in greater detail.

3.6.2 Terrace Area Drainage Basin

Water quality samples were collected in June 1996 from two of the stream systems in the Terrace Area drainage basin. These samples are the only samples analyzed at the time of this report (Konopacky, 1996b). The sparse data suggest that the baseline water quality of these streams is similar to that of Sherman Creek.

3.7 GROUND WATER HYDROLOGY

Ground water characterization studies at the Kensington Gold Project site began in 1988 and have continued since publication of the 1992 FEIS. Page 3-15 of the 1992 FEIS presents the results of studies conducted through June 1991. The following discussion incorporates data presented in the 1992 FEIS with data from monitoring activities through October 1995. Studies conducted since June 1991 generally confirm previous characterizations of ground water hydrology and ground water quality in the project area. Recent ground water characterization studies have included the area of the proposed DTF site.

3.7.1 Mine Site Ground Water Flow

Recorded mine water discharge is variable. As reported in the 1992 FEIS, mine water discharge previously ranged from 100 to 400 gpm. The majority of the water enters the exploration workings along a northwest-southeast oriented fracture system. As reported in the 1992 FEIS, the seasonal variation in ground water flux is believed to be correlated to variations in precipitation and subsequent infiltration through the strata overlying the mine workings.

3.7.2 Terrace Area Drainage Basin

The proposed site for the DTF is located on a terrace above Lynn Canal that is bounded by Sherman Creek to the north and Sweeny Creek to the south. The facility footprint has an average ground slope of approximately 8 percent. Steep, forested slopes occur east of the site.

The terrace is composed of peat and organic soil that overlies sandy glacial till and bedrock. The laterally discontinuous till and soil deposits vary in thickness. The glacial till ranges up to 6 feet in thickness and has a composition that varies from sandy, gravely till to clay-rich till. The generally consolidated till is dense and contains up to 30 percent fines, with occasional large cobble- to boulder-sized clasts of glacial float. The deposit locally is interfingered with alluvial gravels. The bedrock underlying the terrace comprises phyllite and shale. Bedrock is encountered at depths generally between 2.5 and 10 feet across the site, with an average depth of approximately 5 feet. The bedrock is typically unweathered and non-friable, although it has a shallow weathered zone at the surface. The phyllite is oriented nearly vertically. Figures 3-7 and 3-8 present geologic sections through the terrace.

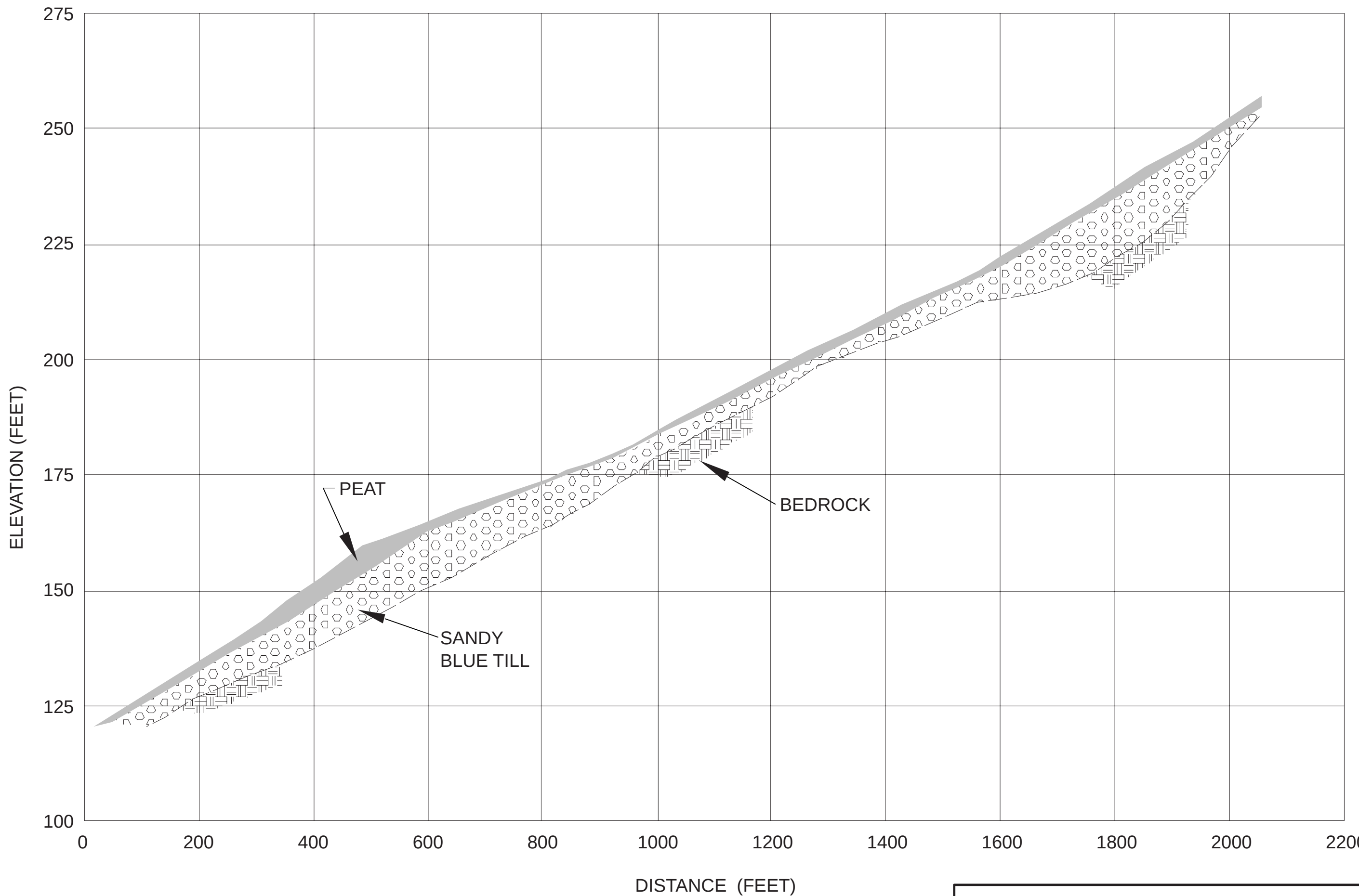


Figure 3-7
Terrace Area Geologic Section
(west to east)

(Vertical exaggeration= 8:1)

(Source: Modified from SRK, 1996b)

214D-29

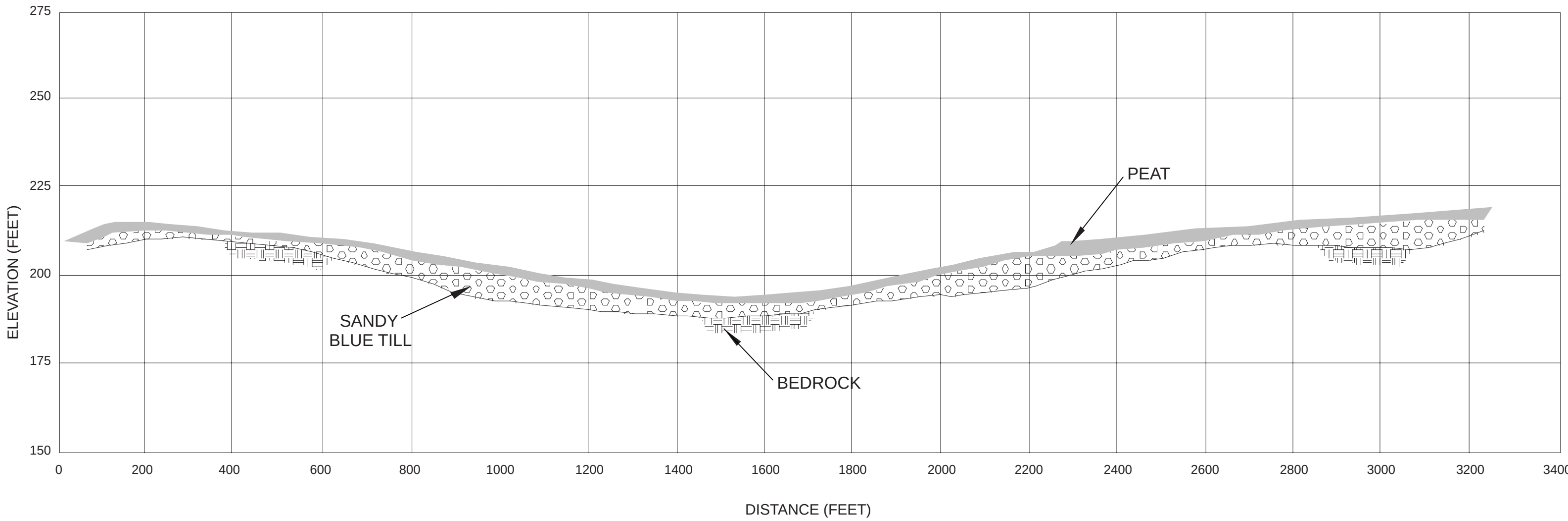


Figure 3-8
Terrace Area Geologic Section (north to south)

(Vertical exaggeration= 8:1)

(Source: Modified from SRK, 1996b)

214D-30

The drainage basin gains water from direct precipitation, hillside runoff, and subsurface flow in the bedrock. Conversely, water is lost through evapotranspiration, infiltration into ground water, and lateral subsurface flow toward Sherman Creek, Sweeny Creek, and Lynn Canal.

All of the upper units have saturated zones and zones of perched water, and ground water is present in the till and bedrock. Piezometers installed in the DTF area identified a perched water zone within or at the bottom of the till layer; the ground water table was identified within the bedrock. The potentiometric surface of the regional ground water table tends to conform to surface topography, but is influenced by the structure of the bedrock. Ground water principally flows from east to west toward Lynn Canal, but flow directions locally deviate toward the small creeks within the terrace area.

Estimated hydraulic conductivities are on the order of 1×10^{-2} cm/sec for the organic mat and 1×10^{-6} to 1×10^{-3} cm/sec for the till; however, in situ or laboratory hydraulic conductivity tests have not been performed on either material. Packer and recharge tests of the fractured phyllite bedrock suggest hydraulic conductivities in the range of 10^{-5} cm/sec. Intact bedrock permeability tests indicate hydraulic conductivity on the order of 10^{-7} cm/sec or less. Because overlying materials typically have higher permeabilities than fractured bedrock, the competent bedrock contact may form a hydrologic boundary.

3.8 GROUND WATER QUALITY

Ground water quality has been monitored during exploration operations in the underground mine and in nine ground water monitoring wells from June 1988 to October 1995. Five more wells were added to the monitoring network in 1990 and 1991. Ground water samples typically have low concentrations of most constituents, which are consistent with the short residence times expected for shallow ground waters in mountainous terrain (Montgomery Watson, 1996a). Figure 3-9 depicts the locations of ground water monitoring wells in the Sherman Creek basin.

Page 3-19 of the 1992 FEIS presents the results of studies conducted from June 1988 through June 1991. The following discussion summarizes those results and presents additional water quality data collected from July 1991 through October 1995, including results from recent characterization studies conducted in the Terrace Area drainage basin. Because of the quantity of data, Appendix G presents summary tables of monitoring information. Pages 3-19 and 3-20 of the 1992 FEIS provide additional information on ground water quality.

3.8.1 Mine Water

The water discharged from the 800-foot adit and sampled at the sedimentation pond from June 1988 through September 1995 was calcium sulfate-type, with TDS ranging from 70 to 1,268 milligrams per liter (mg/L) (mean value of 539 mg/L; see Table 3-8). The measured pH of

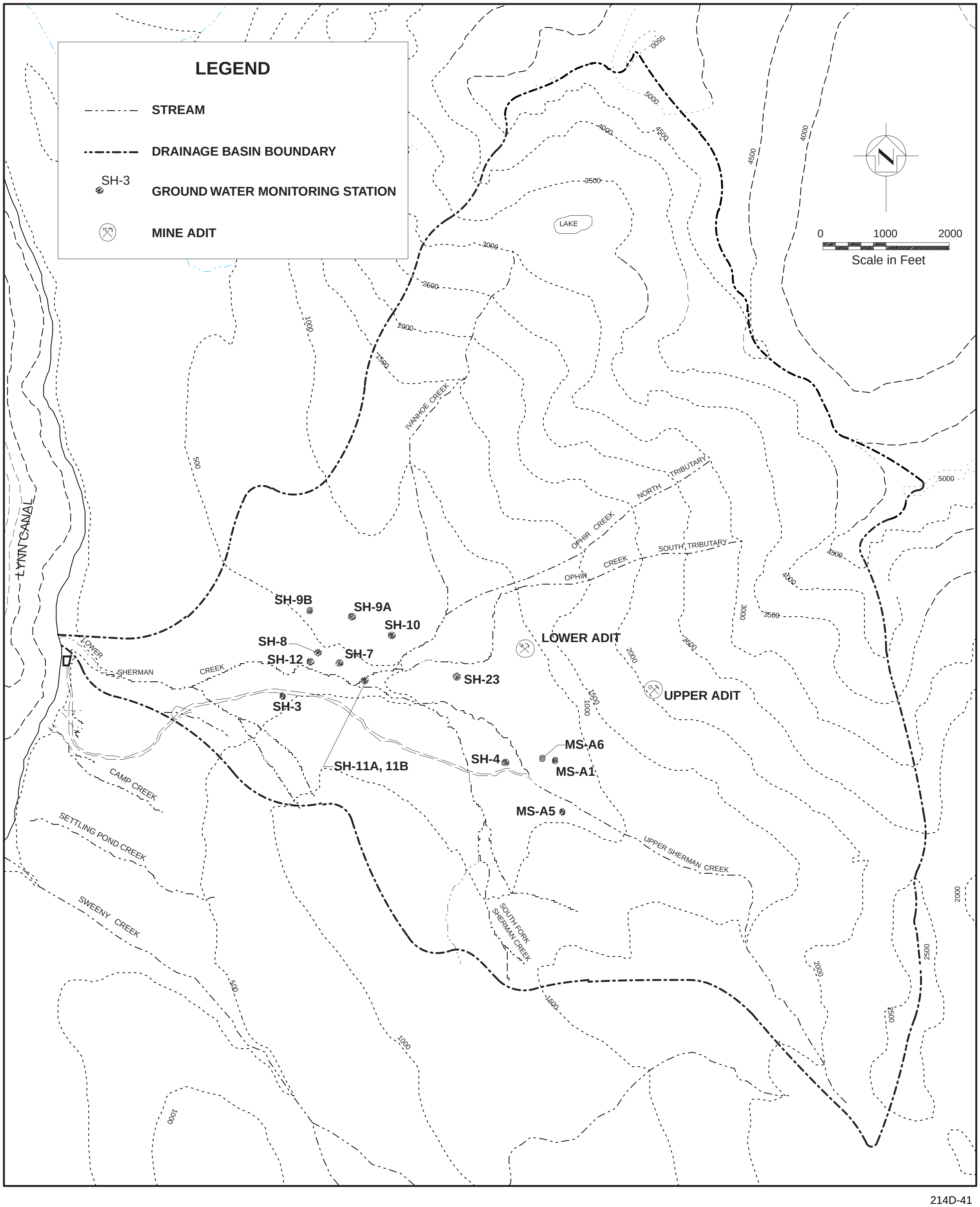


Figure 3-9. Ground Water Monitoring Wells in Sherman Creek Drainage Basin (Source: Adapted from Montgomery Watson, 1996a and SRK, 1996d)

these samples ranged from 6.8 to 8.3. Most metals monitored during this period had mean values less than their laboratory detection limits. Tables 3-8 and F-3 list metals with mean values greater than their laboratory detection limits. The following metals had mean values above their laboratory detection limits: total aluminum (0.17 mg/L), total iron (0.28 mg/L), total manganese (0.04), dissolved manganese (0.03 mg/L), dissolved molybdenum (0.05 mg/L), and total molybdenum (0.05 mg/L). Mean values are within the range of concentrations typical of natural ground waters in the Juneau area (USFS, 1992).

Analyses of samples collected from the 800-foot adit between December 1989 and October 1990 indicated the presence of cyanide in three forms: free cyanide, weak acid dissociated cyanide, and total cyanide (Montgomery Watson, 1996b). Section 3.8.2 presents a more detailed discussion of cyanide detections.

Samples collected at the 2,050-foot adit from May 1988 through June 1993 are calcium bicarbonate-type water. These samples had TDS concentrations ranging from 26 to 102 mg/L (mean value of 57 mg/L) and measured pH values ranging from 7.0 to 7.9. The mean values for most metals monitored during this period were less than their laboratory detection limits. The mean values for the following metals were above their detection limits: total aluminum (0.2 mg/L), total copper (0.006 mg/L), and total iron (0.24 mg/L). Data have not been collected at this location since June 1993.

3.8.2 Sherman Creek Drainage Basin

Fourteen ground water monitoring wells were installed in the Sherman Creek drainage basin. Data from 10 of these wells (i.e., SH-3, SH-4, SH-9A, SH-9B, SH-11B, SH-12, SH-23, MS-A1, MS-A5, and MS-A6) were used in this Final SEIS to evaluate ground water quality in the basin. The remaining four wells (i.e., SH-7, SH-8, SH-10 ,and SH-11A) were contaminated by grout during installation, which elevated pH values in their waters; data from these wells were excluded from the following analysis.

Data from the 10 monitoring wells are considered to be representative of natural ground water conditions at the site (Montgomery Watson, 1996a). Five of the wells have been sampled monthly or quarterly from November 1989 to October 1995. Two monitoring wells, SH-9B and SH-23, were added to the monitoring network in April and February 1990, respectively. Three more wells, MS-A1, MS-A5, and MS-A6, were added to the monitoring network in January 1991.

Ground water in the Sherman Creek drainage is divided into two types based on the Piper and Stiff classification scheme (Montgomery Watson, 1996a). Six of the monitoring wells (i.e., SH-3, SH-9A, SH-9B, MS-A1, MS-A5, and MS-A6) have calcium bicarbonate-type water, which is consistent with the major surface water grouping. The remaining four wells (i.e., SH-11A, SH-11B, SH-12, and SH-23) have sodium-calcium bicarbonate-type water.

The ground water quality monitoring effort focused primarily on characterization for trace metals, as well as TDS, electrical conductivity (a measurement of salinity), pH, turbidity, and temperature. Appendix G and the *Technical Resource Document for Water Resources* (SAIC, 1997a) present detailed discussion of water quality data. Samples collected from the Sherman Creek drainage from August 1989 through October 1995 have TDS values ranging from 18 to 1,900 mg/L and pH values ranging from 5.7 to 12.0 (Montgomery Watson, 1996a). Total metal concentrations varied with the time of year and spatially between wells; however, measured concentrations were typically at or near detection limits. Concentrations for total arsenic ranged between 0.98 and 2,900 parts per billion (μg/L); total barium ranged from levels below the detection limit to 7,400 μg/L; total cadmium ranged from levels below the detection limit to 300 μg/L; total chromium ranged from levels below the detection limit to 2,480 μg/L; total copper ranged from 2.2 to 16,200 μg/L; total lead ranged from 1 to 690 μg/L; total mercury ranged from levels below the detection limit to 1.51 μg/L; total selenium ranged from levels below the detection limit to 6.5 μg/L; and total silver ranged from levels below the detection limit to 503 μg/L.

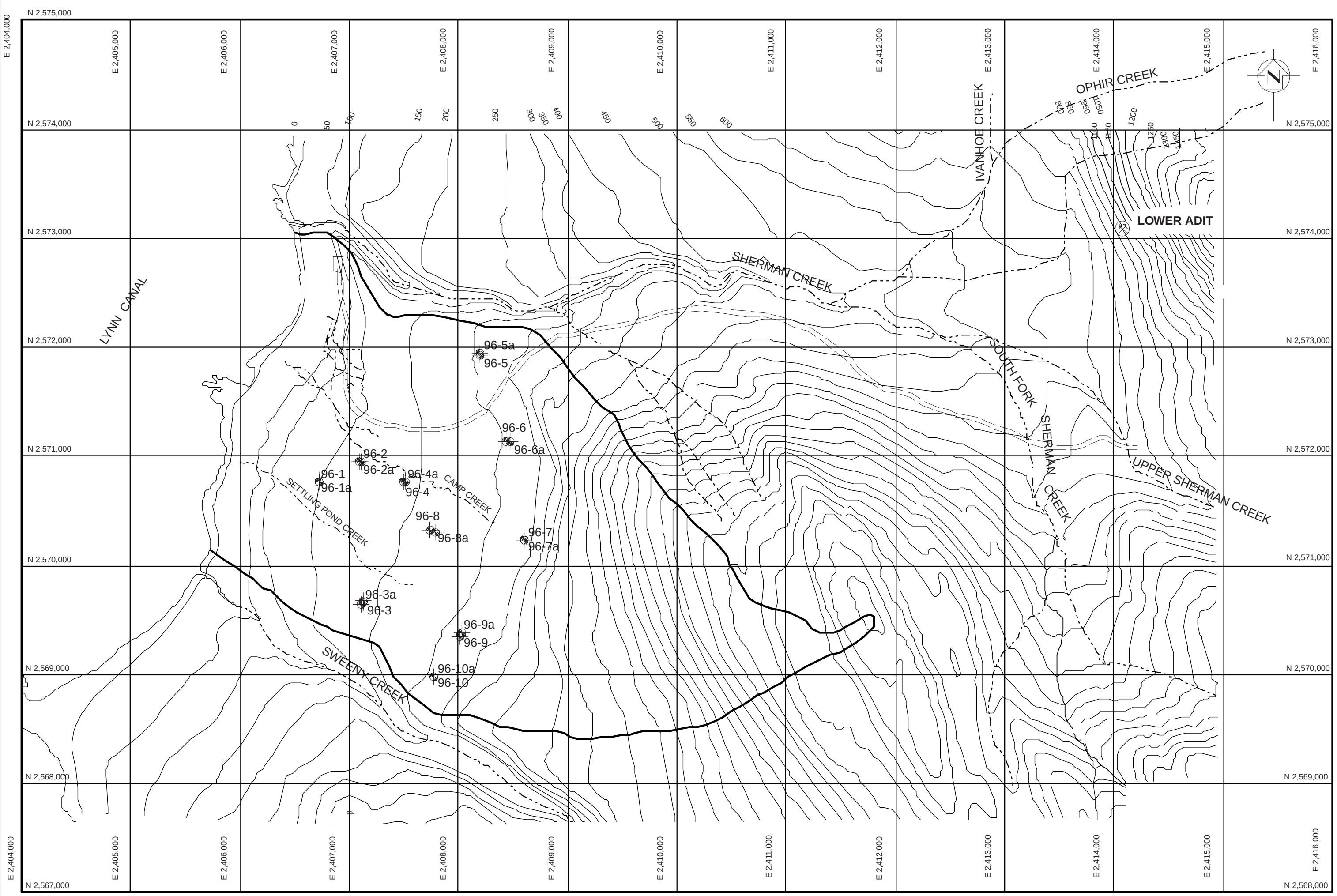
Analyses of ground water samples collected between November 1989 and October 1990 indicated the presence of nitrate, ammonium, orthophosphate, and three forms of cyanide. Nitrate, ammonium, and orthophosphate could be residual chemicals from exploratory blasting at the site, although cyanide is not normally used in explosives. It is also unlikely that cyanide would occur in detectable concentrations under natural conditions in this environment (Montgomery Watson, 1996a). It is likely, therefore, that cyanide was falsely detected. High nitrate concentrations can cause analytical interference if laboratory procedures are not strictly followed.

3.8.3 Terrace Area Drainage Basin

The quality of the ground water in the Terrace Area drainage basin was measured during limited sampling in 1996. Appendix G and the *Technical Resource Document for Water Resources* (SAIC, 1997a) present detailed discussion of these data. These samples had mean electrical conductivity (a measurement of salinity) of 370 μmhos/cm and mean TDS values of 229 mg/L. Arsenic, iron, manganese, and zinc were the only dissolved metals detected in a majority of collected samples. Concentrations for total trace metals varied among samples. Total metal concentrations were measured above detection limits for aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc in most samples. For some of these analytes (e.g., total aluminum and total iron), measured concentrations varied by more than two orders of magnitude. In contrast, dissolved anionic constituents were notably less variable. Figure 3-10 shows the locations of monitoring points for the Terrace Area drainage basin.

3.9 AQUATIC RESOURCES

The following descriptions of aquatic resources were derived from site-specific field studies, published reports, and scientific literature. The discussion summarizes the descriptions presented on page 3-20 of the 1992 FEIS to the extent necessary to effectively incorporate the



LEGEND

MINE ADIT

DRAINAGE BASIN BOUNDARY

STREAM

96-1 BOREHOLE/WATER QUALITY MONITORING LOCATION

400 0 400 800

SCALE IN FEET

Figure 3-10
Monitoring Points in Terrace Area Drainage Basin
(Source: SRK, 1996c)

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results of studies conducted since publication of the 1992 FEIS. The following sections pertain to aquatic resources within the area:

- Oceanography
- Marine biota
- Commercial fisheries
- Freshwater biota.

3.9.1 Oceanography

Additional oceanographic studies were conducted since publication of the 1992 FEIS. Studies were completed in 1992 and 1995 to provide additional baseline water quality data and address concerns from local fishers regarding circulation patterns in the vicinity of Point Sherman (Kessler and Vigers, 1992; Kessler & Associates and EVS, 1992; Andrews and Wilson, 1995a; Andrews and Wilson, 1995b). The following discussion briefly summarizes the information presented in the 1992 FEIS, as well as the results of these more recent studies. Page 3-24 of the 1992 FEIS provides a more complete discussion on the oceanography of the site.

Any water discharged from the Kensington Gold Project site would ultimately reach Lynn Canal, a glacially formed fjord that is part of a complex fjord system in Southeast Alaska. The canal is generally between 650 and 1,000 feet deep through much of its central portion, but deepens to 1,950 to 2,300 feet in its southern reaches. Near Point Sherman, in the vicinity of the project area, the canal is approximately 6.2 miles wide. The maximum water depth of 900 feet occurs approximately 1.25 miles from shore. Offshore from Comet Beach, the bathymetry (i.e., bottom topography) is complex due to the presence of rock outcrops, ledges, slopes, and gullies (Dames and Moore, 1988).

The oceanography of Lynn Canal is discussed extensively in the 1992 FEIS, as well as by other studies (e.g., McLain, 1969). McLain (1969) describes the circulation of Lynn Canal as principally estuarine (i.e., seaward surface flow with a corresponding landward deep flow that balances mass transport). The circulation is dominantly tidally driven, but wind also influences the overall circulation pattern. The estuarine flow is typically seasonal, with stronger forcing during the summer (July/August) when fresh water input to the canal is at a yearly peak. Tidal flow exhibits a semi-diurnal pattern and is consistent throughout the year. The influence of wind tends to be localized with a greater influence in winter corresponding to the highest average wind speeds.

Point Sherman Region

During development of the TAR, local fishers commented that present measurements taken from current meter mooring location A (Figure 3-11) were not representative of the circulation conditions that exist closer to shore in the vicinity of the proposed marine outfall.

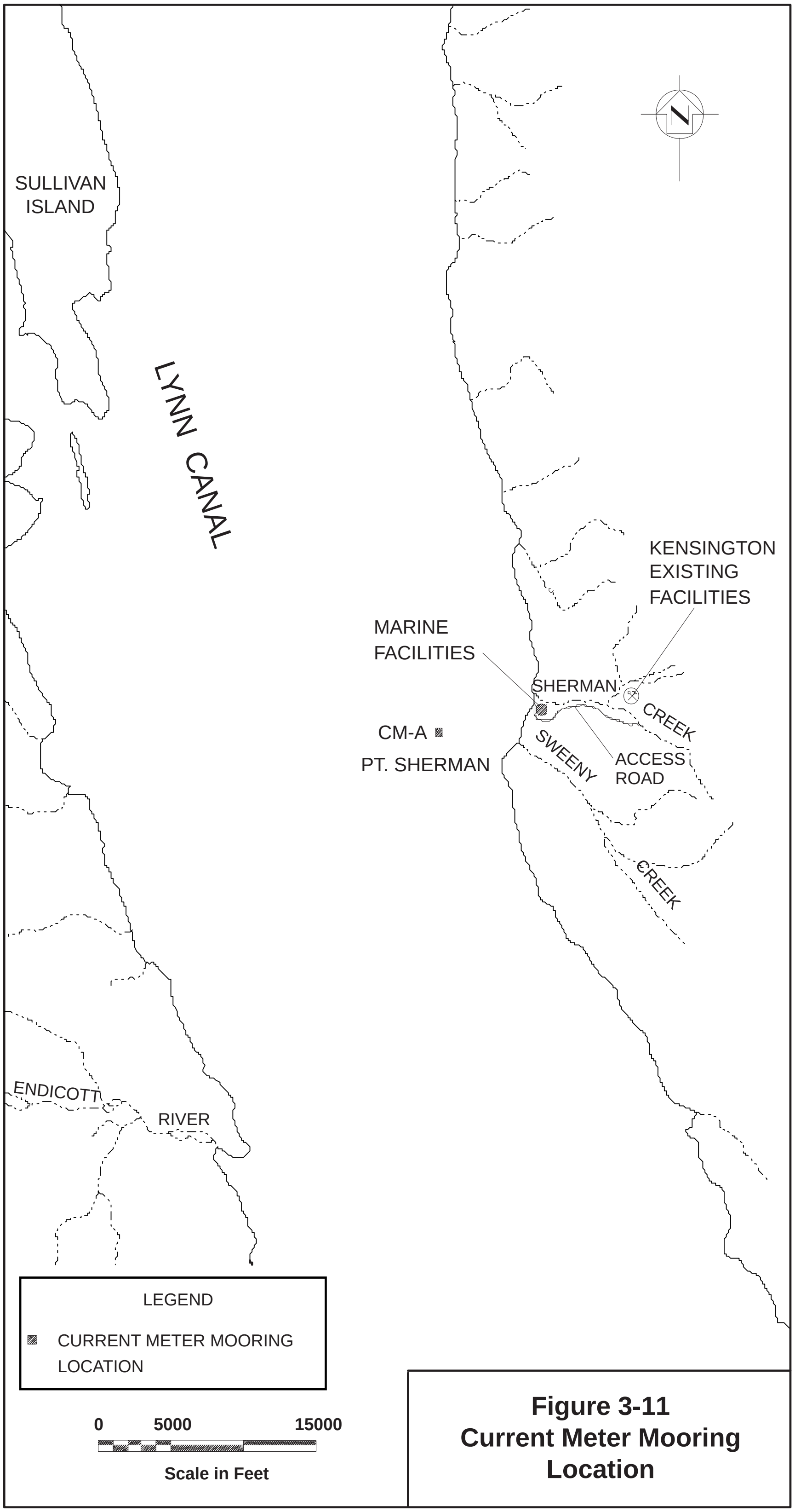


Figure 3-11
Current Meter Mooring Location

214D-42

The fishers noted that closer to shore, nets had been observed to collapse from the lack of a current and, at other times, to move in circular patterns. Such a recirculation pattern (i.e., eddy) could be caused by tidal flow sweeping past the sharp bathymetry in the Point Sherman/Comet Beach region. The concern over the presence of recirculation centered on its ability to redistribute a marine discharge, particularly as the area supports significant commercial fishing activity (Andrews and Wilson, 1995a).

The implications of this recirculation were considered by Kessler and Vigers (1992). Their analysis of the Rescan (1990) data led them to conclude that such an eddy-like feature would be subject to control by the tidal currents and would be highly variable in strength and position, similar to vortices shed by a turbulent wake. An additional investigation using field measurements of the currents in this area was conducted in March and July 1995 (Andrews and Wilson, 1995a; Andrews and Wilson, 1995b). Currents at two depths were examined along multiple transects aligned approximately perpendicular to the shoreline. Results showed the presence of recirculation during both seasons and during flood and ebb tidal phases. Current flow off the point was consistent with the overall direction of the tidal flow; however, currents in the nearshore areas reversed and turned in complex patterns. Currents in the Point Sherman area are controlled by the bathymetry with some evidence that stronger flows are confined to surface waters of 100 feet or less. Away from the immediate Point Sherman area, current reversals were limited to within 0.25 to 0.50 miles of shore. Differences between the two seasons were not observed, although comparisons with water stratification were not possible.

Water Quality

The water quality of Lynn Canal can be characterized by a number of physical and chemical properties. Parameters of primary concern include water temperature and salinity, which control the density and mixing of different water masses. The presence of suspended solids, metals, and nutrient concentrations is also important because they could be altered by effluent discharges. Changes to the water quality of Lynn Canal could, in turn, affect biological communities. Much of the information available for characterizing water quality conditions is based on data collected by Rescan (1990) during September 1988 and April and June 1989.

Water temperature and salinity characteristics in Lynn Canal are affected by fresh water discharges from rivers (i.e., Chilkat, Chilkoot, Skagway, and Taiya) and creeks, solar heating, and estuarine circulation patterns. Seasonal differences in water temperature, salinity, and density stratification within the canal are described by Rescan (1991). During summer, a strong density gradient (i.e., pycnocline) forms in the upper portion of the water column due to solar heating and fresh water runoff. The density gradient separates a warmer, less saline surface layer from colder, higher salinity subsurface waters. The density layer is present from approximately June through September. During winter, the density gradients weaken, and the temperature, salinity, and density characteristics of the water column are relatively uniform with depth (Rescan, 1990).

During September, water temperatures decrease from 52° F near the surface to 41° F at 200 feet. Salinity ranges from 21 to 32 parts per thousand (ppt) in the upper 65 feet. Within 65 feet of the surface, light transmittance ranges from 80 to 90 percent and remains uniform at approximately 90 percent below 65 feet. During April, temperature and salinity conditions do not vary appreciably with depth. Water temperatures range from 38 to 40° F, and salinity ranges from 29.5 to 30.5 ppt. The profile for light transmittance is similar to that observed during September, with approximately 90-percent transmittance throughout the water column, except for slightly lower (80- to 90-percent transmittance) values within the upper 82 feet (Rescan, 1990).

Concentrations of total suspended solids (TSS) in Lynn Canal waters range from less than 1.0 to 6.7 mg/L. Based on measurements at seven depths at each of seven locations near Point Sherman during three sampling periods, the mean TSS concentration was approximately 1 mg/L (Kessler & Associates and EVS, 1992). No appreciable differences with depth, location, or sampling period were evident. The pH of Lynn Canal waters range from 7.26 to 8.95, with values slightly higher in summer than in spring. Nitrate concentrations range from nondetectable (<0.005 micrograms per liter [µg/L]) to 0.48 µg/L, with concentrations higher in summer than in spring. Chlorophyll concentrations are highest (≥4.5 µg/L) in June (Rescan, 1990).

Concentrations of dissolved metals in waters at various depths were measured at two locations offshore from the mouth of Sherman Creek. The following concentrations were reported: arsenic, 0.4 to 2.2 µg/L; cadmium, <0.05 to 0.30 µg/L; copper, <0.10 to 2.25 µg/L; lead, <0.05 to 0.80 µg/L; nickel, 0.29 to 0.54 µg/L; zinc, <1 to 53 µg/L; and iron, <0.5 to 20.4 µg/L. Mercury concentrations were consistently below method detection limits (0.05 µg/L). Concentrations for several metals, including cadmium, copper, lead, and zinc, appeared to be slightly higher during April than June or September, which is consistent with the seasonal differences in seawater nitrate concentrations (Rescan, 1990).

Substrate and Sediment Quality

The characteristics of bottom sediments in Lynn Canal in the Comet Beach area change with depth. The intertidal zone on the eastern shore of Lynn Canal between Point Sherman and Independence Creek consists of moderately sloped, cobble beaches with rock outcrops. These beaches are exposed to storm-generated waves from the north, which probably results in considerable physical disturbance and prevents accumulation of finer grained sediments. Cobble and rock substrates extend subtidally to a depth of approximately 30 feet. Below 30 feet, bottom sediments are finer (i.e., smaller particle diameters), consisting of varying proportions of silt, coarse sand, and gravel, although areas of soft bottom are interrupted by rock outcrops and ledges. Sediments in the deepest, flat-bottomed portions of Lynn Canal consist of relatively fine-grained particles (Dames and Moore, 1988). Based on measurements of bottom sediments from 31 locations offshore from Comet Beach, sand and silt range from approximately 5 to 85 percent and from 15 to 95 percent, respectively (Rescan, 1990). Sediments from inshore locations generally were coarser than those further offshore, although there was considerable spatial variability (Rescan, 1990).

Concentrations of total organic carbon (TOC) in bottom sediments range from 0.25 to 1.27 percent (Rescan, 1990). Sediments from offshore locations generally contain slightly higher concentrations than those from inshore locations, although like grain size, TOC concentrations show considerable spatial variability. Sediment metal concentrations reported by Rescan (1990) generally are consistent with expected background concentrations. For example, ranges for individual metals include arsenic, 6 to 9 milligrams/kilogram (mg/kg); copper, 38 to 48 mg/kg; lead, 10 to 14 mg/kg; iron, 3.6 to 4.8 percent; manganese, 600 to 1,800 mg/kg; nickel, 32 to 46 mg/kg; zinc, 100 to 150 mg/kg; and mercury, 0.04 to 0.09 mg/kg. Cadmium and silver concentrations typically were below analytical detection limits (0.25 mg/kg), although cadmium concentrations have been measured up to 1.1 mg/kg and silver concentrations up to 0.7 mg/kg. These latter values indicate the possibility of either analytical error or human-related effects.

The mean annual deposition rate for solids (i.e., particle flux) was estimated at approximately 900 grams per square meter. Concentrations of metals in sinking particles generally were consistent with concentrations in bottom sediments, except that cadmium, mercury, and zinc were up to several times higher in sinking particles than in bottom sediments (Kessler & Associates and EVS, 1992).

3.9.2 Marine Biota

The following section provides an overview of the biological communities inhabiting Lynn Canal in the vicinity of the proposed project. Much of this information is taken from the 1992 FEIS. Characteristics of marine biota are important because aspects of the proposed project, including construction activities, effluent discharges, and/or accidental spills, have the potential to affect biological resources within Lynn Canal.

Intertidal

The invertebrates inhabiting intertidal zones (between low and high tide levels) of Comet Beach are dominated by marine snails (*Littorina siktana*), acorn barnacles (*Balanus glandula*), and blue mussels (*Mytilus edulis*). A brown algae (*Fucus distichus*) occurs in patches on cobbles in the lower intertidal zones. Rock outcrops in this area support higher densities and greater diversity of organisms than cobble areas, because the rocky habitats are not subject to the physical disturbance caused by wave-induced movements of cobbles.

Subtidal

At depths between 6 and 32 feet, dominant invertebrate taxa are green sea urchin (*Strongylocentrotus drobachiensis*), hermit crabs (*Pagurus* spp.), and seastars (*Pycnopodia helianthoides*, *Leptasterias hexactis*, and *Solaster* spp.). Kelp does not occur in the upper subtidal zone near the mouth of Sherman Creek. Basket stars (*Gorgonocephalus* sp.) and brittlestars (*Ophiopholis aculeata* and *Ophiura* sp.) are less motile species, which also occur in the area (Kessler & Associates and EVS, 1992).

The soft-bottom fauna at depths greater than 32 feet are dominated by polychaete worms and, secondarily, by molluscs. A total of 126 infaunal species were present in three samples collected off Sherman Creek (Dames and Moore, 1988). Based on the low densities and biomass, this study concluded that the infaunal community was relatively sparse and that the habitat was relatively unstable.

A number of crustacean macroinvertebrate species occur near the study area. These include crabs, such as Tanner (*Chionoecetes bairdi*), Dungeness (*Cancer magister*), and king (*Paralithodes* spp.), as well as shrimp, including pink (*Pandalus borealis*), coonstripe (*Pandalus danae*), sidestripe (*Pandalopsis dispar*), and spot (*Pandalus platyceros*). Tanner crabs are consistently the most abundant crab species; pink and sidestripe are the most common shrimp species.

Fish

Salmon are the most important fish species in Lynn Canal from an economic standpoint. Salmonids include sockeye (*Oncorhyncus nerka*), pink (*O. gorbuscha*), chum (*O. keta*), coho (*O. kisutch*), and chinook (*O. tshawytscha*), as well as Dolly Varden char (*Salvelinus malma*) and cuttroat trout (*O. clarkii*). Adult salmon returning to Lynn Canal occur primarily along the eastern shore. Spawning migrations vary somewhat by species, but the primary movement occurs between June and November (Archipelago Marine Research, 1991). During spring to early summer, the newly emerged fry congregate in nearshore waters (i.e., within 50 feet of the shoreline) and feed in the beach and rocky reef habitats for periods up to several days. At an age of 1 to 2 months, the fry move into deeper waters and eventually migrate to the open ocean through the summer and fall. The nearshore area off Comet Beach may be part of a larger shoreline region providing rearing habitat for pink and chum fry and sockeye smolts. However, juvenile salmon may be relatively abundant off Comet Beach because of the circulation patterns and diverse habitat associated with Point Sherman (Archipelago Marine Research, 1991).

Other prevalent fish species within Lynn Canal are Pacific herring (*Clupea pallasi*) and Pacific cod (*Gadus macrocephalus*). Typical demersal (bottom-dwelling) fish species in the area include walleye pollock (*Theragra chalcogramma*), arrowtooth flounder (*Atheresthes stomias*), yellowfin sole (*Pleuronectes aspera*), Pacific halibut (*Hipploglossus stenolepis*), rock sole (*Pleuronectes bilineata*), and starry flounder (*Platichthys stellatus*).

3.9.3 Commercial Fisheries

The discussion of commercial fisheries has not been modified from the 1992 FEIS (pages 3-35 through 3-37). The 1992 FEIS provides harvest data for salmon in Lynn Canal by species for 1985 to 1989. These data have been updated to include more recent information on salmon harvests since 1989. Table 3-9 presents data from 1985 through 1995. Recent information (ADF&G, 1996b) on the 1996 drift gillnet fishery in Lynn Canal indicates a substantial reduction in fish caught compared to 1995: 541 thousand pounds compared to 753 thousand pounds. However, the ex vessel harvest value of the catch was about the same: $1.94 million in 1996 versus $2.03 million in 1995 (both in 1996 dollars). The harvest values do not include the value of roe. The relative increase in harvest value in 1996, given the lower harvest numbers, is due to a rise in the number of high-value sockeye salmon caught compared to the previous year.

Table 3-9. Commercial Salmon Harvests in Upper Lynn Canal (1985–1995) (in numbers of fish)*

Harvest Year	Sockeye	Coho	Pink	Chum
1985	303,241	98,290	200,192	672,202
1986	289,906	82,121	38,115	381,382
1987	415,881	53,630	165,748	392,938
1988	351,876	81,537	208,423	377,768
1989	471,934	50,307	110,436	123,671
1990	357,418	63,070	101,035	210,532
1991	307,811	128,365	5,472	210,189
1992	286,035	108,753	351,562	245,247
1993	173,113	59,952	11,336	306,586
1994	171,729	140,764	147,306	685,449
1995	88,572	79,949	15,613	568,468

*Chinook salmon harvests are not reported because they are a minor component of the commercial harvest.
Source: ADF&G, 1996a.

3.9.4 Fresh Water Biota

This section presents additional information that was made available for stream systems, habitat capability modeling, and assessment of rearing populations since publication of the 1992 FEIS. Pages 3-37 through 3-44 of the 1992 FEIS provide additional information.

The Sherman Creek drainage basin is composed of four streams: upper Sherman Creek, Ivanhoe Creek, the main stem of Ophir Creek, and an unnamed creek called the Ophir Creek tributary. Ophir Creek enters Sherman Creek from the north at an elevation of approximately 440 feet. Most of the Ophir Creek and Ivanhoe Creek drainages have high or very high gradient mountain slope channels. The Forest Service stream classification system designates these drainages as having A1 and A4 channel types, which have little capability to support fish. Dolly Varden char have been captured in Ophir Creek and the Ophir Creek tributary (Konopacky Environmental, 1996a), indicating some fish use of these streams. Although fish are present in these creeks, these creeks are not used regularly for fishing.

Six small stream systems between Sherman and Sweeny Creeks in or near the Terrace Area basin were identified and sampled for fish in 1996 (Konopacky Environmental, 1996b). Flows in all identified channels were low, ranging from 1 to 25 gpm. Fish were not captured in any of the systems.

Trace Element Concentrations in Fish Tissues From Sherman Creek

Baseline levels of nine trace elements (i.e., silver, arsenic, cadmium, chromium, copper, mercury, nickel, lead, and selenium) were measured in fish from the Sherman Creek drainage (Konopacky Environmental, 1996a). Elemental concentrations were reported per gram of wet or dry weight for whole fish. Five streams in the drainage system were sampled for fish: lower, middle, and upper Sherman Creek; Ophir Creek; and the Ophir Creek tributary. Prickly sculpin (*Cottus asper*) and pink salmon embryos and fry were collected only from lower Sherman Creek; Dolly Varden were collected from all streams.

As shown in Table 3-10, Dolly Varden from the Ophir Creek tributary had the highest tissue concentrations of all elements except selenium. The levels could be elevated in fish from the Ophir Creek tributary because 1) the fish were collected immediately downstream from the outfall pipe of the existing settling ponds, 2) exploration and construction activity occurred recently in that portion of the drainage, 3) mining activity has been greater historically in that portion of the drainage than in other portions of Sherman Creek, and 4) levels of trace elements in that portion of the drainage are naturally higher than in other sub-drainages (Konopacky Environmental, 1996a).

Mercury concentrations tended to be higher in large char, except in lower Sherman Creek where small char showed the highest levels. Selenium concentrations were highest in fish from the main stem of Ophir Creek followed by fish collected in the Ophir Creek tributary.

Prickly sculpin had higher concentrations of arsenic, chromium, nickel, and lead than Dolly Varden char in lower Sherman Creek, while Dolly Varden had higher concentrations of silver. The concentrations of selenium, cadmium, copper, and mercury did not differ substantially among species.

Pre-emergent pink salmon fry collected from lower Sherman Creek in April had lower concentrations of the tested elements than did Dolly Varden char or prickly sculpin. A single, combined sample of dead pink salmon embryos and sac-fry collected in April had extremely high concentrations of arsenic, chromium, copper, nickel, and lead. The much lower concentrations in live pre-emergent fry collected in the same field sample probably indicates that the elements were concentrated in the embryos and sac-fry after death.

Table 3-10. Concentrations of Elements (in μg/g [ppm] wet weight) in Dolly Varden Char From the Sherman Creek Drainage[a]

	Sherman	Sherman Creek		Ophir Creek		EPA Screening
Element	**Lower**	**Middle**	**Upper**	**Main**	**Tributary**	**Value (ppm)[b]**
Silver	0.0031	0.0051	0.0023	0.0051	**0.0087**	NA
Arsenic	0.1390	0.1350	0.1760	0.0390	**0.2173**	3.0
Cadmium	0.0320	0.0253	0.0563	0.0547	**0.0727**	10.0
Chromium	0.0727	0.0993	0.0690	0.1203	**0.4570**	NA
Copper	1.1233	1.2800	1.5600	1.6100	**2.4533**	NA
Mercury	0.0149	0.0187	0.0121	0.0189	**0.0201**	0.6
Nickel	0.1920	0.2287	0.1970	0.1913	**0.4497**	NA
Lead	0.0293	0.0282	0.0156	0.0143	**0.0393**	NA
Selenium	0.6367	0.6200	0.6767	**0.9267**	0.7533	50.0

Note: Bolded values are the highest averages per element.
a. Values are averages of all size classes.
b. Screening values based on adult consumption of a single 8-ounce meal per month.
NA = Not applicable.
Source: Konopacky Environmental, 1996a.

The concentrations of arsenic, cadmium, mercury, and selenium in Dolly Varden char do not pose a risk to human health via consumption, based on screening values designated by the U.S. Environmental Protection Agency. Screening values for the other five elements have not been established, as depicted in Table 3-10. Hazard quotients for humans were low for all four elements (Konopacky Environmental, 1996a).

Abundance of Spawning Salmon

Surveys of spawning salmon have continued since 1990 (except 1994) in Sherman Creek and were conducted from 1990 to 1993 in Sweeny Creek (Konopacky Environmental, 1994). Pink salmon are the most numerous species, with no established runs of other species. Chum salmon are occasionally present in low numbers. Coho salmon are observed infrequently in Sweeny Creek.

As shown in Table 3-11, the pink salmon runs in both Sherman and Sweeny creeks are strongly cyclic, with even years having greater numbers of returning fish. Pink salmon enter the streams after July 26, and peak escapement occurs around August 24. Sherman Creek downstream from the anadromous fish block was stratified into 12 reaches to facilitate counting. Although all 12 reaches are used for spawning, reaches 3 and 9 show consistently low usage; none of the reaches consistently dominated use. The total estimated escapement for 1992 exceeded 5,800 fish. The fishery takes between 20 and 80 percent of the returning fish, with higher rates occurring during years of high abundance (Hoffmeister, 1996). Consequently, the total pink salmon return to Sherman Creek in 1992 was approximately 10,000 fish.

Chum salmon occur sporadically in Sherman and Sweeny Creeks (Konopacky Environmental, 1994). The pattern of occurrence suggests that these fish are strays from other nearby streams.

No fish of any species were found during electrofishing surveys conducted in the four small stream channel systems in the Terrace Area drainage basin (Konopacky Environmental, 1996b). In addition, fish were not found in the two unnamed stream channels that drain into

Table 3-11. Estimated Escapements into Sherman and Sweeny Creeks (1990–1995)*

	Number of Fish	
Year	**Sherman Creek**	**Sweeny Creek**
1990	3,805	2,023
1991	160	17
1992	5,888	2,143
1993	55	0
1994	no count	no count
1995	368	no count

*Weekly counts during spawning season and 2-week stream life.
Source: Pentec, 1991; Konopacky Environmental, 1994; Konopacky Environmental data files.

Sherman Creek. The lack of fish in these small channels may be due to the intermittent flows that occur during the summer and frozen winter months, the lack of food supply or a viable connection with Lynn Canal, or the presence of numerous fish passage barriers.

Gravel Quality in Spawning Areas

The particle size distributions of spawning gravels can significantly affect the incubation of salmonid eggs (Chapman, 1988). The survival of salmon embryos generally increases with increasing mean particle size and fredle index (i.e., a measure of the pore size and permeability of the sediment), but decreases markedly as the percentage of fine materials increases (Chapman, 1988). High survival rates are observed when the mean particle size exceeds 15 millimeters (mm) and the fredle index exceeds 5. The survival rates decrease significantly when the percentage of material smaller than 0.85 mm exceeds 10 percent (Chapman, 1988).

The size distribution of gravels within the spawning areas of Sherman and Sweeny Creeks was measured to obtain baseline information on the particle size distributions (Konopacky Environmental, 1992). A McNeil-type gravel sampler was used to obtain eight substrate core samples from two reaches of each creek on April 23, 1991. Each sample was wet-sieved through the following sieve sizes: 101.60 mm, 50.80 mm, 25.40 mm, 12.70 mm, 6.35 mm, 1.68 mm, 0.42 mm, and 0.15 mm. Sieve data were used to compute the geometric mean particle size and the fredle index value of each sample. Geometric mean particle sizes ranged from 13.15 mm for a sample in the upper reach of Sweeny Creek to 71.66 mm in lower Sherman Creek. Fredle index values ranged from 4.783 in upper Sweeny Creek to 39.746 in lower Sherman Creek. The computed index values were not significantly different between creeks or in the upper and lower reaches of a single creek. A 0.85-mm screen was not used in the baseline sieve analyses; however, none of the samples had more than 10 percent particles smaller than 1.68 mm. The results indicate that the spawning quality of stream gravels is high at all sites.

Aquatic Invertebrate Populations

Benthic macroinvertebrate populations, which provide a significant food source for stream-dwelling fish, are quite sensitive to chemical and physical changes in the stream environment. Both Sherman and Sweeny Creeks were sampled with a Surber Sampler in September 1991, July 1995, and December 1995 to obtain baseline information on the benthic macroinvertebrates inhabiting these two project area streams (Konopacky Environmental, 1992; Konopacky Environmental, 1996a).

Sherman Creek was sampled using two sampling designs. In 1991, benthic macroinvertebrates were sampled in two reaches in lower Sherman Creek: a lower reach located 10 to 100 feet upstream from the stream mouth and an upper reach located 950 to 1,000 feet upstream from the mouth. In 1995, five strata throughout the drainage were sampled: lower, middle, and upper Sherman Creek; Ophir Creek; and the Ophir Creek tributary. Sampling in 1991 was conducted with a 300-micron mesh Surber Sampler; in 1995, the mesh was 1,000 microns.

In 1991, annelid worms accounted for 78 percent of the macroinvertebrates sampled in lower Sherman Creek. The insects included five ephemeropteran (i.e., mayfly) families, five plecopteran (i.e., stonefly) families, three trichopteran (i.e., caddisfly) families, and three dipteran (i.e., true fly) families. Densities did not differ between the lower and upper reaches. Shannon-Weaver diversity and evenness indices were used to evaluate 1) the entire invertebrate samples and 2) the non-annelid portion of the sample. The diversity and evenness indices were not different for the lower and upper reaches for all invertebrates and for non-annelid invertebrates.

In 1995, few annelids were caught in the large mesh sampler. The remaining invertebrate species were similar to those observed in 1991, with mean invertebrate densities significantly lower in lower Sherman Creek than in the other four strata. The mean densities across all strata were significantly higher in July than in December. The mean Shannon-Weaver diversity index was not different across stream strata in either July or December, but was higher in December than in July.

In 1991, macroinvertebrate sampling was conducted in two reaches of lower Sweeny Creek (125 to 200 feet and 775 to 800 feet upstream from the mouth) with the 300-micron sampler. Annelid worms were less dominant in Sweeny Creek than in Sherman Creek, comprising 44 percent of the sampled invertebrates (Konopacky Environmental, 1992). The insects included 4 ephemeropteran (i.e., mayfly) families, 4 plecopteran (i.e., stonefly) families, 13 trichopteran (i.e., caddisfly) families, and 4 dipteran (i.e., true fly) families. As in Sherman Creek, differences between the lower and upper reaches were not apparent. Total invertebrate and non-annelid invertebrate densities were statistically higher in Sherman Creek than in Sweeny Creek. The Shannon-Weaver diversity and evenness indices for all invertebrates, however, were statistically higher in Sweeny Creek than in Sherman Creek. The diversity index was not statistically different between streams for non-annelid invertebrates, but the evenness index remained higher in Sweeny Creek.

All four primary functional groups of insects (i.e., collectors, scrapers, shredders, and predators) were present in both streams and in all sampling periods. The collectors were represented by ephemeropterans and chironomids, scrappers by ephemeropterans and trichopterans, shredders by plecopterans, and predators by plecopterans, trichopterans, and dipterans.

3.10 SOILS, VEGETATION, AND WETLANDS

3.10.1 Soils

The baseline description for soils at the site has not changed since publication of the 1992 FEIS. Page 3-44 of the 1992 FEIS presents a more detailed description of this resource. Appendix H of this Final SEIS presents background information on soils. This information was taken from Appendix D4 of the 1990 DEIS and is referenced in the 1992 FEIS.

3.10.2 Vegetation

The baseline description for vegetation at the site has not changed since publication of the 1992 FEIS. Page 3-44 of the 1992 FEIS provides a more detailed description of this resource. Appendix H presents background information on vegetation. This information was taken from Appendix D4 of the 1990 DEIS and is referenced in the 1992 FEIS.

The 1992 FEIS ruled out the potential occurrence of a number of threatened and endangered plant species, as well as State sensitive species as defined by the Alaska Natural Heritage Program (see pages 3-48 and 3-49 of the 1992 FEIS). One species—western paper birch *(Betula papyrifera* var *commutata*)—was identified on the site and was proposed for listing as State sensitive. Subsequent to publication of the 1992 FEIS, this species was not listed as State sensitive and, therefore, is not addressed in this Final SEIS.

The Forest Service released a sensitive species list for the Alaska region in January 1994 that identifies 13 plant species known or suspected to occur within the Juneau Ranger District. These species are crucifer, a member of the mustard family with no common name *(Aphragmus eschscholtzianus);* Norberg arnica *(Arnica lessingii* spp. *Norbergii*); goose grass sedge (*Carex lenticularis* var. *dolia*); pretty shooting star (*Dodecatheon pulchellum* spp. *Alaskanum*); northern rockcress (*Draba borealis* var. *maxima*); Kamchatka rockcress (*Draba kamschatica*); davy managrass (*Glyceria leptostachya*); truncate quillwort (*Isoetes truncata*); Calder lovage (*Ligusticum calderi*); pale poppy (*Papaver alboroseum*); Choris bog orchid (*Platanthera chorisiana*); Loose-flowered bluegrass (*Poa laxiflora*); and Kamchatka alkali grass (*Puccinellia kamtschatica*). An additional species, ascending moonwort (*Botrychium ascendens*), is considered sensitive by the U.S. Fish and Wildlife Service and could be added to the Forest Service list in the future.

A 1991 survey of the site documented the occurrence of *Platanthera chorisiana*. *Carex lenticularis* was also observed at the site (ACZ, 1991a). Since this species was not identified to the variety level, it is assumed that the plant observed was the common variety rather than the sensitive species. *Dodecathon* and *Poa* species were also observed but not identified to the species level. Due to the habitat preferences and physical characteristics, respectively, of these species, it is unlikely that the individuals observed during the survey were sensitive species (USFS, 1997a).

3.10.3 Wetlands

The baseline description for wetlands at the site has been expanded since publication of the 1992 FEIS. The description of wetlands presented on page 3-47 of the 1992 FEIS uses two approaches: 1) a plant community approach that identifies plant communities at the landscape level based strictly on vegetation characteristics and 2) a plant association approach that uses a combination of soils and vegetation characteristics to assign particular plant associations to specific soil types (DeMeo and Loggy, 1989). The plant community approach was used to describe the occurrence of wetlands on a general scale and was not carried forward in subsequent analyses. The plant association approach was carried through the 1992 FEIS impact analysis.

Page 3-48 of the 1992 FEIS briefly discusses wetland functions and value, and Appendix H (Table H-11) of this document presents a summary table. The discussion in this Final SEIS focuses on "jurisdictional" wetland and wetland habitat aspects within the project area. Quantitative analyses presented in Section 4.8.3 focuses on plant associations and jurisdictional wetlands only.

Figure 3-12 illustrates the extent of jurisdictional wetlands identified within the project area. Certain activities in jurisdictional wetlands are regulated under Section 404 of the Clean Water Act, as administered by the Corps of Engineers and EPA. Jurisdictional wetlands are identified and delineated using the three-parameter approach defined in the Corps of Engineers Wetlands Delineation Manual (USCOE, 1987). Under normal conditions, all three criteria—hydrophytic vegetation, hydric soils, and wetland hydrology—must be present at a site for it to qualify as a jurisdictional wetland. For the Kensington Gold Project, 1,123 acres of jurisdictional wetlands were delineated within the project area (SRK, 1997a).

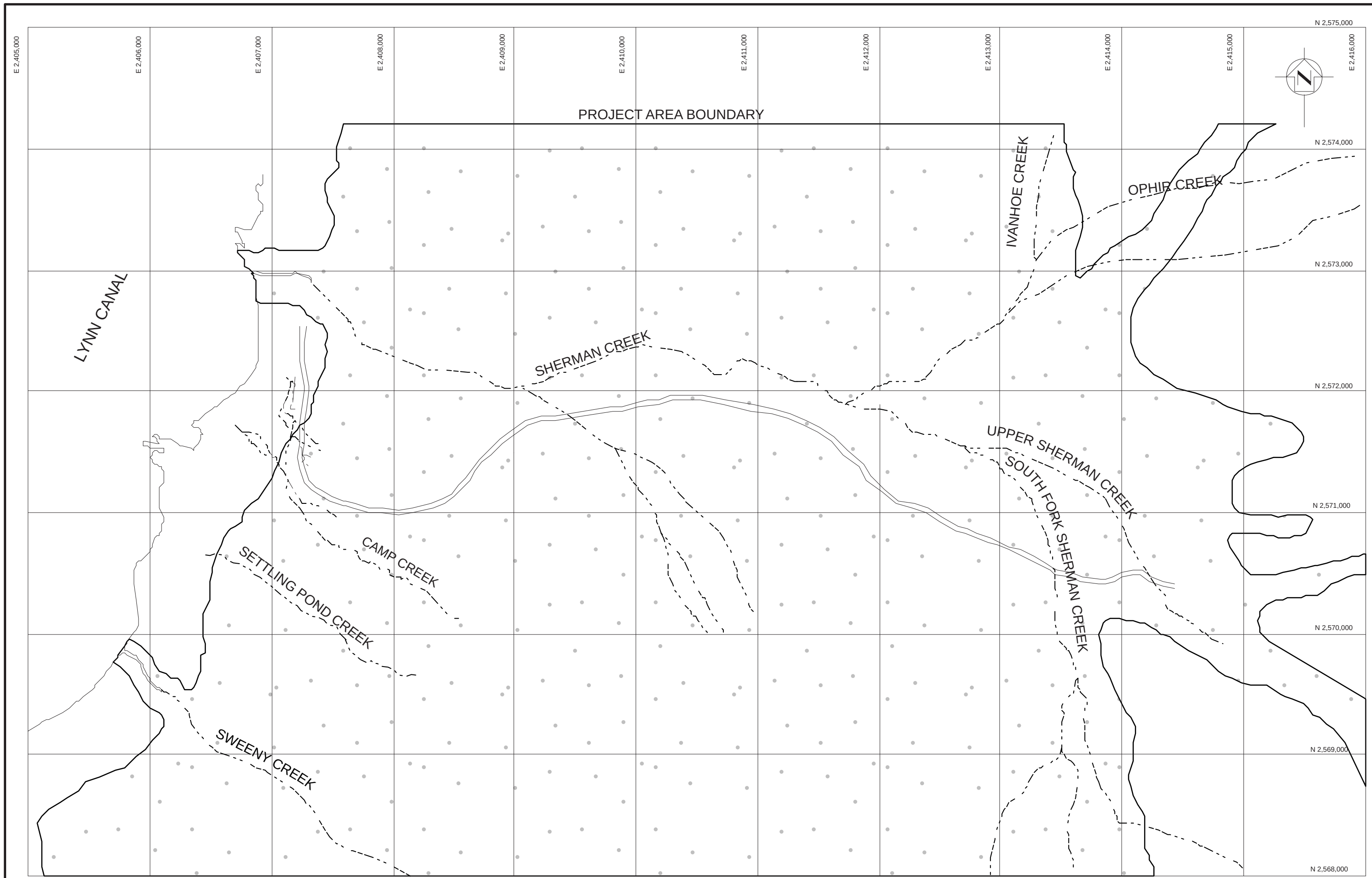
An area lacking one or more of the three criteria can still exhibit wetland characteristics (e.g., wetland vegetation). These non-jurisdictional wetlands are not subject to regulatory requirements; however, they are often of interest in terms of the habitat value they provide to wildlife.

One method for describing wetland habitats is the Wetland and Deepwater Habitat Classification System (i.e., Cowardin System), which was developed by Cowardin et al. (1979). This system uses a combination of vegetation and hydrology to classify wetland habitats. Wetlands identified under the Cowardin System are not necessarily jurisdictional. The Cowardin System also forms the basis for National Wetlands Inventory mapping conducted by the U.S. Fish and Wildlife Service.

Classifying wetlands within the project area using the Cowardin System facilitates comparisons with wetlands exhibiting similar characteristics both within and outside Southeast Alaska. Using the Cowardin System, vegetated wetlands in the study area are grouped into four categories: palustrine forested, palustrine scrub-shrub, riverine, and estuarine.

Wetland habitat occurring within the creek drainages and on the adjacent slopes consists of palustrine forested wetlands, whereas the flowing water and channel beds constitute riverine wetland habitat. Forested wetlands are dominated by mountain hemlock (*Tsuga mertensiana*) with an understory that includes Alaska blueberry (*Vaccinium alaskaense*), skunk cabbage (*Lysichitum americanum*), and deer cabbage (*Fauria crista-galli*). Small upland inclusions occur frequently within these forested wetlands, primarily in areas where soil or slope conditions are inadequate to support wetland hydrology. The overstory in these upland areas can also consist of hemlock (*Tsuga* spp.) and Sitka spruce, although the understory is dominated by devil's club (*Oplopanax horridum*) and salmonberry (*Rubus spectabilis*). Appendix I provides a species list indicating the wetland status of plants occurring in the project area (ACZ, 1991a).

While upland inclusions can be present throughout the drainages, forested wetlands form the predominant habitat type. This habitat type extends throughout the Sherman Creek and Sweeny Creek drainages, as well as the lower portions of Ophir and Ivanhoe Creeks.



LEGEND

WETLANDS

UPLANDS

0 500 1000 2000

Scale in Feet

Figure 3-12
Kensington Mine
Wetlands Locations
(Source: Modified from SRK, 1997a)

214D-43

Palustrine scrub-shrub wetlands correspond to the muskeg areas, where relatively gentle topography supports the accumulation of dense mats of organic material and saturated soil conditions. Vegetation in these areas is a mixture of herbaceous species, low-growing shrubs, and stunted trees dominated by tufted clubrush (*Scirpus caespitosus*), bog kalmia (*Kalmia polifolia*), and lodgepole or shore pine (*Pinus contorta*). This habitat type occurs on more gentle slopes, such as the Terrace Area and the area east of the confluence of Sherman and Ophir Creeks.

National Wetland Inventory maps identify estuarine wetland habitat along Comet Beach (USFWS, 1979). The discussion of substrate and sediment quality in Section 3.9.1 of this SEIS describes this unvegetated, cobble-bedded habitat.

3.11 WILDLIFE

The discussion on the occurrence and abundance of wildlife has not been revised. See page 3-49 of the 1992 FEIS. No animal species that are found within the project area have been added to the threatened and endangered animal species list since 1992.

3.12 RECREATION

The discussion on recreation has not been revised. See page 3-63 of the 1992 FEIS for a complete discussion.

3.13 CULTURAL RESOURCES

Pages 3-67 through 3-70 of the 1992 FEIS discuss cultural resources in the project area. This section summarizes and expands the 1992 FEIS discussion.

Significant cultural resources are unlikely to be present within the area to be affected directly by construction of any of the alternatives. Historic mining resources at the project site, as delineated by the operator in meetings with the Forest Service and SAIC archaeologists in February 1997, have been well-documented and determined ineligible for the National Register of Historic Places. Two historic structures are located at the old Kensington adit camp on the mountainside at an elevation of 2,000 to 2,050 feet. Preliminary evaluation of these two structures indicates that they are not eligible for the National Register of Historic Places (Hall, 1991).

No other cultural resources are known or reported at the project site, and the potential for cultural remains representing earlier resource extraction is considered to be low. In studies conducted for the 1992 FEIS, this evaluation was based on consideration of three factors: extensive disturbance by historic mining activities; steep landforms impairing access; and natural barriers to Sherman Creek which limit its aquatic resource potential (Hall, 1991). This assessment is consistent with major cultural resource overviews of the region (USFS, 1993). Subsequent archaeological investigations, including survey of the DTF site (USFS, 1996c) and the borrow source and explosive storage areas (SAIC, 1997b), further document the absence of evidence of earlier resource extraction at the project site.

Areas exhibiting high potential for archaeological remains representing earlier resource extraction lie outside the area to be affected directly by any of the alternatives in studies conducted for the 1992 FEIS. Three such areas were identified within walking distance of the project site (i.e., within the area of potential indirect effects due to increased site visitation) (Hall 1988; Hall, 1991). Additional archaeological survey and subsurface testing have been conducted at these locations since publication of the 1992 FEIS (SAIC, 1997b). No evidence of archaeological sites was located other than historic mining resources, which have been determined ineligible for the National Register of Historic Places, as noted previously.

Many Tlingit sites are recorded or reported for the greater Berners Bay and Lynn Canal areas. These include areas that are potentially eligible for listing on the National Register of Historic Places as traditional cultural properties, in historically documented tribal territories of Chilkat and Chilkoot Tlingit. As defined by 1992 amendments to the National Historic Preservation Act and subsequent guidelines for implementation, traditional cultural properties are places associated with a living community, rooted in that community's history, and important in maintaining the continuity of that community's traditional beliefs and practices, thus providing a link between the past and the present. According to consultation with Alaska Natives in Juneau, Haines, and Klukwan, no such places are known at the project site, and one potential traditional cultural property is located within walking distance of the project site.

3.14 VISUAL RESOURCES

The discussion on visual resources has not been revised. See page 3-70 of the 1992 FEIS for a complete discussion.

3.15 SOCIOECONOMIC ENVIRONMENT

The description of the socioeconomic environment was revised to include data collected since publication of the 1992 FEIS. Pages 3-74 through 3-107 of the 1992 FEIS provide additional information on this resource. This discussion focuses on socioeconomic conditions in the following areas:

- City and Borough of Juneau
- City and Borough of Haines
- City of Skagway.

These areas are discussed in terms of socioeconomic characteristics, including demographic trends, economic indicators, and capacity of present jurisdictional services.

3.15.1 City and Borough of Juneau

People reside and/or work in the following communities and areas within the City and Borough of Juneau: Juneau, Douglas, North Douglas, Thane, Salmon Creek, Lemon Creek, Mendenhall Valley, Fritz Cove, Auke Bay, and Lena Cove.

The Greens Creek Mine, located west of Juneau on Admiralty Island (annexed by the City/Borough of Juneau in 1994), began operations in 1989, focusing on lead and zinc production. The mine, which employed about 270 workers, suspended production in April 1993. Currently, the mine is being recommissioned for gold and silver production and is scheduled to reopen during spring 1997 with employment expected to reach 230 workers by the end of the year (Kennecott Greens Creek Mining Company, 1996). In addition, the Echo Bay Mines Alaska initiated exploratory activities pursuant to development of the A-J Mine. This effort employed 96 workers in 1994 (Alaska Department of Labor, 1996). In January 1997, Echo Bay announced cessation of its efforts to develop the A-J mine.

3.15.2 Population and Demography

Juneau's population has grown at a steady, moderate pace between 1989 and 1996, adding as many as 3,500 residents. The CBJ Community Development Department estimated a population of 30,209 persons in November 1996. The Alaska Department of Labor provisional estimate of population for the borough as of July 1, 1996, is 29,524. The differences in the two population estimates may be due to timing and methodology.

3.15.3 Employment

Total employment in the Juneau area increased from 13,772 persons in 1990 to 15,812 persons in 1995. Overall employment was up 14.8 percent from 1990, with an additional 2,040 jobs. The largest increase (16.5 percent) was in trade and services employment, which accounted for 338 additional jobs.

While government employment remains the backbone of the Juneau area economy, providing for 43.6 percent of total employment, it has declined in relative importance during the past decade. Between 1980 and 1995, combined trade and services employment grew from 27.1 percent to 37.5 percent of total employment, while government employment decreased from 55.8 percent to 43.6 percent, based on Alaska Department of Labor (1996) statistics (see Table 3-12).

The unemployment rate for the City and Borough of Juneau was 4.5 percent in August 1996. This was slightly higher than the rate (4.4 percent) for the same period in 1995 and reflects the relatively high employment levels during the summer peak. November 1995 unemployment was 6.6 percent.

Income

Table 3-13 presents the 1995 annual payroll and average payroll for both public and private sectors. The total annual income (wages and salaries) in the Juneau area for 1995 was more than $509.3 million. In addition, the average wage for the Juneau area worker in 1995 was estimated at $32,212.

Table 3-12. Employment by Industry for City and Borough of Juneau (1980, 1990, and 1995)[a]

Industry	1980	1990	1995	Percent Change 1980 – 1995
Mining	b	75	187	n/a
Construction	375	414	629	67.7
Manufacturing	92	148	327	255.4
Transportation, Communications, and Utilities	913	911	1,072	17.4
Wholesale and Retail Trade	1,554	2,239	2,920	87.9
Finance, Insurance, & Real Estate	428	496	681	59.1
Services	1,391	2,333	3,017	116.9
Government	6,049	7,099	6,893	142
Federal [c]	1,187	1,056	908	–23.5
State	3,882	4,535	4,315	11.2
Local	980	1,508	1,671	70.5
Total Employment	10,839	13,772	15,812	45.9

a. Refers to employment in industries covered by unemployment compensation insurance.
b. Information withheld for proprietary reasons.
c. Beginning in 1993, Federal employment was corrected for overreporting of approximately 100 workers.
Source: Alaska Department of Labor, 1996; EPA, 1996.

Table 3-13. Non-Agricultural Payroll for City and Borough of Juneau (1995)

Industry	Annual Payroll ($ in thousands)	Average Annual Payroll ($)
Total Private Sector	218,840.5	24,536
Agricultural Services, Forestry, Fisheries, and Miscellaneous	NA	NA
Mining	11,815.1	63,182
Construction	22,982.9	36,539
Manufacturing	10,131.5	30,983
Transportation, Communications, and Utilities	33,672.9	31,411
Wholesale Trade	6,362.1	34,577
Retail Trade	49,508.0	18,095
Finance, Insurance, and Real Estate	20,597.3	30,246
Services	61,880.9	20,511
Unclassifiable	NA	NA
Total Public Sector	290,499.0	42,144
Federal	45,341.4	49,935
State	184,096.0	42,664
Local	61,061.6	36,542
Total Payroll	509,339.6	32,212

NA—Not available because of restrictions on disclosure of data for individual firms.
Source: Alaska Department of Labor, 1996.

Community and Public Services

The discussion of community and public services in the City and Borough of Juneau has been revised in the following areas:

- Education
- Law enforcement, fire protection, and ambulance services
- Hospital and medical services.

Education

The Juneau area has numerous public schools: five elementary schools, with an additional elementary school under construction for occupancy in school year 1997-98; two middle schools; and one high school. The official count (October 25, 1996) for total enrollment in the Juneau School District was 5,627 pupils. Six privately operated schools provide pre-school and kindergarten through eighth grade education.

Currently, enrollment at two elementary schools—Dzantik'i Heeni Middle School, and Juneau-Douglas High School—exceeds the design capacity of the permanent school facility. Portable classrooms are used to absorb some of the excess enrollment. Marie Drake Middle School, which was closed after the opening of the Dzantik'i Heeni Middle School in fall 1994, was adapted to accommodate high school enrollment in excess of Juneau-Douglas' capacity. Capital Elementary School was reopened temporarily to accommodate about 200 Harborview Elementary pupils until the new Riverbend Elementary School is completed for the 1997–98 school year. Upon completion of the new elementary school, the school district expects to be able to accommodate all elementary pupils in permanent classroom space.

Law Enforcement, Fire Protection, and Ambulance Services

Two law enforcement agencies, the Juneau Police Department and the Alaska State Troopers, serve the City and Borough of Juneau. The 45-officer Juneau Police Department is responsible for the Juneau-Douglas area and portions of the Mendenhall Valley, and three State troopers are responsible for the remainder of the borough. Five district fire stations are located in the City and Borough of Juneau. In 1995, 34 firefighters were paid and 100 were volunteers.

Certified emergency medical technicians employed by the fire department provide ambulance services in the City and Borough of Juneau. Four full-time service, radio-equipped ambulances and 34 full-time firefighters who have received advanced life support training provide emergency medical aid in the area.

Hospital and Medical Services

Juneau's health care sector includes the Bartlett Regional Hospital, St. Ann's Nursing Home, and State of Alaska Pioneers Home. The City and Borough of Juneau operate the Bartlett Regional Hospital. Since 1995, the capacity of this facility has been reduced from 64 to 55 beds. Bartlett Regional Hospital handled 13,331 emergency room visits in FY 1996; admitted 3,077 patients, including newborns; and performed 2,089 operations. St. Ann's nursing home provides 45 beds for long-term medical care for the elderly. The recently opened State of Alaska Pioneers Home provides 48 beds for elderly residents, 9 of which are dedicated to long-term nursing care.

Housing

The City and Borough of Juneau Community Development Department preliminary estimate of housing units for November 1996 was 11,523 dwelling units, including 137 live-aboard boats and 27 recreational vehicles. A total of 7,732 units (67 percent of total units) were single-family dwellings, 2,401 multifamily units (21 percent), and 1,225 mobile homes (11 percent). The 1996 average single family vacancy rate was 1.69 percent, the average multifamily vacancy rate was 3.25 percent, and the average mobile home vacancy rate was 0.96 percent. Permit applications for housing units in 1995 totaled 496 units, including 164 houses, 69 zero-lot and townhouse units, 50 duplex units, 113 3-plexes and higher, and 100 other units (e.g., residence hall). Through September 1996, the number of permit applications totaled 299, compared to 338 for the same period in 1995.

In 1996, the average (median) cost for a single family home was $194,900 for a 1,795 square foot home, $234,900 for a duplex (3,240 square feet or 1,620 square feet per unit), $149,900 for an attached (zero lot line) unit (1,173 square feet), and $158,950 for a condominium (1,420 square feet). The median price for lots for sale was $59,900. Construction costs for an average-quality home range between $100 and $110 per square foot.

Fiscal Condition

Revenues and expenditures for the City and Borough of Juneau for the current fiscal year 1997 (adopted operating budget) total $137.2 million. For considering longer term trends, expenditures during FY 1990 totaled $113.1 million, indicating a total increase of about 21 percent over the past 7 years or an annual average growth rate of 2.8 percent or an amount that barely reflected increases in inflation only.

State sources of $32.2 million in FY 1997 are an important source of revenue for the City and Borough of Juneau, representing approximately 24 percent of the total general fund revenues. Municipal taxes collected by the City and Borough of Juneau amounted to $45.3 million in FY 1997 (33 percent of total budgeted revenues). Property tax revenues and sales tax revenues, including sales, liquor sales, hotel, and tobacco excise taxes, are the major sources, generating almost equal shares at $22.8 million and $22.5 million, respectively. User fees and permits at $46.4 million in FY 1997 are the largest revenue sources, accounting for approximately 34 percent of total budgeted revenues.

Education expenditures were the single largest expense in the City and Borough of Juneau at $42.0 million, accounting for approximately 31 percent of the expenditures in FY 1997. The next highest general government expenditures were for public safety and the Bartlett Regional Hospital.

Transportation

The City and Borough of Juneau is serviced from the outside by both air and water. The Juneau International Airport and adjacent float plane lake provide support facilities for daily passenger and cargo jet services, as well as for several air taxi operators. Commercial passenger jets depart daily to Seattle, Anchorage, Fairbanks, and the larger Southeast Alaska cities. Total airport aircraft operations, which include all takeoffs and landings by commercial, general aviation, military, and local civil aircraft, reached an all-time high of 156,000 operations in 1995. Passenger arrivals on major air carriers serving Juneau also reached a new high of 246,620 passengers in 1995 (EPA, 1996).

The Alaska Marine Highway System provides mainline service among Juneau and other southeast communities between Skagway and Haines, Alaska, and Bellingham, Washington, as well as feeder service between Juneau and other southeastern ports. Three major barge lines provide Juneau with weekly Seattle freight service—Alaska Marine Lines provides biweekly service to Juneau from Seattle, and Glacier Marine and Northland Service each provide service once a week from Seattle to Juneau (CBJ Harbors, 1996; Alaska Marine Lines, 1996). In 1996, 25 cruise line vessels, carrying 451,000 passengers, made stops at Juneau, representing an increase of 44 percent over 1993 (CBJ Harbors, 1996).

3.15.4 City and Borough of Haines

The City of Haines is the largest community within the Haines Borough. The Alaska Department of Labor population estimate for July 1, 1996, was 1,400 persons for the city and 2,373 for the borough. The community of Klukwan is located north of the City of Haines on the highway, but is not in the Haines Borough.

Population/Demography

The population of Haines fluctuates on a seasonal basis due to an influx of summer transient and semi-permanent resident populations. The population then decreases with the onset of winter when some of the resident population migrates out for winter work while others travel. Peak demands on Haines community services, therefore, are in the summer months. Table 3-14 presents population trends for the Haines Borough.

Table 3-14. Population History for Haines Borough

Year	Population
1980[a]	1,680
1985[b]	2,034
1990[a]	2,117
1995[b]	2,295
1996[b]	2,373

a. U.S. Department of Commerce, Bureau of Census, 1980 and 1990 Census.
b. Alaska Department of Labor, 1996.

Employment

Total employment in the Haines Borough was estimated in 1995 at 799 on an average annual basis. Peak month (August) employment stood at 1,296. Table 3-15 provides borough-wide employment by industry for 1995.

In 1995, retail trade and government were the largest employers in the Haines Borough, providing approximately 20.5 percent and 20.0 percent of total employment, respectively, on an average annual basis. During the peak month, manufacturing accounted for 31 percent of the monthly total, with retail trade following at 18.4 percent. Transportation, communications, and utilities and services also contributed high employment shares of 18.6 percent and 17.9 percent, respectively, on an average annual basis. The Department of Labor data on employment for the Haines Borough in 1995 did not include fishing and mining employment.

The unemployment rate for the Haines Borough was 5.6 percent in August 1996. This was slightly lower than the rate (5.8 percent) for the same period in 1995 and reflects the relatively high employment levels during the summer peak. November 1995 unemployment was 13.7 percent.

Income

Table 3-16 summarizes the total and average annual payroll by industry sector for the Haines Borough in 1995. As shown in the table, manufacturing and construction with similar payroll levels are the primary contributors to payrolls in the borough economy.

Table 3-15. Employment Profile for the Haines Borough (1995)*

Employment Category	Average Annual Employment	Peak Month (August) Employment
Construction	58	82
Manufacturing	105	407
Transportation, Communications, and Utilities	149	199
Wholesale Trade	3	2
Retail Trade	164	239
Finance, Insurance, and Real Estate	17	18
Services	143	207
Government	161	142
Total Employment	799	1,296

*Refers to employment in industries covered by unemployment compensation insurance.
Source: Alaska Department of Labor, 1996.

Table 3-16. Non-Agricultural Payroll for Haines Borough (1995)

Industry	Annual Payroll ($ in thousands)	Average Annual Payroll ($)
Total Private Sector	16,628.3	26,104
Agricultural Services, Forestry, Fisheries, and Miscellaneous	NA	NA
Mining	NA	NA
Construction	4,118.8	73,487
Manufacturing	4,467.2	42.953
Transportation, Communications, and Utilities	2,915.4	19,566
Wholesale Trade	91.5	45,766
Retail Trade	2,234.5	13,708
Finance, Insurance, and Real Estate	399.2	24,947
Services	2,331.8	16,306
Unclassifiable	2,331.8	16,306
Total Public Sector	5,388.7	33,679
Federal	524.6	47,689
State	1,477.2	43,447
Local	3,386.9	29,451
Total Payroll	22,017.1	27,555

NA—Not available because of restrictions on disclosure of data for individual firms.
Source: Alaska Department of Labor, 1996.

Community and Public Services

This section revises the 1992 FEIS discussion on community and public services in the City and Borough of Haines in education and law enforcement, fire protection, and ambulance services.

Education

The Haines Borough School District provides educational services to the community for kindergarten through 12th grade. All borough school facilities in Haines are located on a 16-acre site, which includes recreational facilities and four buildings: the primary, elementary, high school, and vocational buildings. In 1996/97, total enrollment was 444 pupils.

Law Enforcement, Fire Protection, and Ambulance Services

The 10-person City of Haines Police Department is responsible for the City of Haines and two locations outside the city limits (i.e., the city-owned airport terminal and the Lutak Dock and State ferry terminal). The City of Haines volunteer fire department has a force of 50 trained firefighters, 45 of which are on-call. The Haines Fire Department also provides ambulance service. A five-person central dispatching unit handles dispatching for police, fire, and other emergency services.

Housing

According to the City of Haines October 1995 estimate of housing units, a total of 564 units included 336 single-family, 30 zero-lot, 107 multifamily, and 91 mobile homes. Vacancies ranged from 4 percent for single-family and multifamily to 1 percent for mobile homes. With an average vacancy rate of 3 percent, total occupied units amounted to 544 dwelling units. The Haines area includes extensive private land holdings. According to the Assessor's Office, 1,735 parcels are vacant in the borough. Unlike many other Southeast Alaska communities, Haines has a large inventory of vacant privately held land within a short distance of the downtown area. Much of this land is available for purchase and/or residential development.

Comparatively low-cost housing construction is available in Haines. Although residential construction costs in Juneau are more than $100 per square foot, construction costs in Haines are about $80 to $90 per square foot, depending on the quality of the building.

Fiscal Condition

Total budgeted expenditures for the Haines Borough amounted to approximately $3.1 million in FY 1997. An additional $122,300 was spent on facilities (e.g., library, museum, and Chilkat Center) from funds generated by user charges. Approximately 40 percent of borough spending was on public school operations with the balance spent on general administration, cultural facilities, debt service, and capital projects.

Transportation

Haines is one of the most accessible communities in Alaska, with scheduled air and ferry service, as well as a road link to the Alaska Highway System. The Alaska Marine Highway System provides passenger and vehicle service to Haines approximately five times per week. At present, ferry schedules and capacity to Haines are more than adequate to meet the off-season demand. During the summer, however, vehicle space is frequently booked long in advance. Based on information provided by the Alaska Marine Highway System, passenger and vehicle volumes for 1995 were as follows: passengers embarking – 41,019, passengers disembarking – 40,041, vehicles embarking – 14,478, and vehicles disembarking – 13,732.

Cruise ship activity for Haines was estimated for 1996 at 181 port calls and 94,642 passengers, based on information provided by the City of Haines. Alaska Marine Lines and Glacier Marine barges deliver general cargo weekly. The barges use the Lutak Dock.

3.15.5 City of Skagway

The combination of a deepwater port and good access to the Yukon Territory accounts for Skagway's long history as a trans-shipment center. The area does not have a borough government; however, the city is the second largest in the Skagway-Hoonah-Angoon Census Area (1996 population estimated at 900). The Alaska Department of Labor population estimate for July 1, 1996, was 767 persons for the City of Skagway and 3,816 for the census area.

Population and Demography

At the time of incorporation in 1900, Skagway had approximately 3,000 residents. By 1909, as the gold rush waned, the population was 872 and shrinking. Population has declined since the 1980 census due both to the closure of the railroad in 1982 and the statewide recession of 1986 and 1987. Table 3-17 presents population numbers for Skagway.

Employment

Government agencies do not regularly publish employment and payroll data. A limited amount of Skagway-specific data is available at the statistical sub-area level from the Alaska Department of Labor. It is worth noting, however, that only employees covered under the State's unemployment insurance system are included. Also, employment data indicate that 2 out of 10 industrial categories (i.e., mining and agriculture, forestry, and fishing) are not available because of confidentiality restrictions. Based on this source, total employment comprised 608 full- and part-time jobs in 1995. Retail trade and services had the highest relative shares at 175 and 168 jobs, respectively, representing more than 50 percent of total employment. Transportation is another important employment generator. All three sectors are involved heavily with tourism.

Unemployment figures for Skagway are combined with those of Hoonah and Angoon. The unemployment rate for the Skagway-Hoonah-Angoon Census Area was 2.9 percent in August 1996. This was slightly lower than the rate (3.6 percent) for the same period in 1995 and reflects the relatively high employment levels during the summer peak. November 1995 unemployment was 7.1 percent.

Income

The annual payroll in Skagway totaled $13.8 million in 1995, with more than 65 percent of the total earned during the second and third quarters. Table 3-18 summarizes the total and average annual payroll by industry sector for Skagway in 1995. As shown in the table, services; retail trade; and transportation, communications, and public utilities are the primary contributors to payrolls in the area economy.

Table 3-17. Population History for City of Skagway

Year	Population
1980[a]	814
1990[a]	692
1995[b]	771
1996[b]	767

a. U.S. Department of Commerce, Bureau of Census, 1980 and 1990.
b. Alaska Department of Labor, 1996.

Table 3-18. Non-Agricultural Payroll for City of Skagway (1995)

Industry	Annual Payroll ($ in thousands)	Average Annual Payroll ($)
Total Private Sector	9,784.8	21,274
Agricultural Services, Forestry, Fisheries, and Miscellaneous	NA	NA
Mining	NA	NA
Construction	1,061.9	36,618
Manufacturing	456.5	32,608
Transportation, Communications, and Utilities	2,185.3	34,144
Wholesale Trade	26.9	26.9
Retail Trade	2,684.2	15,338
Finance, Insurance, and Real Estate	146.9	20,985
Services	3,219.3	19,162
Unclassifiable	3.8	3,820
Total Public Sector	4,026.3	27,390
Federal	1,774.6	31,133
State	486.2	40,515
Local	1,765.5	22,635
Total Payroll	13,811,099	22,715

NA—Not available because of restrictions on disclosure of data for individual firms.
Source: Alaska Department of Labor, 1996.

Community and Public Services

The discussion of law enforcement, fire protection, and ambulance services is the only section of community and public services in the City of Skagway revised since publication of the 1992 FEIS.

Law Enforcement, Fire Protection, and Ambulance Services

The Skagway Police Department provides public safety for a 433 square-mile area with four full-time officers (one Chief and 3 officers). According to the Skagway Comprehensive Plan (City of Skagway, 1988), the Police Department does not have sufficient administrative space and holding facilities. Skagway does not have any State troopers.

The Skagway Volunteer Fire Department provides fire suppression and emergency medical response. The department has 1 paid employee, 30 volunteer firefighters, and about 10 volunteer emergency medical technicians. The department has one ambulance; another will be added in early 1997. Although the department is capable of meeting residential demands for fire suppression services, it is not equipped sufficiently to meet commercial and industrial demands, according to the Skagway Comprehensive Plan (City of Skagway, 1988), and is understaffed during the summer tourist season.

Housing

The U.S. Bureau of the Census counted 404 housing units in Skagway in 1990, 285 of which were occupied. The vacancy rates for homeowners and renters were 8.3 percent and 15.5 percent, respectively, at the time the census was taken (April 1, 1990).

Fiscal Condition

The City of Skagway fiscal year 1997 general fund budget amounts to just more than $1.5 million. In addition to the general fund, there are funds for garbage, water, port enterprise, special sales tax, debt service, tourism, and land sale. The city also collects a sales tax and a property tax. The city provides education and public safety services, water, sewer, solid waste disposal, and a variety of other services to local residents and visitors.

Transportation

The Klondike Highway, which links Skagway to the Alaska Highway System, was opened to year-round traffic in 1986. It provides road access for trucks carrying approximately 500,000 tons of lead/zinc concentrate annually from the Faro Mine in Yukon Territory. The highway also has made Skagway more accessible to travelers. According to the Alaska Visitor Statistics Program, about 79,000 arrived in Skagway via this highway in summer 1995 (The McDowell Group, 1995).

Skagway is the northern terminus of the Alaska Marine Highway System. The ferry provides service year-round, with daily stops in the summer and five stops weekly in the winter. Passenger and vehicle traffic on the ferry has increased considerably since the Klondike Highway was opened for year-round use. Based on information provided by the Alaska Marine Highway System, passenger and vehicle volumes for 1995 were as follows: passengers embarking – 38,899, passengers disembarking – 40,569, vehicles embarking – 8,950, and vehicles disembarking – 9,466.

Based on information provided by the Cruise Lines Agency of Alaska in Ketchikan, 19 cruise ships carried 284,000 passengers to Skagway in 1996. Alaska Marine Lines and Glacier Marine provide weekly scheduled barge service to Skagway from Seattle, the city's principal supply center. Skagway also has a community airport with charter service provided by various carriers.

3.16 SUBSISTENCE

The discussion on subsistence has not been revised. Page 3-107 of the 1992 FEIS provides a complete discussion.

3.17 LAND USE

The discussion on land use has not been revised. Page 3-109 of the 1992 FEIS provides a complete discussion.

3.18 NOISE

The discussion on noise has not been revised. Page 3-110 of the 1992 FEIS provides a complete discussion.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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4. ENVIRONMENTAL CONSEQUENCES

This chapter presents the results of analyses of the potential impacts from the four alternatives on each resource discussed in Chapter 3. The scope and level of detail devoted to impact analysis for the different resources are a function of the scoping process and identification of significant issues for this Final Supplemental Environmental Impact Statement (SEIS).

Alternative A is the No Action Alternative and represents the project components of Alternative F, Water Treatment Option 1, as selected in the January 29, 1992, Forest Service Record of Decision (ROD) with modifications that address the requirements of the *Kensington Gold Mine Project*, *Technical Assistance Report* (TAR) (EPA, 1994). U.S. Environmental Protection Agency (EPA) Region 10 prepared the TAR for the U.S. Army Corps of Engineers (Corps of Engineers), Alaska District. Alternative B is the Proposed Action, and Alternatives C and D are modifications to the Proposed Action based on issues identified during the scoping process.

In accordance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) regulations, Chapter 4 describes the direct, indirect, and cumulative impacts, as well as irreversible or irretrievable commitment of resources, for Alternatives B through D. Alternative A was analyzed in detail in the 1992 Final Environmental Impact Statement (FEIS) (USFS, 1992). For the purposes of providing continuity to the analysis and for comparison of alternatives, however, this chapter also summarizes the potential impacts associated with Alternative A. Estimates of cumulative impacts are based on the local geographic area and assume a 16-year life for Alternative A and 14-year life for Alternatives B through D. Projects considered to be reasonably foreseeable in terms of cumulative impact assessment are the Lace River Hydroelectric Project, the Juneau Access Road, the Echo Cove development, and the Jualin Mine.

This chapter also describes proposed mitigation measures and best management practices (BMPs) that the operator would employ to minimize potential impacts to environmental resources. Where appropriate, these measures are discussed with the descriptions and analyses of potential impacts for each alternative.

Chapter Organization

This chapter is organized to facilitate comparison of the potential impacts to the environmental resources from the four alternatives and to minimize redundancy caused by common aspects among alternatives. Sections 4.1 through 4.13 begin by identifying the indicators used to evaluate the potential impacts from each alternative. (Table 4-1 also presents the indicators, as well as issues, used to analyze the potential impacts.) Each section then describes any potential impacts common to all alternatives. Next, each section summarizes potential impacts of Alternative A; the 1992 FEIS provides a detailed discussion. The section then discusses any potential impacts common to Alternatives B through D, followed by descriptions specific to Alternatives B through D. Section 4.14 presents potential cumulative

Table 4-1. Issues and Indicators by Resource

Resource	Issue	Indicators
Air Quality	• Use of diesel fuel instead of liquefied petroleum gas (LPG) for power generation could result in increased air emissions and carbon dioxide.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Emissions and compliance with State and Federal standards and PSD increments • Visual impacts from emissions
Geotechnical Considerations	• The potential for and effects of failure of the dry tailings facility (DTF) should be considered.*	• Risk and consequences of tailings storage facility failure
Surface Water Hydrology	• The cumulative impacts with other projects in Berners Bay should be considered. • The potential for reduction in fish habitat due to water withdrawal should be considered.	• Changes in stream flow regimes • Physical changes in locations and length of stream segments
Surface Water Quality	• Assurances should be given that the discharges under the NPDES permit meet water quality standards.* • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The potential for and effects of DTF failure should be considered.* • The potential for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, personnel camp, snow disposal areas, and diversion ditches should be considered. Riparian areas need to be maintained to minimize sediment input to fresh water.	• Increased sediment in stream beds • Projected effluent quality compared to NPDES permit limits • Risk and consequences of accidents and spills
Ground Water Hydrology and Water Quality	• Assurances should be given that the discharges under the NPDES permit meet water quality standards.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Changes in ground water hydrology • Changes in ground water quality
Aquatic Resources – Marine	• The potential for and effects of DTF failure should be considered.* • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Water quality • Sedimentation • Habitat integrity
Aquatic Resources – Fresh	• Assurances should be given that the discharges under the NPDES permit meet water quality standards.* • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The potential for and effects of DTF failure should be considered.* • The potential for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, personnel camp, snow disposal areas, and diversion ditches should be considered. Riparian areas need to be maintained to minimize sediment input to fresh water. • The potential for reduction in fish habitat due to water withdrawal.	• Habitat integrity • Water withdrawal • Water quality • Sedimentation

*Identified as a significant issue during the scoping process.

Table 4-1. Issues and Indicators by Resource (continued)

Resource	Issue	Indicators
Soils, Vegetation, and Wetlands	• The potential for and effects of DTF failure should be considered.* • The cumulative impacts with other projects in Berners Bay should be considered. • The potential for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, personnel camp, snow disposal areas, and diversion ditches should be considered. Riparian areas need to be maintained to minimize sediment input to fresh water. • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.*	• Extent of vegetation disturbed • Net loss of wetlands
Visual Resources	• The visual effects on tourism, especially on cruise ships and ferries, of the proposed changes should be minimized.*	• Compliance and conformance with visual quality objectives
Socioeconomics	• The socioeconomic evaluation of the 1992 FEIS should be updated. • The cumulative impacts with other projects in Berners Bay should be considered.	• Changes in population, employment, housing, health and social services, public safety, public utilities, revenues, and expenditures
Transportation	• The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Risk and consequences of accidents and spills

*Identified as a significant issue during the scoping process.

effects, Section 4.15 describes the effects of short-term uses on long-term productivity, and Section 4.16 summarizes irreversible and irretrievable commitment of resources.

4.1 AIR QUALITY

This section discusses the potential impacts of atmospheric emissions from the four project alternatives on air quality and visibility. Section 4.1 explains air pollutant sources and activities associated with each alternative and quantifies the expected emission rates for air pollutants. The potential environmental impacts caused by each alternative are discussed according to the following indicators:

- Emissions and compliance with State and Federal standards, as well as compliance with prevention of significant deterioration (PSD) increments
- Visual impacts associated with emissions.

Section 4.10 discusses the potential impacts to visual resources from other sources.

4.1.1 Effects of Alternative A (No Action)

Emissions and PSD Increments

This section discusses the potential impacts from emissions, including carbon dioxide, as well as relevant PSD increments, during construction and production activities.

Construction Activity

The potential impacts to air quality are discussed on pages 4-1 through 4-9 of the 1992 FEIS.

Production Activity

Pollutant emissions during the operational phase of the Kensington Gold Project would be greater than during construction. During operation, primary pollutant emission sources associated with Alternative A would include the following:

- Mining sources (emissions from underground operations and ore handling and storage)
- Access road (vehicle emissions and dust)
- Tailings structure (dust from wind erosion)
- Powerplant (emissions from liquefied petroleum gas [LPG] turbines)
- Borrow pits and screening plant (vehicle emissions and dust from wind erosion).

This section discusses analyses conducted to estimate anticipated air quality impacts. This section also describes other factors, including proximity of public access, source configuration, and meteorology, that could affect the expected ambient pollutant concentrations. Pollutant emission rates were computed using standard equations (TRC, 1995; TRC, 1990). Total suspended particulate (TSP) emissions from the tailings facility were calculated from the structures at maximum size.

A complete inventory was calculated for all emission sources from Alternative A. The primary pollutants from the emission inventory are oxides of nitrogen (NO_X), sulfur dioxide (SO_2), and particulate matter (PM_{10}), with smaller amounts of carbon monoxide (CO) and volatile organic carbons (VOC). Table 4-2 presents emissions predicted for Alternative A.

Table 4-2. Predicted Emissions (production phase) From Alternative A (tons/year)

Emission Type	TSP	PM_{10}	NO_X	SO_2	CO	VOC	Pb
Point	1.58	1.09	138.85	0.22	47.48	6.77	8.15e-06
Fugitive	31.72	22.51	76.61	12.06	64.74	7.26	2.16e-05
Total	33.30	23.60	215.46	12.28	112.22	14.03	2.98e-05

EPA and Alaska Department of Environmental Conservation (ADEC) policy require Alaska ambient air standards and PSD increments to be met at the property boundary of the facility. Ambient air quality impacts for Alternative A were calculated using EPA's COMPLEX1 and Industrial Source Complex models. Modeling for this alternative was performed for the original air quality permit (TRC, 1991). Background concentrations were added to the modeled concentrations to obtain the ambient air quality impact from the facility. This impact was compared to EPA and ADEC ambient air quality standards. Table 4-3 provides the calculated impacts from Alternative A and the corresponding Federal and State standards for each pollutant. As shown, no modeled pollutant concentration is greater than the Federal or State standards for ambient air quality.

EPA and the State of Alaska PSD guidelines do not consider the Kensington Gold Project to be a major facility and, therefore, a PSD analysis is not required. For informational purposes, a PSD increment was added to the Draft SEIS to show that no significant impacts are expected from the mining operation. Table 4-4 presents the results of this analysis. Because incremental analyses are only performed on pollutants with stack emissions greater than 40 tons per year, only nitrogen dioxide (NO_2) and SO_2 were modeled. The values for this analysis are taken from Table 3 of the executive summary of the *Project Report: Air Quality Permit Modification, Kensington Project* (TRC, 1995). All predicted concentrations are well below the PSD increment levels for all modeled pollutants.

Table 4-3. Comparison of Modeled Pollutant Concentrations (production phase) With Ambient Air Quality Standards (including background) for Alternative A

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m^3)	EPA Standard (μg/m^3)*
Nitrogen Dioxide	Annual	12.4	100
Carbon Monoxide	1-hour	2544.2	40,000
	8-hour	394.8	10,000
Particulate Matter	24-hour	57.7	150
	Annual	25.2	50
Sulfur Dioxide	3-hour	156.8	1,300
	24-hour	24.5	365
	Annual	1.5	80

*EPA standards are the same as ADEC standards.

Table 4-4. Comparison of Modeled Pollutant Concentrations (production phase) With PSD Class II Increments for Alternative A

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m^3)	PSD Increment (μg/m^3)
Nitrogen Dioxide	Annual	8.4	25
Sulfur Dioxide	3-hour	156.8	512
	24-hour	24.5	91
	Annual	1.5	20

All fossil fuel-burning equipment has large emissions of carbon dioxide. Most of the carbon dioxide produced by the Kensington Gold Project under all alternatives would result from the power generation units. Alternative electrical generation systems, including hydroelectric, nuclear, and solar power, do not burn fossil fuel. For the small scale and location of the Kensington Gold Project, none of these alternatives is feasible.

Carbon dioxide emissions from power generation for all alternatives were estimated using EPA-published emission factors (EPA, 1995). Alternative A would use five 3.5-megawatt (MW) LPG turbines to produce the electricity for the mine (only three would run simultaneously). Alternative A would produce hourly and annual carbon dioxide emissions of approximately 6 and 55,000 tons, respectively.

Visual Quality

Modeling was not performed to evaluate the potential effects that emissions would have on visual quality under Alternative A. Modeling was conducted for Alternative B, however, which is the worst-case scenario for emissions across all alternatives. Section 4.1.2 discusses the modeling results.

4.1.2 Effects Common to Alternatives B through D

Emissions and PSD Increments

This section discusses the potential impacts from emissions, as well as relevant PSD increments, during construction and operating activities.

Construction Activity

Construction-related pollutant emissions during the pre-production phase for Alternatives B through D would not exceed 9 tons of particulates per year (TRC, 1990). Alternative A is also not expected to exceed this level. The emission levels would essentially be the same for each alternative during the construction period. For every alternative, the total disturbed surface area subject to wind erosion would be approximately 50 acres, and the exposure time would be less than 1 year. Once grading was completed, foundations would be poured and exposed areas stabilized.

Diesel generators would be used as a temporary power supply during the construction phase. Modeling indicates that National Ambient Air Quality Standards would not be exceeded in the area around the project boundary (Richins, 1991). As shown in Table 4-5, applicable PSD increments would not be exceeded.

Slash burning during the construction phase would cause smoke emissions. The burning would be limited to the construction months and would be confined to small, controlled areas to ensure fire safety. Slash burning would have to comply with open burning regulations imposed by ADEC to reduce airborne pollutants.

Table 4-5. Comparison of Modeled Pollutant Concentrations (construction activity) With PSD Class II Increments for Alternatives B Through D

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m^3)	PSD Increment (μg/m^3)
Nitrogen Dioxide	Annual	11.8	25
Sulfur Dioxide	3-hour	141.4	512
	24-hour	22.5	91
	Annual	1.1	20

Production Activity

The pollutant emissions during the operational phase of the Kensington Gold Project would be greater than during construction. During operation, primary pollutant emission sources common to Alternatives B through D would include the following:

- Mining sources (emissions from underground operations and ore handling and storage)
- Haul road (vehicle, including haul truck, emissions and dust)
- Tailings structure (dust from wind erosion)
- Powerplant (emissions from diesel generators)
- Borrow pits and screening plant (vehicle emissions and dust from wind erosion).

Sections 4.1.3 through 4.1.5 discuss the analyses, except for carbon dioxide, used to estimate the anticipated air quality impacts for Alternatives B through D, respectively. The sections also describe other factors, including proximity of public access, source configuration, and meteorology, that could affect the expected ambient pollutant concentrations. Pollutant emission rates were computed using standard equations (TRC, 1995; TRC, 1990). TSP emissions from the tailings facility were calculated from the structures at maximum size.

Alternatives B through D would use four 3.3-MW diesel generators. Three generators would operate at the same time, and one would be used as a backup. Alternatives B through D each would require a total electricity load estimated at 68,400,000 kilowatt (kW) per hour per year (Coeur, 1995). Using EPA-published emissions factors (EPA, 1995), Alternatives B through D would produce hourly and annual carbon dioxide emissions of approximately 8 and 67,000 tons, respectively.

Visual Quality

The potential impacts that emissions would have on visual quality were modeled using the worst-case scenario, Alternative B.

Air pollutant emissions can impair visibility and obscure visually significant features and areas from viewers. Tour ships using Lynn Canal have views of unbroken shorelines, backed by forested foothills and steep, rocky, and snow-capped peaks. Emissions of nitrogen oxides and particulate matter could reduce visual site distances due to light scattering from pollutants in an emitted plume. The screening model VISCREEN was used to determine whether emissions of NO_2 and particulate matter from activities at the Kensington Gold Project would impair visibility from Lynn Canal.

VISCREEN is designed to calculate visual effects parameters for a plume as observed from a given vantage point. The calculated parameters are then compared to screening criteria. This model is a conservative screening tool used by EPA in determining adverse visual impacts to Class I areas.

Class I areas are areas required by EPA and States to remain in a pristine and unspoiled state. Examples of Class I areas include some designated national parks and wilderness areas. Very rigid requirements are imposed on facilities that operate near Class I areas. The nearest Class I area to the Kensington Gold Project is Denali National Park. The Class I requirements were used to show that emissions from the mine and its facilities would have very little visual impact on the surrounding area.

VISCREEN was used to show the visual effects of emissions from the operation of the mine. The screening modeling was specifically applied to study visual impacts of the mine on views of the shoreline from tour ships. The observer in the modeling scenario was placed in the center of Lynn Canal looking toward the shore and the Kensington site. Point emissions of NO_X and particulate matter were modeled using stable Class F meteorological conditions with an average windspeed of 1.93 meters per second. The meteorological conditions were taken from the air quality permit modification. Table 4-6 presents the parameters used for the modeling.

For plume visibility, two variables are used to determine if the plume is perceptible to the human eye: Delta-E and plume contrast. Delta-E is used to specify the perceived magnitude of color and brightness change between the plume and the background. A plume may also be visible if it contrasts with the sky or terrain. A negative contrast indicates that the plume is darker than the background, while a positive contrast means the plume is lighter than the background. Visibility research has determined that the threshold for plume perceptibility is a Delta-E of 1.0 and a contrast of 0.02. The plume visual impact screening model VISCREEN is

Table 4-6. Input Parameters to the VISCREEN Model

Parameter	Value
NO_X Emissions (tpy)	220.58
Particulate Emissions (tpy)	32.02
Background Visual Range (km)	40
Source-Observer Distance (km)	9.8
Minimum Source Class I Distance (km)	1.8
Maximum Source Class I Distance (km)	9.8
Stability Class	F
Wind Speed (m/sec)	1.93

designed to ascertain whether the plume from a facility has the potential to be perceptible to untrained observers under reasonable worst-case conditions. VISCREEN uses screening criteria of Delta-E greater than 2.0 and a plume contrast of 0.05. The values given from the visibility screening performed for the Kensington site show that the plume is barely perceptible and below the given screening limits.

The VISCREEN results show no significant deterioration of visual quality when looking from Lynn Canal toward the mine. Table 4-7 provides the maximum visual impacts and the corresponding Class I screening criteria. Comparison of the predicted impacts with the Forest Service visual quality objectives (VQOs) indicates that these impacts would be consistent with the objectives. Using default worst-case assumptions, the model predicted a slight impact from some plume visibility. Any visual impacts would be mitigated by the climactic conditions (e.g., wind, fog) in the area. The plume would be comparable to a plume generated by the diesel-powered generating backup facility in Juneau, as well as by a cruise vessel traveling along Lynn Canal. The plume would also be similar to the plume from the LPG-fired generators under Alternative A.

4.1.3 Effects of Alternative B (Proposed Action)

Emissions and PSD Increments

Under Alternative B, tailings would be carried by truck to the dry tailings facility (DTF).

Production Activity

Air emissions from Alternative B would be greater than Alternative A for NO_X, SO_2, CO, and PM_{10} primarily because of increased emissions from the powerplant and the increase in fugitive dust emissions from increased borrow, waste rock, and tailings haulage. Table 4-8 presents predicted emissions from Alternative B.

Table 4-7. Maximum Visual Impacts

	Delta E		Contrast	
Background	**Criteria**	**Plume**	**Criteria**	**Plume**
Sky	2.00	1.44	0.05	-0.024
Terrain	2.00	1.07	0.05	0.022

Table 4-8. Predicted Emissions (production activity) From Alternative B (tons/year)

Emission Type	TSP	PM_{10}	NO_X	SO_2	CO	VOC	Pb
Point Sources	30.73	29.85	244.82	156.12	37.03	29.45	4.40e-06
Fugitive Sources	128.27	73.25	367.60	36.11	156.88	29.60	3.04e-06
Total	159.00	103.10	612.42	192.23	193.91	59.05	7.44e-06

Alternative B was modeled for the Air Quality Permit Modification (TRC, 1996; TRC, 1995). Table 4-9 compares modeled concentrations and pollutant background values with Federal and State ambient air quality standards. Table 4-10 compares modeled concentrations of NO_2, SO_2, and PM_{10} to PSD Class II increment levels. Air quality dispersion modeling shows that the emissions from Alternative B are well below both Federal and State ambient air quality standards and PSD Class II increments.

4.1.4 Effects of Alternative C (Marine Discharge)

The emissions and PSD increments under Alternative C would be the same as those under Alternative B.

4.1.5 Effects of Alternative D (Modified DTF Design)

Emissions and PSD Increments

Production Activity

The emissions from Alternative D were not modeled. Predicted emissions from this alternative would be less than from Alternatives B and C due to the reduction of fugitive dust

Table 4-9. Comparison of Modeled Pollutant Concentrations (production activity) With Ambient Air Quality Standards (including background) for Alternative B

Pollutant	Averaging Period	Max. Predicted Concentration (μg/m^3)	EPA/ADEC Air Quality Standard (μg/m^3)
Nitrogen Dioxide	Annual	20.77	100
Carbon Monoxide	1-hour	365.17	40,000
	8-hour	99.15	10,000
Particulate Matter	24-hour	65.79	150
	Annual	25.39	50
Sulfur Dioxide	3-hour	325.84	1300
	24-hour	115.22	365
	Annual	4.93	80

Table 4-10. Comparison of Modeled Pollutant Concentrations (production activity) With PSD Class II Increments for Alternative B

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m^3)	PSD Increment (μg/m^3)
Nitrogen Dioxide	Annual	16.77	25
Sulfur Dioxide	3-hour	153.84	512
	24-hour	42.22	91
	Annual	4.93	20
Particulate Matter	24-hour	25.79	30
	Annual	3.39	17

emissions from the road and stack emissions from the haul trucks as a result of the pipeline. As noted in Chapter 2, Alternative D would not require an additional generator at the DTF. Power for dewatering facilities at the DTF would be supplied via underground lines from the same process area generators as Alternatives B and C. Table 4-11 shows the predicted emissions from Alternative D. Tables 4-9 and 4-10, presented previously, show modeled impacts for Alternatives B and C. The potential impacts from Alternative D would be less than the values for Alternatives B and C and, therefore, would be well below both the National Ambient Air Quality Standards and PSD Class II increments.

4.1.6 Summary

Tables 4-12 through 4-15 summarize the predicted impacts on air quality under each alternative. Predicted impacts for all alternatives are below Federal and State standards. Table 4-12 summarizes predicted emissions of pollutants from each alternative. Alternative A has the lowest total predicted emissions. Table 4-13 summarizes the predicted impacts of each alternative in comparison to Federal and State standards. None of the projected emissions from any alternative exceeds these standards. Except for CO, Alternative A results in the least impact. Values for Alternatives B through and D are depicted as equal, although Alternative D is expected to produce lower pollutant levels due to decreased vehicle traffic. Table 4-14 summarizes the predicted impacts during the construction phase compared to PSD Class II increments. Pollutant concentrations, which are assumed to be the same for all alternatives during construction, fall below the PSD Class II increments. Table 4-15 summarizes the predicted impacts during construction activity compared to PSD Class II increments. All concentrations fall below the PSD Class II increments. Pollutant concentrations would be the least for Alternative A, except for 3-hour SO_2 concentrations. PM_{10} concentrations were not modeled for Alternative A. Alternatives B through D are depicted as equal, although Alternative D is expected to produce decreased pollutant concentrations due to decreased vehicle traffic.

4.2 GEOTECHNICAL CONSIDERATIONS

4.2.1 Effects Common to All Alternatives

The 1992 FEIS presents a geotechnical analysis of all project components under Alternative F, Option 1, including a worst-case scenario for a failure of the tailings dam. This analysis would be the same for all alternatives considered in this Final SEIS, except for tailings management and avalanche hazard. This section describes the avalanche potential under each

Table 4-11. Predicted Emissions (production activity) From Alternative D (tons/year)

Emission Type	TSP	PM_{10}	NO_X	SO_2	CO	VOC	Pb
Point Sources	30.59	29.79	244.82	156.12	37.03	29.45	3.00e-06
Fugitive Sources	77.58	50.44	358.87	35.17	154.44	29.20	3.04e-06
Total	108.17	80.23	603.70	191.29	191.47	58.65	6.04e-06

Table 4-12. Predicted Emissions by Alternative (tons/year)

Source	Alternative A			Alternative B			Alternative C			Alternative D		
	Point	Fugitive	Total	Point	Fugitive	Total	Point	Fugitive	Total	Point	Fugitive	Total
TSP	1.58	31.72	33.30	30.73	128.27	159.00	30.73	128.27	159.00	30.59	77.58	108.17
PM_{10}	1.09	22.51	23.60	29.85	73.25	103.10	29.85	73.25	103.10	29.79	50.44	80.23
NO_X	138.85	76.61	215.46	244.82	367.60	612.42	244.82	367.60	612.42	244.82	358.87	603.70
SO_2	0.22	12.06	12.28	156.12	36.11	192.23	156.12	36.11	192.23	156.12	35.17	191.29
CO	47.48	64.74	112.22	37.03	156.88	193.91	37.03	156.88	193.91	37.03	154.44	191.47
VOC	6.77	7.26	14.03	29.45	29.60	59.05	29.45	29.60	59.05	29.45	29.20	58.65
Pb	8.15E-06	2.16E-05	2.98E-05	4.40E-06	3.04E-06	7.44E-06	4.40E-06	3.04E-06	7.44E-06	3.00E-06	3.04E-06	6.04E-06

Table 4-13. Comparison of Modeled Pollutant Concentrations (production activity) With Ambient Air Quality Standards (including background) by Alternative[a]

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m³) Alternative A	Alternative B	Alternative C[b]	Alternative D	EPA Standard (μg/m³)[c]
NO_2	Annual	12.4	20.8	20.8	20.8	100
CO	1-hour	2,544.2	365.2	365.2	365.2	40,000
	8-hour	394.8	99.2	99.2	99.2	10,000
PM_{10}	24-hour	57.7[d]	65.8	65.8	65.8	150
	Annual	25.2[d]	25.4	25.4	25.4	50
SO_2	3-hour	156.8	325.8	325.8	325.8	1,300
	24-hour	24.5	115.2	115.2	115.2	365
	Annual	1.5	4.9	4.9	4.9	80

a. For comparison to National Ambient Air Quality Standards, background concentrations are included in the results.
b. Values calculated for Alternative B are used for Alternative C, because Alternative C would be the same as Alternative B from an emissions perspective. Alternative D was not modeled.
c. ADEC standards are the same as EPA standards.
d. Values for Alternative A are based on particulate matter rather than PM_{10}.

Table 4-14. Comparison of Modeled Pollutant Concentrations (construction activity) With PSD Class II Increments for All Alternatives

Pollutant	Averaging Period	Max. Predicted Concentration (μg/m³) Alternatives A, B, C	PSD Increment (μg/m³)
NO_2	Annual	11.8	25
SO_2	3-hour	141.4	512
	24-hour	22.5	91
	Annual	1.1	20

Table 4-15. Comparison of Modeled Pollutant Concentrations (production activity) With PSD Class II Increments by Alternative[a]

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m³) Alternative A	Alternative B	Alternative C[b]	Alternative D	PSD Increment (μg/m³)
NO_2	Annual	8.36	16.77	16.77	16.77	25
PM_{10}	24-hour	57.7[c]	25.79	25.79	25.79	30
	Annual	25.2[c]	3.39	3.39	3.39	17
SO_2	3-hour	156.8	153.84	153.84	153.84	512
	24-hour	24.5	42.22	42.22	42.22	91
	Annual	1.5	4.93	4.93	4.93	20

a. PSD increments represent the allowable incremental increase in pollutant concentration; they do not include background concentrations.
b. Values calculated for Alternative B are used for Alternative C, because Alternative C would be the same as Alternative B from an emissions perspective. Alternative D was not modeled.
c. Values for Alternative A are based on particulate matter rather than PM_{10}.

alternative and discusses the risk and potential consequences of a failure from the tailings impoundment (Alternative A) or from the DTF (Alternatives B through D) as an indicator of differences among the alternatives.

4.2.2 Effects of Alternative A (No Action)

Avalanche Hazard

Figure 4-1 shows the avalanche hazard potentials outlined by Fesler and Fredston (1994) with the facility layout that would occur under Alternative A. This figure shows that the potential exists for avalanches to reach the Ophir Creek diversion and, possibly, the tailings pond. Debris and snow from an avalanche could cause temporary blocking of the Ophir Creek diversion, creating flooding. Blocked stream flows in the diversion channel could route to the tailings pond, decreasing contingent storage capacity. In response to issues identified in the TAR, the operator proposed the development of debris and avalanche catch basins (see Figure 4-1) to mitigate potential blocking of the diversion and to prevent avalanches from reaching the tailings pond directly. The operator would have response equipment, including bulldozers and front-end loaders, should catch basins become overtopped (Coeur, 1997). The operator has indicated that appropriate measures would be employed to ensure worker safety. These measures could include limiting or minimizing access to the slide area, not operating removal equipment during times and temperatures that slides normally occur, and requiring continuous radio contact with personnel operating within the slide area.

Tailings Disposal

Pages 4-9 through 4-13 of the 1992 FEIS present a worst-case failure analysis for the Sherman Creek tailings impoundment. This analysis includes two dam failure scenarios: failure under seismic loading and water cutting through the embankment. The 1992 FEIS indicates that both types of dam failure are highly unlikely. The 1992 FEIS specifically cites centerline construction methods as very stable under high seismic loads. This conclusion is supported by extensive experience with similar types of dams at other mines.

4.2.3 Effects Common to Alternatives B Through D

Avalanche Hazard

Figure 4-2 presents the avalanche hazard potentials outlined by Fesler and Fredston (1994) with the common proposed facility layout for Alternatives B through D. Although small runs would have no effect on facilities, this figure shows that portions of Ophir Creek (and the Ophir Creek diversion) exist within a high avalanche hazard area. Ophir Creek could be affected by debris flows, sediment, or snow. The storm water catchment diversion above the mine would traverse areas with moderate potential for avalanches. As discussed for Alternative A, the operator has committed to having equipment available and mitigation measures in place to

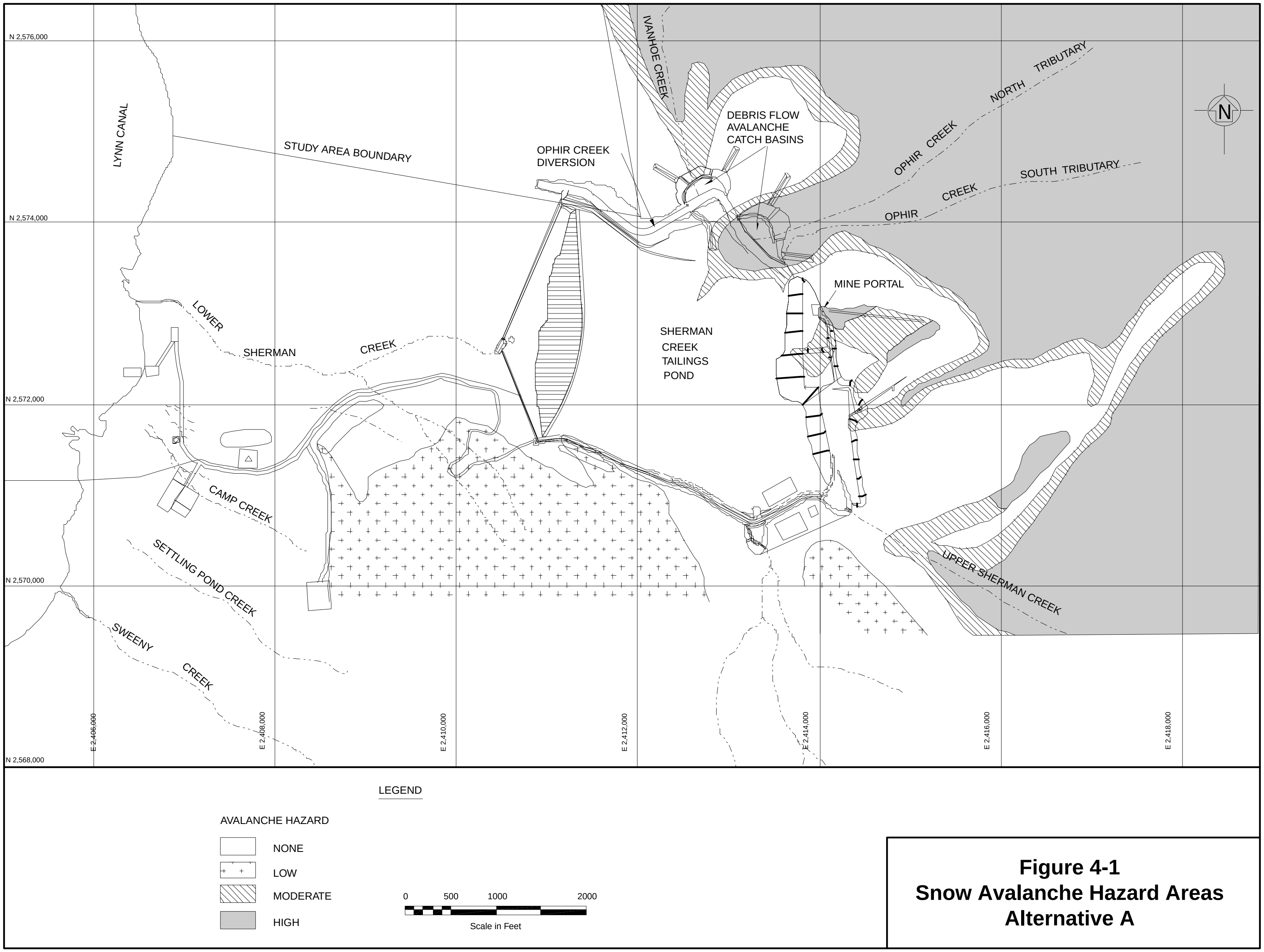

Figure 4-1
Snow Avalanche Hazard Areas
Alternative A

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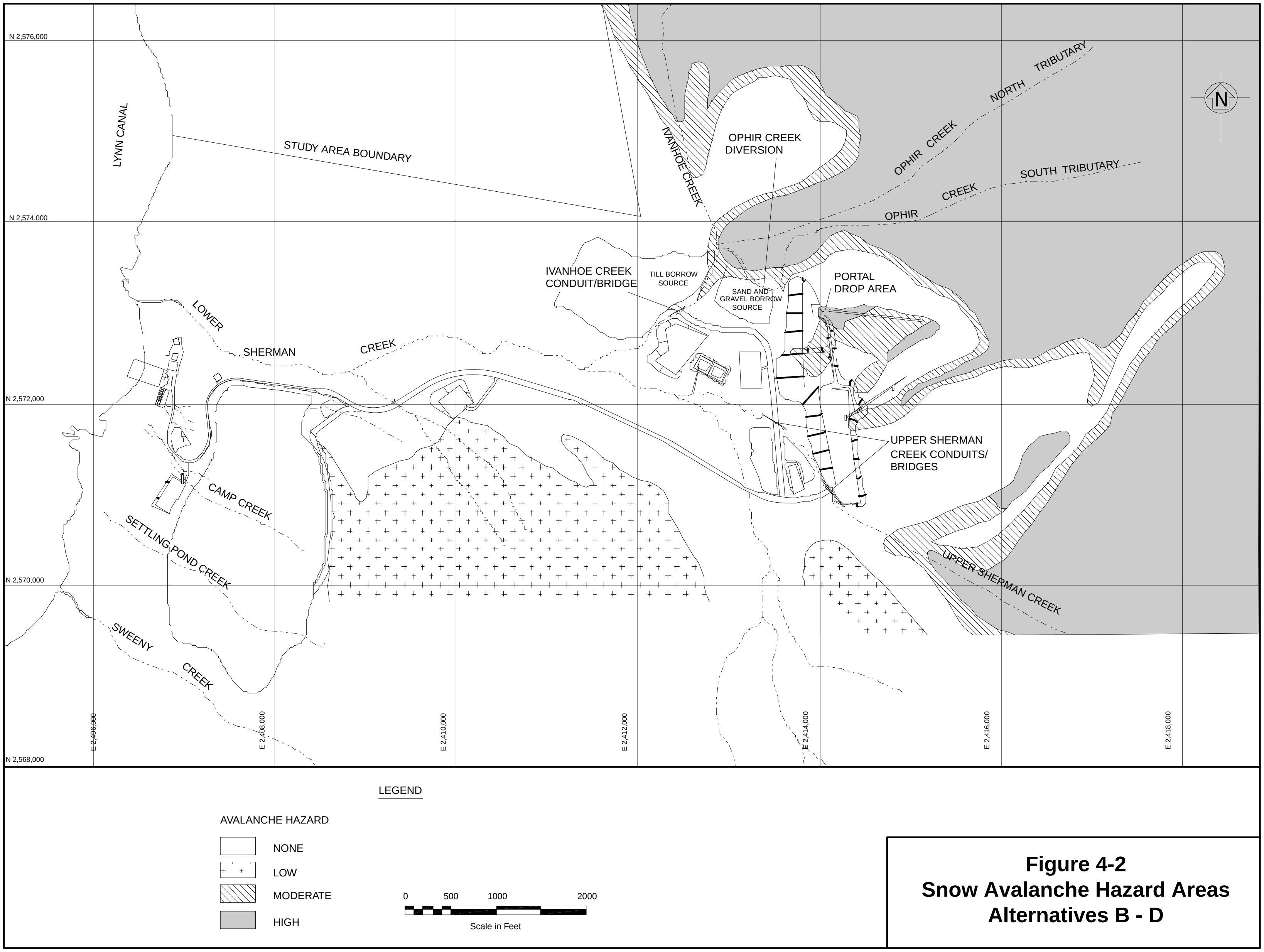


Figure 4-2
Snow Avalanche Hazard Areas
Alternatives B - D

0214D-4.2

remove debris or snow from the diversion channel or from the storm water catchment channel and to employ appropriate measures to ensure worker safety. In addition, an avalanche shed would be constructed above the 800-foot adit to divert snow and debris away from the adit.

Tailings Disposal

Under Alternatives B through D, tailings would be placed in the DTF in a loose, sandy-silty condition. Because of high precipitation conditions at the project site, portions of the pile could become saturated and not drain. This could lead to a failure of the DTF slopes. The failure could occur during active construction or as a result of an earthquake over the long term. The extent of the environmental consequences associated with a specific failure is difficult to project and would depend on the failure mechanism, location, and magnitude. One worst-case failure scenario would be a flattening of the slope of the fully constructed pile that could reach Lynn Canal and Sherman and Sweeny Creeks. The maximum extent of such a failure could cause direct tailings loadings to Sherman and Sweeny Creeks, visual impacts in Lynn Canal, loss of wetlands and vegetation, and a long-term source of further tailings loadings to marine and fresh water until mitigation. Another scenario involves a less extensive upgradient slope failure that could affect the performance of the diversion system and lead to greater saturation, as well as ongoing further degradation of the pile.

Sections 4.2.4 through 4.2.6 discuss the potential effects specific to Alternatives B through D, respectively.

4.2.4 Effects of Alternative B (Proposed Action)

Under Alternative B, drainage systems would be installed at the base of and within the DTF. Intermediate barriers and final cover materials would be used to limit infiltration. The basic design does not include any structural controls to enhance stability. The limited area of compaction along the outer shell is intended only to provide a working surface for reclamation. Alternative B provides for construction of a contingency berm in case ongoing monitoring indicated areas of saturation within the DTF. The berm would be similar to that constructed under Alternative D. As discussed in the *Technical Resource Document for Geotechnical Considerations, Kensington Gold Project* (Klohn-Crippen, 1997) the following critical design elements affect whether saturation would occur:

- Maintaining a consistent level of tailings permeability
- Constructing drainage systems that remove excess water from the tailings
- Establishing impervious barriers to limit infiltration of rain and snowmelt.

The overall behavior of the DTF under Alternative B would rely on the performance of all drainage system components, including each of the intermediate drainage and barrier layers, the final cover, and the toe drain. Variability in the performance of any one part of the system/ unit ultimately could affect the stability of other sections of the pile.

The failure scenarios described previously could be caused by saturation of thin zones within the pile (i.e., a small percentage of the total volume of material). Modeling of the performance of the proposed DTF design is based on the assumption that the as-built condition would be the same as the theoretical design condition. Small variability in as-built conditions could result in saturation levels that would affect stability. Some level of variability would be inevitable, especially because of the natural differences in the construction materials, as well as variable construction conditions during the life of the mine. In addition, seismic deformation would result in movements within the pile and additional variability in performance. While the use of dry tailings management has become more widespread worldwide during the past 5 years, there are no case histories for construction of dry facilities of similar design in comparable high precipitation and seismic activity areas. This increases the uncertainty of the modeling results. The Greens Creek Project near Juneau has a DTF. However, Greens Creek uses compaction to achieve geotechnical stability; Alternative B would rely on drainage of the pile to achieve stability. Because of the above uncertainties and lack of proven examples of similar designs, there is a low to moderate potential that the structure could become sufficiently saturated to initiate failure during active operations and post-closure. Monitoring and pre-determined contingencies would reduce this potential during operations. Chapter 2 presents a general monitoring plan, and the *Technical Resource Document for Geotechnical Considerations* (Klohn-Crippen, 1997) describes the detailed geotechnical monitoring program for cell 1 of the DTF. As noted previously, Alternative B provides for contingencies, including an engineered structural berm, if saturation was detected during operation. The *Technical Resource Document for Geotechnical Considerations* (Klohn-Crippen, 1997) provides a detailed description of the predicted geotechnical performance and stability of Alternative B, including potential difficulties and uncertainties.

4.2.5 Effects of Alternative C (Marine Discharge)

The design of the DTF under Alternative C is the same as Alternative B. The risks of saturation and potential failure, therefore, are the same.

4.2.6 Effects of Alternative D (Modified DTF Design)

Alternative D includes the construction of an engineered structural berm around three sides of all cells of the DTF prior to tailings placement. Figure 2-4, presented in Chapter 2, shows the layout of the berm. Figure 2-10 shows a cross-section of the berm along the western side of the unit. The berm is designed to provide a conservative safety factor for a worst-case condition of saturation of tailings in the lowest lift along the west, north, and south sides under seismic loading. An even higher safety factor would be provided for saturation under normal operating conditions. Under Alternative D, there is minimal risk of widespread failure of the unit.

4.2.7 Summary

The potential for a tailings dam failure under Alternative A is very low, based on the performance of similar existing units worldwide. Under Alternatives B through D, the DTF would be designed to avoid tailings saturation within the unit and resulting failure under static and seismic conditions. For Alternatives B and C, there is a low to moderate potential of such saturation occurring, based on uncertainties related to design assumptions and the limited experience using similar designs. Under Alternatives B and C, the potential for failure during operations would be reduced by extensive monitoring and contingencies. Under Alternative D, the DTF would be constructed with an engineered structural berm that would provide structural stability regardless of tailings saturation.

4.3 SURFACE WATER HYDROLOGY

The Kensington Gold Project would affect surface water hydrology and flow regimes in the Sherman Creek watershed and in the Terrace Area drainage basin. Activities that could affect surface water hydrology and processes include development of diversion channels, dams or runoff conveyance structures, and water demand for mining operations. This section assesses the potential impacts on 1) stream flows and flow regimes and 2) the length and location of stream segments as indicators of differences among the alternatives. The potential impacts are discussed in terms of withdrawals or discharges to streams, as well as diversion channels and impoundments.

4.3.1 Effects of Alternative A (No Action)

Water Withdrawals and Discharges

Fresh water for the mill circuit, potable, and other domestic needs would be supplied from a diversion dam on upper Sherman Creek and from mine drainage. Total water supply demands under Alternative A would average 0.42 cubic feet per second (cfs) (190 gallons per minute [gpm]). The location of the diversion dam would be on the stream reach above the confluence with South Fork Sherman Creek below surface water monitoring station 109 (see Figure 3-2, presented in Chapter 3). Figure 2-1, presented in Chapter 2, shows the location of the proposed dam. The Alaska Department of Natural Resources (ADNR) would permit all water withdrawals.

The catchment area draining to the upper Sherman Creek diversion dam is approximately 1 square mile (640 acres). Withdrawals would reduce stream flows in Sherman Creek by an average of 0.42 cfs and could affect critical flow requirements in lower Sherman Creek during winter, but this impact would be small. Based on the average monthly flows for lower Sherman Creek (see Table 3-4), a 0.42-cfs withdrawal would result in an average flow reduction ranging from 5 percent in February to 1 percent in June. ADNR would require minimum surface water flows (instream flows) to maintain necessary flows for production of aquatic life, based on recommendations from the Alaska Department of Fish and Game (ADF&G). Table 4-16 presents instream flow requirements by month for upper Sherman Creek. The operator has

Table 4-16. Estimated Mean Flows and Instream Flow Requirements for Upper Sherman Creek

Month	Upper Sherman Creek Estimated Mean Flows[a] (cfs)	Upper Sherman Creek Instream Flow Requirements[b] (cfs)
October	17.9	5
November	10.8	5/3[c]
December	5.6	2
January	3.6	2
February	4.1	2
March	9.9	3
April	14.4	4
May	17.7	4
June	17.8	4
July	9.6	4
August	11.1	4
September	21.8	4/5[d]

a. SRK (1997c).
b. Instream flows required by ADNR permit.
c. 5 cfs required for the first 15 days of the month; 3 cfs for the remainder of the month.
d. 4 cfs required for the first 15 days of the month; 5 cfs for the remainder of the month.

proposed the establishment of systems using mine drainage, if required, to augment mine water supply. This source would be used to replace withdrawals from upper Sherman Creek during critical periods if it is necessary to meet instream flow requirements.

Current mine drainage, estimated to be between 0.2 to 0.8 cfs (100 to 400 gpm), discharges from the 800-foot adit to settling ponds near surface water station 101 (see Figure 3-2). After settling in the ponds, the drainage is discharged to the south Ophir Creek tributary above the confluence with Ivanhoe Creek. This discharge currently augments flows in Ophir, Ivanhoe, and lower Sherman Creeks. Under Alternative A, treated mine drainage would be collected and discharged through the marine outfall. The marine discharge would result in reducing average stream flows in the Ophir/Ivanhoe Creek diversion and in lower Sherman Creek by 0.2 to 0.8 cfs from its current level. Based on average monthly flows (see Table 3-4), the marine discharge of mine drainage would result in a maximum reduction of flow ranging from 10 percent in February to 2 percent in June in lower Sherman Creek.

Diversion Channels and Impoundments

Alternative A would involve approximately 2.1 miles of stream diversion channels. Chapter 2 provides detailed descriptions of diversion channels and runoff control structures. Upper Sherman Creek flows, including flows from South Fork Sherman Creek, would be diverted from the south side of the tailings impoundment via a buried pipeline designed to convey a 25-year, 24-hour storm event. An Ophir Creek diversion would be designed to route the runoff and drainage that would occur from the probable maximum flood (PMF) around the tailings impoundment. The Ophir Creek diversion would be approximately 2,950 feet in length and return diverted flows to lower Sherman Creek below the impoundment via a concrete spillway (see Figure 2-1).

The diversions would result in the loss and physical destruction of the natural channels in the areas that would be replaced by the diversions. As analyzed in the 1992 FEIS, temperature alterations caused by the Ophir Creek diversion would not be significant on lower Sherman Creek. The Ophir Creek spillway would require a design to ensure proper energy dissipation to avoid scouring or alteration of the channel at the point it enters lower Sherman Creek.

The diversions would not be expected to significantly impact the overall flow regimes in the Sherman Creek watershed because they are designed to pass through drainage occurring from the undisturbed basins above the mine. Impacts to flow velocities and temporal changes in flows would not be expected. High flushing flows that normally occur during spring runoff would not be affected in Ophir Creek as a result of the diversion, because it would be designed to convey the PMF. Flows up to the 25-year, 24-hour event would not be affected by the upper Sherman Creek diversion pipeline.

After mine closure, the Sherman Creek and Ophir Creek diversions would be removed. The channels would be reconstructed and routed through the tailings facility. The channels would be sized to route the PMF flow and engineered to be self-maintaining channels. A program of regular inspection and maintenance of these channels would be required in perpetuity after completion of operations.

The proposed tailings dam and impoundment would be built across the lower Sherman Creek drainage. Discharge from the tailings impoundment under normal operations would be controlled through the outfall according to the National Pollutant Discharge Elimination System (NPDES) permit. As studied in the 1992 FEIS, a worst-case scenario for failure of the tailings dam would discharge an estimated peak flow of 17,000 cfs (7.6 million gpm) to the Sherman Creek drainage, thereby removing approximately 215,000 tons of tailings from the impoundment. The flood would also entrain large quantities of soil and rock debris, scouring the existing channel, upper banks, and side slopes. Additional debris loading likely would occur from mass wasting along the side slopes, thereby adding more sediment and debris loads to the flood flow. The 1992 FEIS also notes that the likelihood of a failure is very low, based on the design of the unit and the performance of similar existing dams.

The tailings impoundment would capture precipitation that occurs on the impoundment and beach area, as well as contain runoff from the process area. This catchment would be approximately 225 acres. This catchment area would be insignificant compared to the total area of the watershed, and impounding the storm runoff for this catchment would not significantly impact or reduce flows in lower Sherman Creek. As noted above, excess water in the impoundment would be discharged to Lynn Canal at the NPDES-permitted outfall.

4.3.2 Effects Common to Alternatives B Through D

Water Withdrawals and Discharges

Under Alternatives B through D, the total demand for fresh water at the mine, mill, and camp site is estimated at 0.52 cfs (234 gpm). This demand is essentially the same as for Alternative A (0.42 cfs [190 gpm]), and the potential impact on stream flows in lower Sherman Creek would not be significantly different. ADNR would be responsible for permitting all water withdrawals.

An infiltration gallery would be installed upstream of the process area on upper Sherman Creek to collect water for storage in a 300,000-gallon fresh water tank (see Figures 2-2 through 2-4, presented in Chapter 2). In contrast to the diversion proposed under Alternative A, the infiltration gallery would collect water from the stream into a collection gallery while letting a majority of stream flow pass downstream. Pumping water from the infiltration gallery would reduce flows temporarily because the gallery would capture water from the creek to replace the amount pumped. In order to meet instream flow requirements, pumping from the infiltration gallery would be avoided to allow upper Sherman Creek flows to pass to lower Sherman Creek.

Like Alternative A, withdrawals under Alternatives B through D could affect stream flow in Sherman Creek, although impacts would be small. Based on the average monthly flows for lower Sherman Creek (see Table 3-4), this rate of demand would result in a reduction of average flow ranging from 7 percent in February to 1 percent in June. Under Alternatives B and D, this reduction only would occur in upper Sherman Creek between the infiltration gallery and outfall 001 (see Section 4.3.3). As noted for Alternative A, ADNR would impose instream flow requirements to protect aquatic life.

Diversion Channels, Runoff and Collection, and Stream Crossings

Alternatives B through D would involve construction of the same storm runoff diversion channels. Channels would be constructed to route and control runoff at the process area in the Sherman Creek drainage and for the DTF in the Terrace Area drainage basin between Sherman and Sweeny Creeks. The total length of required stream diversions and catchments would be 12,054 feet (2.3 miles). In addition, the haul road would require five stream crossings. An additional storm runoff channel and toe drain totaling 8,481 feet (1.6 miles) would be required around the DTF embankment to collect drainage and provide catchment of runoff from the unit. The *Technical Resource Document for Water Resources* (SAIC, 1997a) provides detailed descriptions of the diversion channels, runoff control structures, and stream crossings.

Personnel Camp, Mill Area, and Water Treatment Plant (Mine Process Area)

Alternatives B through D would require two channels to control runoff and route stream flows around the process area in the Sherman Creek basin. The first channel would be a storm water diversion constructed to catch surface runoff from the upper watershed east of the process area. The length of the channel would be 2,992 feet (0.6 mile) and provide drainage for approximately 157 acres (0.2 sq. miles).

The second channel would route Ophir Creek west to Ivanhoe Creek at approximately the 670-foot elevation. The diversion would be 862 feet (0.2 miles) in length and would be designed to provide drainage from approximately 497 acres (0.8 sq. miles). The diversion would combine with Ivanhoe Creek approximately 2,140 feet (0.4 miles) above the Ivanhoe confluence with Sherman Creek (see Figure 4-2). The confluence of the diversion and Ivanhoe Creek would be approximately 509 feet (0.1 miles) above the natural confluence of Ophir and Ivanhoe Creeks. The natural channel could be affected along this 509-foot stream reach during high flows. Impacts could occur because this reach now would be required to convey drainage from both the Ivanhoe and the Ophir creeks sub-basins. The drainage area for Ivanhoe Creek at this location is approximately 418 acres (0.7 sq. miles). The additional drainage area from the Ophir Creek sub-basin would be about 497 acres (0.8 sq. miles), approximately doubling the drainage area. Using information provided from baseline hydrologic modeling (Knight Piesold, 1994), the average annual peak daily flow would increase approximately 41 cfs in this reach. Impacts could include channel down cutting, movement of bed material, and scouring along the sides of the channel. To mitigate potential impacts, a series of channel improvements would be implemented within this reach. Improvements would include removal of existing debris in the channel, stabilization of the creek bed, and channelization or widening of the creek, as required. The Forest Service would require the use of riprap to armor at least 300 feet of streambank immediately downstream of the diversion along Ivanhoe Creek. This would prevent erosion and scouring of the channel in this reach. The use of large woody debris to be incorporated with the riprap would also be required. This would provide cover for fish and promote development and improvement of aquatic habitat.

Haul roads would require four stream crossings in the process area. One crossing would be a bridge that would replace the current bridge that crosses South Fork Sherman Creek. Construction of the bridge would occur above the stream channel, and direct impacts to the creek bed or to flows would not be expected. Appropriate Forest Service BMPs would be applied during construction to minimize erosion and potential impacts. Sections 4.3.3 through 4.3.5 discuss the remaining crossings.

Impacts to lower Sherman Creek are not expected as a result of diversion channels proposed for the process area. Because these channels would be designed to divert natural drainage occurring from the upper Sherman Creek basin, flow regimes within the basin would not be affected significantly. High flows that normally occur during spring runoff would not be affected. These flows would provide velocities necessary to maintain natural channel geomorphologic conditions and flush accumulated sediments that naturally deposit during low-flow conditions. The bridge on South Fork Sherman Creek would be designed at a height to allow flows smaller than the 100-year, 24-hour event to pass below the road.

DTF Area

Under Alternatives B through D, two storm water diversion channels would be constructed in the upper watershed east of the DTF facility. The purpose of these diversions would be to prevent drainage generated from unimpacted areas in the watershed from running onto the DTF embankment. The diversions would route flows around the facility. The first diversion would provide drainage from a 90-acre sub-basin and route flows north and then west around the embankment before converging with Camp Creek. The length of this diversion is estimated to be 4,522 feet (0.9 miles) (SRK, 1996b). A second diversion would provide drainage from a 58-acre sub-watershed and route flows south and then west to Settling Pond Creek. The length of this diversion is estimated to be 3,678 feet (0.7 miles). Section 2.3.5 provides a detailed description of these channels.

An additional storm runoff channel and toe drain totaling 8,481 feet (1.6 miles) would be required around the DTF embankment to collect drainage and provide catchment of runoff from the unit. Runoff and drainage from the DTF would be routed to a sediment detention pond. Section 2.3.5 presents detailed descriptions of DTF diversion channels and the sediment pond.

All the proposed diversion channels would be constructed in an area that currently is drained by a series of small intermittent channels. The construction of these diversions would create channels in areas where channels currently do not exist, thereby disturbing soils and vegetation. Sections 4.7 and 4.8 discuss the potential impacts associated with these resources.

One haul road crossing of an unnamed tributary to lower Sherman Creek would be required below the explosives storage area (see Figures 2-2 through 2-4). This tributary is ephemeral (i.e., only flows as a result of precipitation events). This crossing would consist of several 52-inch diameter culverts placed to route flows and runoff under the road. Appropriate Forest Service construction BMPs would be used during culvert installation to minimize erosion, and installation would not be conducted if the tributary were flowing (SRK, 1996h). Impacts to flows in lower Sherman Creek would not be expected as a result of these culverts because they would be designed to adequately pass flows that could occur in the channel.

The diversion channels around the DTF embankment are not expected to affect the overall hydrology of this area. Although the DTF would physically impact several of the small intermittent drainages, the proposed channels would be designed to divert natural drainage occurring from the upper sub-basins. The channels would alter the specific runoff and drainage pattern in the area; however, the natural flow regimes and discharge from the basin would not be affected significantly.

4.3.3 Effects of Alternative B (Proposed Action)

At present, mine drainage augments flows averaging between 0.2 and 0.8 cfs to the south Ophir Creek tributary, Ivanhoe Creek, and lower Sherman Creek. Under Alternative B, mine drainage would be discharged from the process area to the sediment detention pond. After full development, mine drainage is estimated to be between 1.3 cfs to 2.2 cfs (600 to 1,000 gpm). The sediment detention pond would discharge to Sherman Creek approximately 150 feet above the confluence with South Fork Sherman Creek (see Figure 2-2). This scenario would result in reducing average stream flows in Ophir and Ivanhoe Creeks by 0.2 to 0.8 cfs from current levels. Discharge to Sherman Creek below the sediment detention pond and above Ivanhoe Creek would be increased by 1.3 cfs to 2.2 cfs (600 to 1,000 gpm). Below Ivanhoe Creek, the net increase would be 1.1 to 1.3 cfs (500 to 600 gpm). Based on average monthly flows (see Table 3-4), the net increase would result in a maximum flow augmentation ranging from 15 percent in February to 3 percent in June in lower Sherman Creek. This flow augmentation is not a significant increase compared to peak flows expected from storm events, and impacts to the stream channel are not expected.

Under Alternative B, the remaining three stream crossings would be constructed using long-span, low-profile bottomless arch conduits to route creek flows (SRK, 1997c). Two road crossings 180 and 300 feet in length would be required on upper Sherman Creek along the channel, respectively. In addition, one road crossing 180 feet in stream length would be required on Ivanhoe Creek. The conduits would be designed to pass flows up to the 10-year, 24-hour event. Figure 4-3 shows the locations of these stream crossings.

The bottomless conduits proposed for these crossings are designed to minimize impacts by maintaining the natural creek bed and the immediately adjacent flood plain. Potential impacts to the stream channel, however, could still occur from the conduits. Stream flows could be channelized within the conduits during extreme flow events, resulting in erosion of bed materials, straightening of the channel, and downcutting. This could cause changes to the channel grade (slope) and, subsequently, cause erosion to the channel both upstream and downstream. Scouring around the long footings of the conduit could also cause erosion and channel degradation.

As mitigation, riprap would be required to armor all footings and minimize erosion. The conduits would also be located in reaches where the potential for channelization during extreme flows would be minimized. Other mitigation would include removal of debris that could impede flows and placement of riprap within the main flow path to stabilize the low flow channel (SRK, 1996h). Appropriate Forest Service BMPs would be applied during construction to minimize the number of times that equipment crosses the streambed and to limit the area and time of disturbance. ADF&G would coordinate with the Forest Service to identify critical periods for anadromous fish in lower Sherman Creek to minimize impacts during instream construction activities.

4.3.4 Effects of Alternative C (Marine Discharge)

As indicated previously, mine water discharge currently augments flows averaging between 0.2 and 0.8 cfs to Ophir, Ivanhoe, and lower Sherman Creeks. Under Alternative C, treated mine drainage would be collected and discharged through the marine outfall. The potential impact to stream flows would be similar to those discussed for Alternative A, reducing average stream flows in Ophir and Ivanhoe Creeks by 0.2 to 0.8 cfs from current levels. This reduction also would occur in lower Sherman Creek, because mine drainage would be routed to the marine outfall. Based on average monthly flows (see Table 3-4), the marine discharge of mine drainage would result in a maximum reduction of flow ranging from 10 percent in February to 2 percent in June in Sherman Creek.

The potential impacts associated with haul road stream crossings are the same as Alternative B.

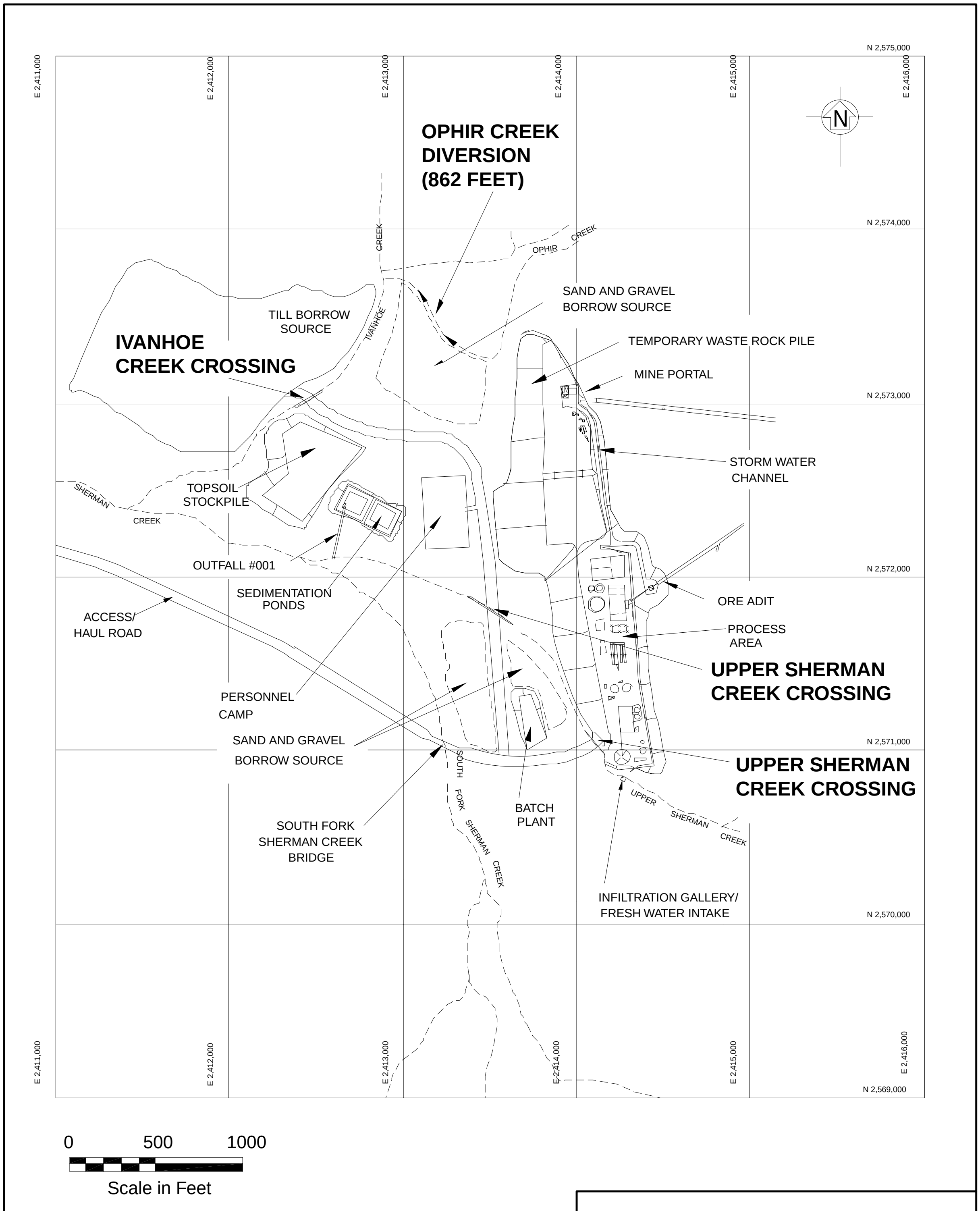


Figure 4-3
Creek Crossings
and Ophir Creek Diversion

0214D-4.3

4.3.5 Effects of Alternative D (Modified DTF Design)

Under Alternative D, mine drainage management would be similar to Alternative B, discussed in Section 4.3.3. In addition, a pipeline would be constructed to slurry tailings from the mill to a dewatering facility near the DTF. An additional pipeline would be used to return reclaimed water back to the mill for reuse. Because water would still be recycled for use in the mill, this alternative would not result in additional water demands or water withdrawals or effects to basin hydrology beyond those for Alternative B.

Under this alternative, bridges would be used for the two haul road crossings on upper Sherman Creek and the one on Ivanhoe Creek. The bridges would be constructed at a minimum height sufficient to pass the peak flow from the 50-year, 24-hour storm event, plus an additional 6 feet to allow clearance for debris.

Potential scouring and erosion could occur around the footings (i.e., abutments) for the bridges during high stream flow events. This potential, however, would be less than that associated with the conduit crossings proposed under Alternatives B and C because the footings would be installed, at a minimum, above the 50-year, 24-hour flood plain. Footings for the conduits proposed under Alternatives B and C would run the entire length of the conduit and would be installed along the 10-year, 24-hour flood plain. The use of bridges would reduce the potential for channelization, bed erosion, and downcutting because extremely high flows would not be totally confined.

Appropriate Forest Service BMPs would be applied during bridge construction to minimize erosion, minimize the number of times that equipment crosses the existing creek bed, and limit the area and time of disturbance. ADF&G would coordinate with the Forest Service to identify critical periods for anadromous fish in lower Sherman Creek to minimize impacts during in-water construction activities.

4.3.6 Summary

Table 4-17 summarizes the potential hydrologic impacts and descriptions for all alternatives. Water demand for all alternatives is approximately the same. Estimates for Alternative A are slightly lower (190 gpm) than for the other alternatives (234 gpm). This difference is insignificant, constituting only 0.1 cfs in stream flow and water withdrawal from Sherman Creek. For 234 gpm (0.52 cfs), the rate of demand would result in a reduction of average flow that ranges from 7 percent in February to 1 percent in June in lower Sherman Creek.

Alternative A would require two main diversions to divert flows from the upper watershed around the process area and tailings impoundment. The total length of these diversions would be 2.1 miles.

Table 4-17. Summary of Hydrologic Impacts by Alternative

Alternative	Water Withdrawals		Stream Flow	Other
A (No Action)	190 gpm (0.42 cfs)	Impoundment on upper Sherman Creek.	Potential impact to instream flows during critical periods. Marine discharge of mine drainage, reducing average stream flow 0.8 cfs in lower Sherman Creek.	Tailings dam and impoundment; 225-acre catchment; dam failure would release 17,000 cfs to lower Sherman Creek.
B (Proposed Action)	234 gpm (0.52 cfs)	Infiltration gallery on upper Sherman Creek.	Potential impact to instream flows during critical periods. Discharge of mine drainage to Sherman Creek, increasing average stream flow 1.3 cfs. Potential impact to stream channels at haul road crossings from conduits, including channelization, erosion of bed materials, and downcutting.	DTF with drainage catchment totaling 1.6 miles.
C (Marine Discharge)	234 gpm (0.52 cfs)	Infiltration gallery on upper Sherman Creek.	Potential impact to instream flows during critical periods. Marine discharge of mine drainage, reducing average stream flow 0.8 cfs in Sherman Creek. Potential impact to stream channels at haul road crossings from conduits, including channelization, erosion of bed materials, and downcutting.	DTF with drainage catchment totaling 1.6 miles.
D (Modified DTF Design)	234 gpm (0.52 cfs)	Infiltration gallery on upper Sherman Creek.	Potential impact to instream flows during critical periods. Discharge of mine drainage to Sherman Creek, increasing average stream flow 1.3 cfs. Reduced potential impacts to stream channels at haul road crossings from bridges.	DTF with drainage catchment totaling 1.6 miles.

Alternatives B through D would require four main diversions totaling 2.3 miles. One stream diversion would be required to divert Ophir Creek away from the process area, and a second one would provide catchment for runoff from the watershed above the process area. In addition, these alternatives would require two additional diversions to provide catchment of runoff from the watershed above the DTF embankment. Alternatives B through D would also require 1.6 miles of additional channel catchments and a toe drain to capture drainage and runoff from the DTF embankment.

Natural hydrologic flow regimes would not be disrupted significantly by any alternative. The potential impacts of water withdrawals on instream flow requirements during critical flow periods are common to all alternatives. All alternatives could require mitigation through the use of alternative ground water sources (e.g., mine drainage) during critical flow periods. The Ophir Creek diversion proposed under Alternatives B through D would increase average monthly discharge by 41 cfs in a 509-foot stream reach of Ivanhoe Creek. The channel in this reach would be improved to mitigate potential impacts from increased flows. This increased discharge could cause scouring and bedload erosion of the channel in this reach. Restoration of the stream channel would be required after cessation of mine operations.

The marine discharge of mine water under Alternatives A and C would reduce average stream flows in Ophir and Ivanhoe Creeks by 0.2 to 0.8 cfs from current levels. Under Alternatives B and D, mine water would be discharged to lower Sherman Creek, increasing average stream flows by 1.1 to 1.3 cfs and reducing average stream flows in Ophir and Ivanhoe creeks by 0.2 to 0.8 cfs. These withdrawals and discharges would not be expected to significantly impact stream flows in these streams.

Under Alternative A, an unlikely failure of the tailings dam would heavily impact lower Sherman Creek. The DTF, proposed under Alternatives B through D, would physically destroy several small intermittent drainages within its proposed footprint.

Potential impacts to stream channels could occur at haul road crossings for all alternatives. Impacts could include channelization, erosion of bed materials, and channel downcutting. The potential for these impacts would be lower under Alternative D because this alternative uses bridges on upper Sherman Creek and Ivanhoe Creek instead of the long-span bottomless arch conduits under Alternatives B and C.

4.4 SURFACE WATER QUALITY

This section discusses the potential impacts of the four project alternatives on local surface water quality (fresh water). Activities or sources that could affect surface water quality include mine drainage and discharge; tailings disposal: accidental spills; development of sand, gravel, and till source areas and roads; and other construction activities. The potential environmental impacts caused by each alternative are discussed using three indicators: sedimentation, effluent quality, and accidental spills.

4.4.1 Effects of Alternative A (No Action)

Sedimentation

Under Alternative A, the potential for sediment loading to Sherman Creek and other area streams within the watershed would be highest during construction. Sediment loading would be greatest during initial construction activities at the process area, the tailings facility, and the marine terminal and would decrease as operations stabilize and approach baseline conditions.

Actual erosion and sediment loadings to streams depend greatly on specific weather patterns and storm events, as well as on the effectiveness of applied Forest Service BMPs to control erosion. Storms producing high rates and volumes of rainfall have the potential to produce relatively higher volumes of runoff with more energy to entrain sediments in disturbed areas. Erosion and sediment loadings are expected to be relatively higher during high-intensity rainfall events or rainfall events producing high volumes of runoff.

Initial construction under Alternative A would include roads, camp and mill facilities, a water treatment plant, a water supply diversion and storage impoundment on upper Sherman Creek, diversion channels around the tailings impoundment, drainage and sediment control structures, and temporary waste rock storage. A total of 282 acres would be disturbed.

For all alternatives, appropriate BMPs as required by the Forest Service or the appropriate cooperating agency would be employed to control erosion and sediment loadings to streams. Mulching and revegetation would be used on disturbed areas. Travel areas would be graveled. Sediment from areas affected by construction would be controlled by straw bale barriers, grass filter waterways, and sediment collection traps in roadside ditches. Concentrated runoff from surface drainages would be routed through sediment detention basins. Runoff from the mine and mill site area and waste rock storage would be routed to the tailings pond, settled, and discharged to Lynn Canal.

The final Plan of Operations would include a series of BMPs required by the Forest Service (USFS, 1996b) that would be applied during construction and operations to address erosion control, protection of riparian areas and streambanks, and construction issues. These BMPs would address roads, quarries, and borrow pits; snow removal; and site access and closure. As discussed on page 4-18 of the 1992 FEIS, the sediment and nonpoint source water pollution control measures should be adequate to protect the local surface water resources from potential degradation of water quality from sediment loadings.

Effluent Quality

Under Alternative A, process wastewater would be managed in a tailings impoundment and discharged through a marine outfall. The water quality of Sherman Creek would not be affected by effluent discharges during normal operation. The primary pathway for potential contamination of local surface water from tailings effluent would be seepage from, or failure of, the tailings dam or leakage or rupture of the effluent pipeline. The tailings impoundment would be designed with a seepage collection pond below the dam. Seepage would be pumped from the pond back to the impoundment. Therefore, the potential for significant volumes of seepage bypassing the pond and discharging to Sherman Creek is low. If seepage were discharged, however, the characteristics would be the same as those of the tailings effluent. Section 4.6 discusses the characteristics of the projected marine discharge.

Accidental Spills

Section 4.13 provides a detailed discussion of the expected volume and frequency of transportation traffic and the probability of spills for both diesel fuel trucks and cyanide transport trucks. Section 4.6 discusses the potential impacts of spills on fisheries.

Accidental spills of tailings effluent could occur through rupture of the discharge pipeline or failure of the dam. The probability of effluent pipeline failure is assumed to be similar to a diesel pipeline (i.e., 0.89 failures per thousand miles per year). For the approximate 1.6 miles of effluent pipeline that parallel Sherman Creek, this would represent a probability of 0.0014 spills per year (1.4 in 1,000). The composition of such discharges would be the same as the projected marine discharge characteristics.

4.4.2 Effects Common to Alternatives B Through D

Sedimentation

Under Alternatives B through D, sediment would be controlled primarily through the use of sediment detention ponds. Ponds would be used to minimize erosion and sedimentation from four areas: 1) personnel camp, mill area, and water treatment plant, 2) till borrow area, 3) sand and gravel borrow areas, and 4) DTF. As discussed under Alternative A, the potential for erosion and sediment loadings below project disturbance areas would be highest during construction activities. Erosion and sediment loadings would be expected to be higher during high-intensity rainfall events or rainfall events producing high volumes of runoff.

The construction of the following primary areas would have the potential to generate sediment and cause sedimentation in streams:

- Personnel camp, mill facilities, and water treatment plant
- Till borrow area
- Sand and gravel borrow areas
- Haul roads
- DTF embankment.

The minimum disturbed area under Alternatives B through D would be 250 acres. Sections 4.4.3 through 4.4.5 present the potential acreage disturbed for Alternatives B through D, respectively. For all alternatives, BMPs would be employed to minimize and control sediment loading to area streams. Mitigation measures would include mulching and revegetating disturbed areas, graveling traffic areas with crushed borrow rock, and using straw bale barriers, grass filter waterways, filter fabric, and sediment collection traps as needed to protect erosive areas affected by construction. Sediment detention basins would be used to remove sediment prior to discharge to streams or wetlands. This section analyzes the potential for sedimentation during the construction of the areas listed previously and describes BMPs for controlling sediments.

Personnel Camp, Mill Area, and Water Treatment Plant

A sediment detention pond (process area pond) would be constructed to control storm runoff and mitigate potential impacts from sediment erosion from the personnel camp, mill area, vehicle washing area, north sand and gravel borrow area, and mine drainage treatment plant (46 acres). The *Technical Resource Document for Water Resources, Kensington Mine Project* (SAIC, 1997a) describes the design of the sediment detention basin. Traffic areas would be covered with crushed gravel from the borrow area to minimize erosion. The sand and gravel borrow area would be constructed to minimize soil erosion from cut slopes and exposed surfaces during construction according to BMPs established by the Forest Service. Silt fences, straw bale barriers, and slash windrows would be used in the borrow area as required.

Under the NPDES permit, effluent from the process area pond could not exceed the total suspended solid (TSS) daily maximum level of 30 mg/L and monthly average of 20 mg/L. This would be accomplished by using BMPs throughout the catchment area and enhanced settling within the pond. The mine drainage treatment system would include both underground settling and surface filtration, which would ensure compliance of TSS levels in the mine drainage with effluent limits. Sediment loadings from the pond that meet these limits are not expected to significantly impact Sherman Creek. The finer (non-settleable) sediments that could be released would remain entrained by normal flow velocities in Sherman Creek and be discharged to Lynn Canal. Sections 4.6 and 4.7 provide additional discussion of potential impacts from sediment loadings.

Flocculants would be added to the process area pond to treat flows to meet limits for TSS. Runoff and treated mine drainage from storm events less than the 100-year, 24-hour event would be routed through a pipe to Sherman Creek. Runoff from storms exceeding this event would be routed to Sherman Creek via a spillway, and loading of sediments to lower Sherman Creek could occur. The potential impacts from these extreme events would be small because the detention pond would still settle a majority of eroded sediments and control high-velocity flood flows to the channel. In addition, modeling indicates that finer (non-settleable) sediments that could be released during high flows would remain suspended by the normal flow velocities in Sherman Creek (SRK, 1996g). These suspended solids would be transported to Lynn Canal. This would limit the potential impacts to spawning gravels and the benthic environment from fine sediments. Section 4.6 presents additional discussion regarding potential impacts of sediment loadings to Lynn Canal.

Turbidity in water is caused by the presence of suspended matter, such as clay, silt, and finely divided organic matter. State water quality criteria for Sherman Creek and Camp Creek require that turbidity in the discharge not exceed 5 Nephelometric Turbidity Units (NTUs) above natural conditions when the natural condition is 50 NTUs or less and not cause more than a 10-percent increase in turbidity when natural conditions are greater than 50 NTUs, not to exceed a maximum increase of 25 NTUs.

Although turbidity and TSS are fundamentally different parameters, both are reduced by the same treatment technologies. In evaluating compliance with the turbidity standards at outfall 001, it is useful to separately consider the two components of the discharge: the treated mine drainage and the storm runoff. During dry weather, the only component of the discharge from outfall 001 would be treated mine drainage. While the untreated mine drainage might be high in turbidity, treatment would include chemical precipitation and clarification, followed by filtration. Pilot testing studies conducted by the operator indicate that this treatment would consistently reduce turbidity to levels less than 1 NTU. Data collected from Sherman Creek (Coeur, 1996c) show turbidity levels typically between 1 and 2. Under dry weather conditions, therefore, the discharge should not increase turbidity, and the criteria should be met consistently.

During minor rainfall events, the discharge from outfall 001 would be a mixture of storm runoff and treated mine drainage. The treatment system at outfall 001 would provide polymer addition and settling, which should reduce turbidity in the storm water. Minor rainfall events are not expected to significantly disturb materials in the process area, and detention time in the two settling ponds would remain long. In addition, the very low turbidity level of the treated mine drainage would act as a dilutant for the storm runoff. While minor rainfall events are not expected to increase turbidity levels in Sherman Creek above the typical 1 to 2 NTUs range, the treatment system, combined with the dilution effect from the treated mine drainage, should easily provide compliance with the water quality criteria for turbidity.

Under major rainfall events, storm water would dominate the discharge at 001. While the levels of turbidity in the process area runoff are expected to increase, the polymer dosage applied to the runoff in the treatment ponds would be increased as well. In addition, when turbidity is greater than 5 NTUs in Sherman Creek, a greater increase would be allowed by the turbidity criteria. Tests conducted on simulated high rainfall runoff (Great Western, 1996) indicate that turbidity can be reduced with polymer addition to 6 NTUs under laboratory bench test conditions. Based on these results, the turbidity criteria should be met at the outfall. The final NPDES permit would include instream turbidity monitoring above and below outfall 001.

Haul Roads

The existing road at the project site would be upgraded and relocated to support construction of the DTF, subsequent mining, and ore-processing activities (see Figures 2-2 through 2-4, presented in Chapter 2). The road would be widened to a 60-foot running width with turnouts as needed for safety, thus increasing the potential for erosion and sedimentation. Additional ancillary roads would be constructed to access other facilities, including the explosives storage area, the infiltration gallery, laydown areas, the camp, and borrow sites. Stream crossings, described in Section 4.3.2, would be required on an ephemeral creek below the explosives storage area (one crossing), on South Fork Sherman Creek (one crossing), on upper Sherman Creek (two crossings), and on Ivanhoe Creek (one crossing) (see Figures 2-2 through 2-4).

Truck use of the haul road would be about 75 percent less under Alternative D than under Alternatives B and C. This would result in less potential for road surface erosion and stream sedimentation under Alternative D. Under Alternatives B through D, ditches would be constructed along the length of all roads with cross culverts installed to provide local drainage. Appropriate Forest Service BMPs (e.g., straw bale barriers, filter fabric, and sediment collection traps) would be applied to control sediments along the storm ditches. Storm runoff and eroded sediment from the roads would be monitored at various sampling locations according to NPDES permit provisions and discharged to wetland areas at NPDES-permitted outfalls. The NPDES permit would require the operator to develop and implement a storm water pollution prevention plan (SWPPP), including BMPs, for haul road discharges. With appropriate design and maintenance of BMPs, as required by the Forest Service and incorporated in the SWPPP, these discharges are not expected to cause significant impacts to wetland areas and are not expected to affect area streams.

Till Borrow Area and South Sand and Gravel Borrow Area

Erosion could occur from the till borrow area. The borrow area would be constructed to minimize soil erosion from cut slopes and exposed surfaces during construction using appropriate BMPs established by the Forest Service. Interim drainage within the borrow area would include the use of silt fences, straw bale barriers, and slash windrows, as required. Storm runoff from this area would be collected and routed to a sediment pond for settling and infiltration into coarse materials. Discharge from this pond would only occur during storm events exceeding the 100-year, 24-hour event via a spillway. If required, the discharge would be routed to a wetland area north of Sherman Creek (see Figures 2-2 through 2-4) and, if required, flocculants would be added to enhance settling prior to discharge. This discharge also would be addressed by the NPDES permit and SWPPP, including monitoring requirements and BMPs. Potential discharges are not expected to significantly impact wetlands or affect area streams. The south sand and gravel borrow area would drain internally and infiltrate into porous materials.

DTF Embankment

Potential sources of runoff associated with the DTF embankment include reclaimed areas, placed waste rock, and tailings, as well as stockpiles of waste rock and soil, depending on the construction stage of the DTF. The catchment area for runoff and the proportion of reclaimed versus active placement areas would change throughout the period of operation. The maximum catchment area and, therefore, the worst-case scenario for runoff and sedimentation, is estimated to be 92 acres during a period near the later stages of the mine operation.

A sediment detention pond would be constructed to control storm runoff and erosion of sediments from all disturbed areas at the DTF site. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997a) provides a detailed description of the design of the sediment detention basin. Runoff from storms exceeding the 100-year, 24-hour storm event would be routed to Camp Creek over a spillway. Similar to the process area pond, the NPDES permit would require that effluent from the DTF pond meet the TSS daily maximum level of 30 mg/L and monthly average of 20 mg/L. This would be accomplished through the use of BMPs at the DTF site and enhanced settling within the pond. Flocculants would be added to the pond to ensure compliance with effluent limits. Sediment loadings from the pond in accordance with these limits are not expected to significantly impact Camp Creek below the DTF. The finer (non-settleable) sediments that could be released during high flows would remain entrained by the normal flow velocities in the channel (SRK, 1996g). Potential sediment loadings to Camp Creek could occur from extreme events larger than this event. Observations have noted that surface water flows from this channel do not outfall to Lynn Canal, but terminate at Comet Beach. These observations indicate that sediments would not be discharged to Lynn Canal. Section 4.7 provides additional discussion on the potential effects of sediment loadings on aquatic life.

Because similar background conditions are expected in Camp Creek and the DTF settling pond system is comparable to the process area settling pond system, the State turbidity criteria should also be met at outfall 002. The final NPDES permit would include turbidity monitoring above and below outfall 002.

Effluent Quality

Under Alternatives B through D, ore processing would remove most of the potentially acid-generating sulfide materials. The sulfide concentrate would be sent offsite for further processing. Therefore, the flotation tailings are not expected to generate acid. To support this conclusion, the operator conducted total sulfur and acid generation potential testing of flotation tailings produced by two pilot-scale milling process runs in 1996. The flotation tailings from the two runs had sulfide concentrations of 0.027 and 0.04 percent (see the *Technical Resource Document for Water Resources* [SAIC, 1997a]). The neutralization potential to maximum potential acidity (NP:MPA) of a flotation tailings sample was 166:1. Ratios of 3:1 or less generally are considered as having the potential to generate acid.

Under normal operating conditions, the discharge point for mine drainage and DTF effluent would vary depending on the alternative. Therefore, Sections 4.4.3 through 4.4.5 describe pollutant loadings to Sherman and Camp Creeks under normal operating conditions from flows less than the 100-year, 24-hour storm event under Alternatives B through D, respectively.

Accidental Spills

Sections 4.4.3 through 4.4.5 discuss the potential impacts to surface water resources that could result from accidental spills or traffic accidents under Alternatives B through D, respectively.

4.4.3 Effects of Alternative B (Proposed Action)

Sedimentation

Alternative B would disturb a total of 250 acres, which is the minimum amount of estimated total disturbed area for any alternative. The major areas disturbed and the potential for impacts from erosion and sedimentation to streams are the same as those described for Alternatives B through D in Section 4.4.2. The small differences in acreage to be disturbed between Alternative B and the other alternatives are primarily because pipelines would not be used under Alternative B to transport fuel, tailings, or treated effluent between the mine process area and the DTF area or the marine terminal. Overall, the potential for impacts to Sherman Creek or the creeks draining the area of the proposed DTF from erosion and sedimentation are low because BMPs would be applied to minimize potential impacts.

The potential impacts associated with the use of conduits for haul road crossings under Alternatives B and C on upper Sherman Creek and Ivanhoe Creek are discussed in Section 4.3.2. Extreme events could cause erosion on the streambed, channel downcutting, and scouring around the conduit footings. These impacts could potentially increase sediment loading to downstream reaches during extreme flow events. The degree of sediment loading, above that which occurs naturally, would depend on the size distribution of particles and the volume of material eroded from the crossing, the size of the flow event, and the effectiveness of the BMP practices employed.

Forest Service BMPs would specifically be applied to minimize erosion during construction of stream crossings. These BMPs would include minimizing the number of times equipment crosses the creek bed, limiting the area of impact, and minimizing the time of disturbance. Stream crossing construction also would be avoided during critical periods for anadromous fish. The Forest Service and ADF&G would coordinate in defining these periods.

Effluent Quality

Treated Mine Water Effluent

Treated mine water would be routed through a pipe and discharged into a sediment pond designed to control runoff from the process area. The flow rate from the sediment pond would vary, depending on the volume of discharge from various storm events and the quantity of discharge from the mine water treatment plant. The rate of discharge from the treatment plant would vary with mine dewatering rates, which are estimated to range between 600 and 1,000 gpm, during active operations (SRK, 1996d).

Mine water would be discharged to Sherman Creek at outfall 001. Impacts to Sherman Creek are not expected as a result of the discharge of the treated mine water. Table 4-18 provides the projected discharge characteristics and water quality-based NPDES permit limits for fresh water discharges from the process area pond. The water quality criteria for several metals are based on hardness (i.e., the toxicity of the metal to aquatic life depends on the hardness of the water). The NPDES permit limits would provide for “tiered” limits, thereby allowing the operator to determine the applicable limit based on the instream hardness at the time of sampling. There is no evidence to suggest that the variability in hardness itself could affect aquatic life. The untreated mine water quality is based on statistical analysis of the monitoring data for existing station 101, the current mine drainage discharge point. The *Technical Resource Document for Water Resources* (SAIC, 1997a) presents the complete results of and assumptions for the statistical analysis.

As indicated in Table 4-18, the treatment plant could be operated to achieve compliance with all indicated discharge limits. The treatment technology proposed (i.e., precipitation and settling followed by filtration) would remove virtually all metals present as insoluble species. Thus, the effluent characteristics shown are based on the soluble concentrations detected in the station 101 discharge (Montgomery Watson, 1996a). The projected levels in treated mine drainage are conservative in that most soluble metals concentrations at station 101 were non-detects. In addition, other existing facilities use the same technology to achieve reductions in soluble metals (through adsorption and co-precipitation of soluble species). If operational monitoring indicated that higher than anticipated levels of metals were present in soluble (dissolved) form, some pre-conditioning (e.g., sulfide or borohydride addition) could be used to reduce metal solubility and achieve the discharge concentrations shown.

Ammonia and nitrate previously were detected in the mine drainage at levels above projected permit limits during periods of blasting. In response, a BMP for blasting operations

Table 4-18. NPDES Effluent Limitations and Discharge Quality

Parameter	Daily Maximum Limit (Hardness: 50/100/200)[a] g/L	Monthly Average Limit (Hardness: 50/100/200) [b] g/L	Untreated Mine Drainage Station 101, 90th Percentile Concentration[c] g/L	Treated Mine Drainage, Outfall 001[c] g/L	Projected DTF Area Discharge, Outfall 002[c] g/L
Arsenic (µg/L)[d]	0.36	0.18	3.2	1.7[e]	2.46
Cadmium (µg/L)	1.08/1.86/3.21	0.54/0.93/1.60	ND (0.2)	ND (0.2)	ND (<3.0)
Chromium (µg/L)	16.0	7.98	ND (10)	ND (10.0)	ND (<20)
Copper (µg/L)	9.22/17.73/34.06	4.60/8.84/16.98	20	3.9[f]	6.92
Lead (µg/L)	2.16/5.23/12.63	1.08/2.61/6.30	3.0	1.0[g]	0.88
Mercury (µg/L)	0.02	0.01	ND (<0.05)	ND (<0.5)	ND (0.2)
Nickel (µg/L)	26.88	13.40	ND (<10)	ND (<10.0)	5.22
Selenium (µg/L)	8.21	4.09	ND (<5)	ND (<5.0)	0.09
Silver (µg/L)	0.20	0.10	0.21	0.10[g]	0.08
Zinc (µg/L)	65.04/77.21/77.21	32.42/38.48/38.48	23	10[g]	32.76
Ammonia, Total (mg/L)	3.45	1.72	<2[h]	<2	1.56
Nitrate (mg/L)	20.0	10.0	<10[i]	<10[i]	4.59
TDS (mg/L)[j]	1,000[j]	NA	787.0	<800	<1,000[k]
pH (s.u.)[l]	6.5 – 8.5	6.5 – 8.5	6.8 – 8.3	6.8 – 8.3	6.8 – 8.3
TSS (mg/L)	30	20	39.0	30/20[m]	30/20[m]

a. Daily maximum limits would be applied to any one sample.
b. Monthly average limitations would be the mean of the four weekly samples.
c. The levels in parentheses represent the lowest detection limits achieved by the operator using standard EPA methods.
d. The method detection limit for total arsenic is 3.0 µg/L using standard EPA methods for wastewater analysis. The method detection limit is the lowest measurable level at which meaningful data can be obtained. Arsenic concentrations cannot be accurately reported below this limit. In the NPDES permit, therefore, the operator would demonstrate compliance with the arsenic limits by showing that arsenic levels in the discharge were below 3.0 µg/L. Reported levels below the 3.0 µg/L have been presented in this table. However, they should only be considered as demonstrating that the actual concentrations are below the method detection limit. Detectable levels of arsenic have been observed in background samples in upper Sherman Creek (station 109). All reported levels have been below the method detection limit, however.
e. Value assumes reduction through treatment due to adsorption and co-precipitation.
f. Based on theoretical hydroxide solubility at pH 8.5.
g. Value assumes removal of the metal through adsorption and/or co-precipitation.
h. Value assumes implementation of an explosives BMP plan.
i. Control of nitrate using an explosives BMP plan should ensure all levels below 10 mg/L.
j. TDS criteria are based on site-specific criteria applied for by the operator—pending ADEC adoption and EPA approval.
k. There are no data to specify TDS levels in DTF effluent. However, TDS levels in the DTF are expected to be less than the requested site-specific standard of 1,000 mg/L. As a worst-case scenario, waste rock runoff could have comparable TDS levels to mine drainage—787 mg/L. For tailings seepage, the TDS level in effluent from pilot mill testing conducted by Coeur (1996c) was 810 mg/L. Reclaimed area runoff and coarse till drainage would not be expected to have elevated levels of TDS and should be well below 1,000 mg/L.
l. pH data are the range of values reported to date for station 101. There are no data to describe the pH range for the DTF area discharge. However, because of the relatively inert tailings, waste rock, and coarse till and the contributions from reclaimed area runoff, a pH range comparable to the mine drainage was included in this table. These levels are comparable to pH ranges detected in lower Sherman Creek.
m. The proposed settling pond system is specifically designed to meet the daily maximum and monthly average TSS limits.

NA = Not Applicable.

ND = Non-Detect.

Source: Modified from Coeur, 1996c.

would be required in the NPDES permit that should ensure no further exceedances. The BMP would include the use of insoluble blasting agents and good housekeeping practices. Similar practices have proven successful in limiting ammonia and nitrate concentrations at existing mines.

Alternative B would lead to increased levels of total dissolved solids (TDS) in Sherman Creek and Camp Creek through discharges of mine drainage and DTF effluent, respectively. TDS levels in the discharges could approach 1,000 mg/L, based on existing mine drainage discharge data. During instream low flows, these levels could be observed in the creeks downstream of the discharges. Background TDS concentrations in the creeks are generally less than 100 mg/L.

The State of Alaska has both a human health and an aquatic life water quality standard for TDS that would be applicable to fresh water discharges from the Kensington Gold Project. The human health standard for TDS is 500 mg/L with neither total chlorides nor sulfates exceeding 200 mg/L. The aquatic life standard is 1,500 mg/L and, more relevant, less than one-third above background levels. Under Alternatives B and D, these standards could not be met without additional treatment. The operator requested the State to establish site-specific criteria of 1,000 mg/L TDS and 500 mg/L sulfate for Sherman Creek. The Public Notice for the requested site-specific criteria was published during the week of January 27–31, 1997. EPA's ROD and final NPDES permit cannot be issued for fresh water discharges of wastewater without the site-specific criteria or project modifications to reduce TDS levels in the discharges.

Available literature indicates that there are no documented effects on fish at TDS levels below 1,500 mg/L, even during sensitive life stages. Toxicity tests were performed on fish and macroinvertebrates using synthetic effluent with TDS levels up to about 2,000 mg/L. The ionic composition of the synthetic effluent was comparable to the anticipated TDS composition in the actual discharges. The fish toxicity studies found no toxicity at any TDS concentrations. The macroinvertebrate testing found toxicity at about 1,400 mg/L but not at 1,000 mg/L. The macroinvertebrate testing did not include *Drunella doddsi*, a macroinvertebrate species for which literature indicates is often intolerant to sulfate concentrations above 50 mg/L. The primary component of TDS in the Kensington Gold Project discharges would be calcium sulfate. *Drunella doddsi* has been found in baseline studies of Sherman Creek where natural sulfate levels are below 50 mg/L. This macroinvertebrate may be a food source for resident fish. However, it has also been observed in Sherman Creek below the existing discharge where sulfate concentrations under instream flow conditions have exceeded 100 mg/L. Apparently, watershed-specific factors may allow *Drunella doddsi* to survive at higher sulfate/TDS concentrations at the Kensington Gold Project site than in other watersheds. Even if effects on this species were observed, it may be replaced by an alternative food source.

In reviewing the basis for the one-third above background life standard for TDS, the State of Alaska only found evidence of documented effects on algae. Such variations can apparently cause undesirable algal food sources and nuissance plant species (ADEC, 1995). Under Alternative B, discharges from the Kensington Gold Project would not cause such effects. This is demonstrated by existing observations downstream of the current discharge where TDS levels are significantly greater than one-third above background levels. Under NPDES permit requirements, surveys of ongoing discharge toxicity and instream aquatic habitat, as well as macroinvertebrates and fish, would be performed throughout the life of the mine. The *Technical Resource Document for Water Resources* (SAIC, 1997a) presents a complete discussion of the anticipated TDS levels in the discharges.

The State drinking water standard for TDS is apparently based on laxative and taste effects (ADEC, 1995). The only scientific reference to TDS-related laxative effects is a 1952 National Research Council study showing that magnesium can cause laxative effects at concentrations of 500 to 1,000 mg/L. Magnesium is not expected to be detected at these levels in discharges from the Kensington Gold Project; existing mine drainage data show all magnesium levels below 54 mg/L. Sodium sulfate and magnesium sulfate cause laxative effects but only at concentrations above 2,000 mg/L. The sulfate and chloride standards of 200 mg/L are based on taste. As noted previously, the site-specific standard request is only for sulfate, not chloride. Chloride levels in existing mine drainage discharge have been consistently below 100 mg/L. There are no scientific references defining the forms of sulfate and levels that cause taste concerns (ADEC, 1995). Many existing water supply systems throughout the United States have sulfate levels well above 200 mg/L. Sulfate levels in the existing mine drainage previously have approached 500 mg/L with no evidence of objectionable taste. In addition, it is unlikely that either Sherman Creek or Camp Creek would be used as a drinking water source downstream of the discharges during active operations. The location of the withdrawal for domestic water at the process area is above the discharge point. After mine closure, the discharges would cease, and both TDS and sulfate levels are expected to return to naturally occurring concentrations.

The potential for long-term generation of acid drainage and associated metals loadings is a concern at many mine sites. Mine drainage data collected for the past 6 years give no indication of potentially acidic conditions (Montgomery Watson, 1996a; Montgomery Watson, 1996b). In addition, the geology of the ore body includes primarily non-acid-generating materials.

As discussed under Section 4.4.2, the treated mine drainage would be combined with runoff from the process area. The principal source of pollutants in this area under normal operating conditions would be the temporary waste rock pile. The waste rock pile would comprise approximately one-third of the drainage area. Runoff from the remainder of the process area would not be contaminated (i.e., there are no significant sources of pollutants other than TSS). All mill operations would be enclosed, and tailings would be transferred directly from the filters to covered trucks. Assuming that the untreated mine drainage represents the worst-case composition of waste rock pile runoff, the combined waste rock and uncontaminated area runoff would not exceed water quality standards (see the *Technical Resource Document for Water Resources* [SAIC, 1997a]). In addition, the operator tested the waste rock for acid generation potential. Acid-base accounting of representative samples of the waste rock showed an NP:MPA of 4.5:1 to 672:1, with most samples having ratios greater than 10:1 (see Appendix E).

DTF Effluent

Effluent from the DTF would be discharged to Camp Creek at outfall 002. Modeling was performed to estimate the water quality of effluent that would be expected to be discharged from the DTF sediment detention pond. The model combined leachate or estimated water quality data from all expected sources, including reclaimed area runoff, coarse till drainage, tailings drainage, and waste rock runoff, with anticipated flows. Reclaimed area runoff is expected to be uncontaminated and has been characterized using data collected for ephemeral drainages in the vicinity of the DTF. Coarse till drainage characteristics were projected based on coarse till leachate analyses. Tailings drainage could represent either residual moisture from the milling process or infiltration through the pile. Tailings drainage was characterized using mill water produced during a 1996 pilot test by the operator and flotation tailings leachate analyses (Coeur, 1996c). The highest values for each parameter from these tests were included in the effluent characterization. As discussed previously, existing mine drainage is assumed to be the worst-case composition of waste rock runoff. Table 4-19 summarizes estimates of flow rates occurring from each source. These flows would vary depending on actual precipitation events and monthly and annual variations in precipitation. Table 4-18, presented previously, provides the worst-case scenario for water quality discharges from the DTF. All concentrations are below the applicable water quality-based limits except for monthly average copper and zinc concentrations at a hardness of 50 mg/L. Downstream hardness typically would exceed 200 mg/L, and the higher limits based on elevated hardness would apply. Low residual ammonia and nitrate levels in the discharge would be ensured by the blasting BMP required by the NPDES permit.

The operator has also applied for the same site-specific criteria for Camp Creek as Sherman Creek: 1,000 mg/L for TDS and 500 mg/L for sulfate. These levels are not expected to adversely affect water quality in Camp Creek for the same reasons as previously described for Sherman Creek.

As noted previously, the existing data indicate that the projected discharge quality at outfall 002 would meet water quality-based NPDES permit limits. The discharge would be monitored under the NPDES permit to ensure compliance with these limits. If pollutant levels were higher than projected, EPA would require the operator to undertake measures to meet permit limits, including providing treatment such as the system used for mine drainage.

Accidental Spills

Under Alternative B, vehicle accidents could affect surface water quality because the proposed haul road essentially parallels Sherman Creek with several crossings (see Figure 2-2, presented in Chapter 2).

Diesel fuel and lead nitrate would be transported from the facilities at Comet Beach to the process area and represent the highest risks for affecting surface water quality. In addition,

Table 4-19. Estimated Average Discharges From DTF Embankment

Contributing Source	Anticipated Quarterly Flows (gpm)				
	Jan, Feb, Mar	Apr, May, Jun	Jul, Aug, Sep	Oct, Nov, Dec	Annual
Waste Rock Runoff	91.7	45.3	93.7	213.0	111
Tailings Drainage	2.9	5.0	5.0	8.4	5
Coarse Till Drainage	28.8	6.7	27.8	156.0	55
Reclaimed Runoff	89.0	9.6	19.2	57.8	44
Quarterly Totals	212.0	67.0	146.0	435.0	215

dewatered tailings and waste rock would be transported to the DTF area for placement into the embankment, thereby creating the potential for surface water contamination.

Diesel fuel would also be transported from storage tanks at the marine terminal to the process area. Approximately 1,300 fuel shipments per year using a 5,000-gallon tanker truck would be required to supply fuel for vehicles and power generation. The maximum consequences of a transportation accident and spill would be the release of 5,000 gallons of diesel fuel to Sherman Creek with the potential for migration to Lynn Canal.

Approximately two truck shipments each carrying about 5 tons of lead nitrate would be required each year for laboratory analyses. The worst-case scenario would be a lead nitrate transportation accident releasing 5 tons of lead nitrate to Sherman Creek with the potential for migration into Lynn Canal.

The transport of dewatered tailings from the process areas to the DTF embankment would require approximately 28,600 truck shipments per year using trucks with a 50-ton capacity. The worst-case scenario would be a transportation accident releasing 50 tons of tailings to Sherman Creek. More likely, a much smaller volume would be released to the creek because the road is generally at least several hundred feet from the stream. The potential impacts would include potential damming of the channel from the tailings, diversion of surface flows, and flooding above the upper banks, which would create overland flows. Tailings eventually would be transported to Lynn Canal. The potential impacts on the water quality of lower Sherman Creek that would result from a spill or discharge of tailings would depend on the volume of flows to dilute pollutants and the rate of discharge to the creek. Data from leachability tests of the flotation tailings show very low concentrations of toxic pollutants, which are not appreciably different from background levels in Sherman Creek. The *Technical Resource Document for Water Resources* (SAIC, 1997a) presents a detailed discussion of tailings test results.

Section 4.13 discusses the expected transportation traffic and the probability of spills for trucks carrying tailings, diesel fuel, and lead nitrate. Sections 4.6 and 4.7 discuss the potential impacts of spills on fisheries.

4.4.4 Effects of Alternative C (Marine Discharge)

The potential impacts to surface water quality from Alternative C would be very similar to those described for Alternative B in Section 4.4.3. The major differences relevant to potential impacts to surface water are that under Alternative C, 1) diesel fuel would be transported from the marine terminal to the process area by pipeline and 2) mine water and DTF effluent would be combined and discharged directly to Lynn Canal. Process area runoff would be discharged to lower Sherman Creek via the sediment detention pond.

Sedimentation

The total area disturbed under Alternative C would be 253 acres. Under this alternative, a pipeline would be constructed to transport diesel from the tanks located at the marine terminal to the process area and powerplant. The potential for erosion and sedimentation to Sherman Creek would increase during the construction phase of this pipeline. This initial construction would provide a temporary disturbance paralleling the access/haul road for 2.2 miles (approximately 2.7 acres). Sedimentation impacts to Sherman Creek are anticipated to be low from this activity. BMPs would be employed during construction to control erosion and sediment loading to the stream. Mulching and revegetation would be used to reclaim the disturbed area.

Under Alternative C, treated mine water and DTF effluent would be piped to Lynn Canal for discharge. Sediment loadings would not occur, therefore, to fresh water from mine drainage or DTF effluent. Alternative C would include the same potential sediment-related impacts associated with discharge of process area runoff as Alternative B. It is anticipated that sedimentation impacts to Sherman Creek would be low from construction of the effluent pipeline. BMPs would be employed during construction to control erosion and sediment loadings to the stream. Mulching and revegetation would be used to reclaim the disturbed area. Potential impacts could only occur from a pipeline rupture and spill, as discussed in the following section.

Alternative C would have the same type of haul road stream crossings as Alternative B; therefore, the potential impacts from sedimentation would be the same. Section 4.4.3 discusses these impacts.

Effluent Quality

Under Alternative C, DTF or mine drainage discharges would not affect fresh water quality because of the marine discharge. In addition, site-specific criteria for TDS and sulfate would not be needed for Sherman and Unnamed creeks. Impacts could only occur from a pipeline rupture and spill. Under Alternative C, the potential water quality effects from process area runoff, including runoff from the temporary waste rock pile, are the same as under Alternative B (see Section 4.4.3).

Accidental Spills

Vehicle accidents or a rupture of the diesel or effluent pipelines could affect surface water quality. The potential for impacts from vehicle accidents under Alternative C are the same as those described for Alternative B for lead nitrate and tailings (see Section 4.4.3). The potential for vehicle accidents, spills, and impacts to Sherman Creek by trucking diesel would be eliminated by the pipeline.

The relative proximity of the diesel pipeline to the Sherman Creek channel would provide the potential for leakage of fuel to surface water. The worst-case scenario for a pipeline rupture would be that the entire pipe volume of diesel fuel would flow into Sherman Creek. The maximum volume of the pipeline is estimated to be 17,000 gallons.

Under Alternative C, mine drainage and DTF effluent would also be piped to Lynn Canal for discharge. Pollutant concentrations in mine drainage and DTF effluent are very low.

Therefore, an individual spill would not significantly affect water quality in Sherman Creek or Camp Creek.

Section 4.13 discusses transportation traffic and the probability of spills for trucks carrying lead nitrate and tailings and presents the probability of a diesel pipeline rupture. Sections 4.6 and 4.7 discuss the potential impacts of spills on fisheries.

4.4.5 Effects of Alternative D (Modified DTF Design)

Sedimentation

The total area disturbed under Alternative D would be 270 acres. The tailings slurry pipeline would provide a 10 foot wide linear disturbance paralleling the access/haul road for 1.5 miles, which is approximately 1.8 acres. The return recycle pipeline would parallel the slurry pipeline and result in no significant increase in the area disturbed. It is anticipated that the potential sedimentation impacts to Sherman Creek associated with construction and operation would be low. BMPs would be employed during construction to control erosion and sediment loading to the stream. Mulching and revegetation would be used to reclaim the disturbed area from the initial construction, and BMP practices would be employed to minimize erosion along the pipeline during mine operation. As discussed previously, this alternative would include 75 percent less truck use of the haul road. This would cause less potential for road surface erosion and stream sedimentation.

Alternative D incorporates a modified design for the DTF embankment that would involve construction of an engineered structural berm. This design would increase the size of the footprint approximately 18 acres, providing more surface area available for erosion. Because of the use of BMPs and the projected performance of the sediment detention pond, this design modification is not anticipated to significantly change the potential for sediment loadings and impacts to surface water from those described under Alternatives B and C in Sections 4.4.3 and 4.4.4, respectively.

Under Alternative D, haul road crossings on upper Sherman Creek and Ivanhoe Creek would be bridges. The potential impacts associated with the use of bridges for these crossings are discussed in Section 4.3.5. Extreme events could cause scouring and erosion around the footings (i.e., abutments) of the bridges. Erosion would increase the potential for sediment loading to downstream reaches during extreme flow events. The degree of sediment loading, above that which occurs naturally, would depend on the size distribution of particles and volume of material eroded from the crossing, the size of the flow event, and the effectiveness of the BMP practices employed. As discussed in Section 4.3.5, the potential for erosion and any resulting sedimentation would be less than that associated with the conduit crossings under Alternatives B and C.

Effluent Quality

The potential impacts associated with the discharge of process effluents or waste sources are the same as those described for Alternative B in Section 4.4.3.

Accidental Spills

The potential for impacts from vehicle accidents under Alternative D are the same as those described for Alternative B for lead nitrate and diesel. Under Alternative D, the potential for vehicle accidents, spills, and impacts to Sherman Creek by trucking tailings would be eliminated by a tailings pipeline to the DTF area. A catastrophic rupture of the tailings pipeline near the dewatering facility would result in a release of 270,000 gallons and associated solids; however, spills would most likely be much smaller in magnitude and involve substantially less material. Minor pipeline failures would be contained within the pipeline's secondary containment (double walls). Although the pipeline parallels the haul road, any released material could spill to Sherman Creek. The operator characterized flotation tailings produced from two pilot-scale milling runs in 1996. These data show very low levels of leachable pollutants in the tailings.

Section 4.13 discusses transportation traffic and the probability of spills for trucks carrying diesel fuel and lead nitrate and presents the potential for a tailings pipeline rupture. Sections 4.6 and 4.7 discuss the potential impacts of spills on fisheries.

4.4.6 Summary

The potential for impacts from sedimentation would be the greatest during construction periods for all alternatives. The degree of erosion and sedimentation are a function of the intensity and volume of storm events. Alternative A would have the largest area of disturbance (281 acres) of all alternatives, thereby providing the greatest potential for erosion and sedimentation, especially during construction periods. Alternatives B through D would have similar areas of disturbance, with Alternative B being the lowest (250 acres). The small differences in acreages potentially disturbed among Alternatives B through D are because of proposed pipelines; Alternative C would have a diesel pipeline, and Alternative D would have a tailings slurry pipeline. Pipeline construction would create a linear disturbance along lower Sherman Creek, with a corresponding increase in the potential for erosion and impacts to water quality. However, the pipelines would also reduce road traffic and the associated potential for road surface erosion and stream sedimentation.

Under Alternative A, marine discharge would eliminate the potential fresh water quality impacts from pollutant loadings from the impoundment. Sherman Creek only could be affected from an unlikely failure of the tailings dam. Treated mine drainage and process area storm water would be discharged to lower Sherman Creek under Alternatives B and D; however, minimal impacts to surface water quality are expected. Marine discharge to Lynn Canal under Alternative C would eliminate pollutant loadings, and, therefore, the associated potential impacts to Sherman Creek and Camp Creek from treated mine drainage and DTF effluent.

Accidental spills or pipeline ruptures of fuels and process effluents under all alternatives could affect the water quality of lower Sherman Creek. Alternative A would have onsite processing using cyanide. Alternatives B through D would not involve onsite processing and, therefore, would eliminate cyanide as a potential source of surface water impacts. Alternatives B and D would include increased use of diesel fuel and, therefore, potential for diesel spills.

Potential increases in sedimentation to downstream reaches could occur at haul road crossings under all alternatives. The potential for these impacts would be lower under Alternative D because of the use of bridges on upper Sherman Creek and Ivanhoe Creek instead of the long-span bottomless arch conduits under Alternatives B and C.

4.5 GROUND WATER HYDROLOGY AND QUALITY

The Kensington Gold Project could affect local ground water hydrology and quality. Activities that could affect ground water resources and quality include mine drainage, treatment, and water discharge; waste rock storage; tailings storage; and accidental spills from transportation accidents or pipeline ruptures. Ground water hydrology could be affected by drawdowns of local aquifers, which could change the amount of water reaching receiving streams. The placement of the tailings disposal areas could affect the amount of infiltration serving to recharge shallow aquifers. In addition, chemical constituents of leachate from tailings or waste rock could affect ground water quality. The exposure of ground water to air within the mine workings also could produce changes in ground water chemistry.

Some impacts to ground water have occurred already because of the historic mining activities and recent exploration. At present, ground water collects in existing areas of the mine and discharges to the surface after treatment through a pond system. This flux of ground water into the mine affects the natural ground water recharge-discharge characteristics of the area by creating a small drawdown in the ground water table.

The potential impacts to ground water do not differ significantly among Alternatives B, C, and D. This section, therefore, only analyzes the potential impacts on ground water hydrology and ground water quality associated with Alternative A and those that are common for Alternatives B through D. The potential environmental effects caused by each alternative are discussed using changes in hydrology and water quality as indicators.

4.5.1 Effects of Alternative A (No Action)

Ground Water Hydrology

Mine Workings

The underground mine drainage currently causes, and will continue to produce, changes in the ground water flow direction and recharge rates in the vicinity of the active mine workings. Ground water in the area would flow toward the underground workings. The zone of influence of the mine drainage is limited, however, because of the low permeability of the aquifer and the steep surficial topography of the strata. Combined with the fact that ground water is not used in the area, these impacts to ground water hydrology would be localized and are not considered significant.

Tailings Management

The 225-acre tailings impoundment would be constructed over generally low permeability sediments of the glaciofluvial and glaciolacustrine tills. Measurements for hydraulic conductivity in this area have ranged between 7.4×10^{-6} and 8.8×10^{-7} centimeters per second; this part of the basin is considered to be gaining (i.e., net water balance is generally increasing). These two factors combine to suggest that potential impacts to the recharge and natural discharge of ground water in this area would not be significant.

Ground Water Quality

Mine Workings

Impacts to ground water quality could include chemical changes as ground water is exposed to oxygen in the mine workings. Existing monitoring data on mine drainage generally show no evidence of acid generation or variation from natural background quality. Sections 3.8.1 and 3.8.2 summarize existing ground water monitoring data.

Waste Rock Seepage

Water leaching through waste rock and infiltrating to ground water could impact ground water quality. Under Alternative A, waste rock would be used in construction of the tailings embankment, road surfacing, rip-rap, and final reclamation activities. Some waste rock would remain in the pile within the impoundment drainage area. The *Technical Resource Document for Water Resources* (SAIC, 1997a) presents the results of geochemical testing of ore and waste rock. These data suggest that both the potential for impacts related to poor quality leachate and the acid generation potential of these minerals are very low.

Tailings Seepage

Direct seepage from the tailings impoundment into the ground water system and subsequent ground water contamination could affect water quality. Under Alternative A, the operator would construct a collection pond downstream of the tailings embankment to collect seepage. Collected water would be recycled back to the impoundment. The water quality of the seepage would be monitored throughout the mine operation to provide data necessary to determine the need for seepage water quality control measures after final reclamation.

Accidental Spills

Any accidental spill or rupture of a pipeline could impact ground water quality through infiltration of liquids directly into the ground or from infiltration of waters contaminated from the spill. The main sources of potential contamination are the accidental spill or rupture of the marine discharge pipeline and transportation of hazardous materials. Section 4.4 discusses the potential for accidental spills or ruptures of pipelines under Alternative A.

4.5.2 Effects Common to Alternatives B Through D

Ground Water Hydrology

Mine Workings

The potential impacts associated with mine development on ground water hydrology and ground water quality are the same as those discussed for Alternative A in Section 4.5.1. The development of the mine and the mine workings would produce limited impacts that would not be significant to ground water hydrology in the Sherman Creek basin.

Tailings Management

The construction of the DTF would include installation of diversions to carry upslope surface water runoff around the facility. These diversions would contact bedrock and could intercept ground water. Although the interception of ground water should not affect the overall site hydrology, any unsalvaged organic material underlying the DTF would be drained. Draining the organic layers below the DTF would be necessary to support its long-term stability. While dewatering of this material would cause an impact locally, the effects would be limited to areas where drainage is necessary for structural stability. Therefore, the DTF and its associated facilities are not expected to significantly impact ground water hydrology.

Ground Water Quality

Mine Workings

The potential impacts on ground water quality from Alternatives B through D associated with the mine workings would be similar to those described for Alternative A in Section 4.5.1. As discussed previously, flotation tailings and waste rock would have little or no acid generation potential and undetected or very low concentrations of pollutants. Therefore, paste backfill of flotation tailings and backfill of waste rock should not affect ground water quality.

Waste Rock Seepage

Water leaching through waste rock and infiltrating to ground water could impact ground water quality. Waste rock would be used in construction of the process area foundation and DTF, as well as for mine backfill. A temporary storage pile would be maintained near the mine portal for the first 3 to 4 years of operation. Section 2.3.3 provides a detailed description of waste rock management under Alternatives B through D. As discussed previously, geochemical testing indicates that impacts on ground water quality from waste rock are not expected.

Tailings Seepage

The low permeability layer underlying the DTF would be designed to minimize contact between tailings seepage and ground water. Seepage would be drained and routed to a sediment detention basin and discharged to Camp Creek. Geochemical testing of flotation tailings show virtually no acid generation potential and undetected or very low concentrations of toxic pollutants. Therefore, impacts to ground water quality are not expected from seepage from the DTF.

Accidental Spills

Any accidental spill or rupture of a pipeline could impact ground water quality through infiltration of liquids directly into the ground or from infiltration of waters that have become contaminated from the spill. Sections 4.3 and 4.13 discuss the potential sources of spills or accidents and the probability of occurrence for Alternatives B through D.

4.5.3 Summary

The potential impacts associated with mine development on ground water hydrology and ground water quality would be the same for all alternatives. Potential impacts to hydrology in the Sherman Creek basin or to water quality are not expected from either the development of the mine or mine workings.

Waste rock would be primarily managed and disposed of in the tailings impoundment under Alternative A and disposed of in the DTF embankment or backfilled under Alternatives B through D. Geochemical testing and modeling conducted by the operator indicate that potential impacts to ground water quality would not be significant under either of these approaches.

The potential impacts to ground water from tailings seepage would not be significant under any alternative. Under Alternative A, tailings impoundment seepage would be collected in a pond and monitored to determine the need for any mitigation after closure. Under Alternatives B through D, seepage from the DTF would also be collected during operations. Flotation tailings have negligible acid generation potential and are not expected to affect ground water quality.

A spill or pipeline rupture under all the alternatives could affect ground water quality. The potential impacts from a cyanide spill could only occur under Alternative A.

4.6 AQUATIC RESOURCES – MARINE

Implementation of any of the alternatives would have the potential to affect the marine environment. Effects to the marine environment can be assessed through chemical changes in water quality and physical changes to marine habitats. The following indicators were used to assess the extent of potential impacts to the marine environment:

- Water quality
- Sedimentation
- Integrity of marine habitats.

None of the alternatives is expected to have any measurable effects on oceanographic processes within Lynn Canal. Currents and tides can affect the dispersion and fate of wastewater discharges to Lynn Canal and materials spilled in Lynn Canal. Therefore, this section discusses oceanographic processes that could affect the significance of potential impacts to marine water quality and biological resources.

4.6.1 Effects of Alternative A (No Action)

Water Quality

Wastewater Discharge

Under Alternative A, wastewater would consist of effluent from the tailings impoundment (i.e., tailings water and mine water) that would be treated by enhanced settling to remove the larger suspended solids. The NPDES permit would define receiving water limits for the wastewater discharge. Following discharge, the effluent plume would rise in the water column, due to its lower density and buoyancy, and mix rapidly with ambient sea water. Mixing between the effluent plume and receiving waters would dilute the wastewater. The resultant constituent concentrations would depend on the initial concentrations in the effluent, plume dilution rates, and settling of effluent particles. Table 4-20 lists the estimated concentrations of trace metals in the effluent before initial dilution. The *Technical Resource Document for Water Resources* (SAIC, 1997a) discusses the approach for deriving these estimates, including new data compiled by the operator since publication of the 1992 FEIS. Cyanide would require the largest dilution (31:1) to achieve compliance with the applicable standards. With a projected discharge rate of 3,200 gpm, a mixing zone of about 100,000 gallons or 13,700 cubic feet (i.e., a cube 24 feet on each side) of sea water would be necessary. EPA and ADEC would make a final determination on the size of a mixing zone during the NPDES permitting process for this alternative.

Exposure of aquatic organisms to the effluent plume within the mixing zone would pose the greatest potential for acute or chronic toxicity. Due to the size of the mixing zone and the nature of the effluent, however, exposure to the effluent plume is not expected to produce significant effects. As discussed in Chapter 2, the location of the outfall was moved to one-half mile offshore at a depth of about 300 feet. This was done in response to comments in the TAR and by local fisherman related to nearshore eddies in the vicinity of Point Sherman. These eddies could have affected mixing and available dilution at the outfall location identified in the 1992 FEIS. The new outfall location was established based on a study in 1995 on currents near Point Sherman (Echo Bay Mines, 1995). This study indicates that nearshore eddies form in shallow (less than 100 feet) waters within one-quarter to one-half mile offshore. By locating the outfall one-half mile offshore at a depth of 300 feet, the discharge would be beyond the eddy influences. In addition, the new location is outside of the primary nearshore commercial fishing area.

The potential for bioaccumulation of effluent-derived metals also is small. The greatest potential for tissue bioaccumulation of metals would be for bottom-dwelling invertebrates, which could ingest effluent particles deposited on the seafloor. Because the magnitude of expected changes in sediment metal concentrations attributable to the effluent discharge is small, the potential for significant increases in bioaccumulation is considered negligible.

Table 4-20. Marine Discharge Quality Under Alternative A

Parameter	Background, Lynn Canal (μg/L) [a]	Predicted Marine Discharge Quality, Outfall 001 (μg/L) [b]	Average Monthly Limits (μg/L)[b]	Dilution Factor
Ag	0.001	0.3	1.88	NA
As	1.48	2.7[c]	1.4[c]	NA[c]
Cd	0.2	0.2	7.61	NA
Cr	0.2	4.3	40.94	NA
Cu	0.85	13.7	2.37	8.44:1
Hg	0.0007	0.04	0.02	2.16:1
Ni	0.08	5.3	5.81	NA
Pb	0.17	10.0	4.59	2.23:1
Se	ND	2.8	10.0	NA
Zn	1.2	20.5	47.49	NA
CN	ND	25.5	0.82	31.07:1

a. EPA, 1994.
b. See the *Technical Resource Document for Water Resources* (SAIC, 1997a) for derivation of outfall characteristics and NPDES permit limits.
c. As discussed in Section 4.4, the method detection limit for arsenic is 3.0 μg/L. Compliance with permit limits would be demonstrated by reporting concentrations less than 3.0 μg/L. Because the projected arsenic concentration at outfall 001 is less than 3.0 μg/L, no dilution would be required to meet permit limits.
NA = Not Applicable.
ND = Non-Detect.

The wastewater discharge would be required to meet NPDES permit limits for a daily maximum TSS level of 30 mg/L and a monthly average of 20 mg/L at the point of discharge. Compliance would be achieved using BMPs throughout the catchment area and enhanced settling in the impoundment. Effluent discharges could result in elevated suspended solids concentrations within the immediate vicinity of the outfall. Proportional reductions in light transmittance could be associated with the elevated suspended solids concentrations; however, any effects from reduced light transmittance on phytoplankton productivity are expected to be insignificant.

Sewage included in the tailings effluent would not be expected to have significant impacts on marine aquatic resources because the wastewater should not contain appreciable levels of any substances considered potentially toxic or harmful to marine organisms. Bacteria present in the sewage effluent could be consumed and accumulated by filter-feeding bivalves.

Accidental Spills

Alternative A would use LPG as the primary fuel for onsite operations. LPG is extremely volatile and would evaporate rapidly from a spill to surface waters or to the ground. Therefore, LPG is not expected to persist in the marine environment, and potential impacts to water quality probably would be localized and temporary.

The most likely source of diesel spills to Lynn Canal under Alternative A would be transfers, such as between barges and storage tanks, with relatively small volumes. As discussed in Section 4.12.1, the maximum potential spill during diesel fuel transfer is about 880 gallons. Vessel groundings, collisions, or other accidents causing a rupture in a vessel hull could release large volumes of diesel fuel, although the probability of these spills is considerably lower than the probability of a spill during fuel transfer (see Section 4.1.3).

The dispersion of diesel within Lynn Canal would depend on the combined strength of tidal currents, wind and wave mixing, longer period current patterns, and the extent of previous weathering (i.e., changes to the physical/chemical properties of the material). Diesel consists primarily of low to medium molecular hydrocarbon compounds that are relatively more volatile and water soluble than the higher molecular weight components of crude oils. Therefore, a relatively greater proportion of a diesel spill is lost to evaporation and dissolution than occurs with a crude oil spill. Although diesel is more volatile than crude oils, some of the soluble components, such as the lower molecular weight aromatic compounds, can be acutely toxic to marine organisms. In addition, polycyclic aromatic hydrocarbons (PAHs) within diesel can bioaccumulate in the tissues of marine invertebrates exposed to fuel spills. Bioaccumulation of PAHs in fish tissues are not a concern because fish can metabolize PAHs. Chronic exposures to PAH-contaminated sediments near urbanized settings, however, have been suggested as a possible cause for development of tissue pathologies in bottom-dwelling fish.

Conditions promoting the greatest longevity of diesel fuel residues in the environment would be burial in intertidal muds or marshes, where the potential for evaporation and dissolution/dilution is minimized. Because intertidal muds and marshes do not occur in the immediate vicinity of the project area, the long-term persistence of diesel resulting from a spill is not expected. In addition, it is unlikely that significant portions of a diesel spill would sink to the bottom of Lynn Canal.

Cyanide spilled into Lynn Canal would dissolve readily in water, thereby resulting in acute toxicity to marine organisms within the immediate vicinity of the spill. Long-term changes to water quality would not be expected because cyanide degrades rapidly in the environment. Spills of other chemicals, including chlorine and caustics, are potential sources of acute toxicity to marine organisms. Long-term impacts to water quality are unlikely, however, because these materials would not persist in a toxic form.

Sedimentation

The effluent discharge under Alternative A would not exceed the monthly average TSS limit of 20 mg/L and the daily maximum limit of 30 mg/L included in the NPDES permit. Therefore, the passage of light would not be affected by the discharge.

Because trace metals in the effluent probably would adsorb onto suspended particles, deposition and accumulation of effluent particles in bottom sediments are potential concerns. Based on modeling results described in the 1992 FEIS, settling of effluent particles would be expected to increase the yearly solids deposition rates near the outfall by 3 percent. In addition, accumulation of effluent particles on the bottom could result in increased metals concentrations in bottom sediments of less than 15 percent, with the exception that lead concentrations in sediments near the outfall could increase by an estimated 74 percent above background levels. Changes in solids deposition rates of 3 percent and in sediment metal concentrations of less than 15 percent are considered to be within the range of natural variability.

Under Alternative A, excavation for construction of a temporary barge landing site at Comet Beach could impact marine water quality. Excavation probably would result in short-term increases in suspended sediments in the nearshore waters adjacent to the excavation site. In general, increased suspended sediment concentrations could reduce water clarity and light transmittance of surface waters. Because the nearshore sediments are primarily cobbles (see Chapter 3), which should settle rapidly to the bottom, however, the magnitude and duration of this effect are expected to be minor. Similarly, soils from erosion and/or other materials generated by runoff from other portions of the project area could be transported to Lynn Canal. The potential impacts to nearshore water quality from runoff also are expected to be minor and comparable to the potential effects from discharges by adjacent creeks and streams.

Integrity of Marine Habitats

The construction of the marine terminal would require dredging a portion of Comet Beach in the immediate vicinity of the barge landing area. The dredging would physically disturb approximately 2.3 acres of the cobble beach habitat. The potential for significant impacts from construction and operation of the facility on marine organisms or sensitive habitats is negligible. Increases in suspended particle concentrations are expected to be temporary and localized. Disturbances of substrate also would be localized, and newly constructed facilities probably would be recolonized rapidly.

4.6.2 Effects Common to Alternatives B Through D

Water Quality

Wastewater Discharge

Under Alternatives B through D, sanitary wastewater from the Comet Beach area would undergo secondary treatment prior to discharge to Lynn Canal. Sewage effluent can be a source of suspended solids, organic materials, nutrients, and fecal bacteria and viruses. Because the nearshore waters of Lynn Canal are well mixed, significant accumulations of solids and organic matter from the sewage effluent are not expected. Similarly, eutrophication and oxygen depletion of bottom waters due to increased oxygen demand are not expected. Bacteria and viruses associated with the sewage would experience natural die-off; therefore, the accumulation of bacteria and pathogens in Lynn Canal is not expected.

The discharges of treated sewage represent a potential source for nutrients that could stimulate phytoplankton production within a localized area of Lynn Canal. This effect could be offset by related reductions in light transmittance, however, caused by elevated localized turbidity associated with the effluent plume.

Accidental Spills

Alternatives B through D would use diesel as an onsite energy source. The potential impacts resulting from a diesel spill would be the same as those discussed under Alternative A. As indicated in Section 4.12.1, the maximum potential spill during fuel transfer is 880 gallons. However, the probability of a spill would be greater because of the increased use. Compared to Alternative A, therefore, Alternatives B through D have a higher probability for potential impacts to aquatic organisms from diesel spills. The potential impacts from a spill of cyanide would be eliminated because this material would not be stored or used onsite. The extent of chlorine used at the site would be minimal compared to Alternative A, with a subsequent reduction in the potential extent of impacts related to a spill.

Under Alternatives B through D, ore concentrate would be shipped weekly from the site. The material would be containerized as 1,400-ton loads and transported by barge. Spills of ore concentrate would not be a concern unless containers ruptured, in which case any potential impact would be insignificant and short-term.

Sedimentation

Increases in suspended particle concentrations due to excavation of the landing and/or runoff-related inputs of particles (e.g., soils) to nearshore areas of Lynn Canal would be similar to those described for Alternative A. The magnitude and duration of any potential impacts to marine water quality would be insignificant.

Integrity of Marine Habitats

Under Alternatives B through D, a marine terminal would also be constructed. As described for Alternative A, construction of the facility would require dredging approximately 2.3 acres of Comet Beach in the immediate vicinity of the barge landing area. The dredging would result in a localized physical disturbance of the cobble beach habitat. The potential for significant impacts from construction and operation of the facility to marine organisms or sensitive habitats is negligible. Increases in suspended particle concentrations are expected to be temporary and localized. Disturbances of substrate also would be localized, and newly constructed facilities probably would be recolonized rapidly.

4.6.3 Effects of Alternative B (Proposed Action)

Water Quality

Wastewater Discharge

The potential impacts from Alternative B to marine water quality are associated with 1) direct discharges of treated sanitary wastewater to Lynn Canal and/or 2) indirect impacts from fresh water discharges containing elevated suspended solids, trace metals, and/or nutrients. The effects of direct discharges of sanitary wastewater are addressed in Section 4.6.2. The effects to marine water quality from outflow from Sherman Creek and Camp Creek are expected to be insignificant, assuming that the fresh water discharges meet all NPDES permit limits. Therefore, no acute or chronic toxicity to marine organisms from exposures to the stream inputs to Lynn Canal is expected.

Sedimentation

Under Alternative B, trace metals transported by runoff are expected to adsorb onto natural suspended particles and eventually settle to the bottom of Lynn Canal. The deposition and accumulation of sediment-associated trace metals within shoreline areas of Lynn Canal would be unlikely due to the naturally high turbulence that is responsible for erosion of fine-grained sediments. Instead, small particles probably would be transported to the deeper, quiescent areas of Lynn Canal. Regardless, incremental increases in the trace metal concentrations of these particles are not expected to result in significant increases in metal concentrations and subsequent decline in the quality of bottom sediments. Similarly, no significant changes in uptake and accumulation of metals in tissues of marine organisms are expected.

4.6.4 Effects of Alternative C (Marine Discharge)

Under Alternative C, treated mine drainage and DTF effluent would be combined and discharged directly to Lynn Canal.

Water Quality

Wastewater Discharge

Table 4-21 lists the projected composition of the marine discharge and projected water quality-based NPDES permit limits for Alternative C. The *Technical Resource Document for Water Resources* (SAIC, 1997a) describes the approach used for determining the discharge characteristics. A mixing zone would be needed for compliance with the water quality-based permit limit for copper. For a combined DTF effluent and mine drainage discharge of 1,435 gpm, the discharge would require mixing with 6,113 gallons or 825 cubic feet (a cube approximately 9 feet on a side) of sea water. Under Alternative C, the untreated discharge would be through a multiport diffuser located 300 feet offshore at an elevation of 30 feet below the low-tide elevation. As discussed in Chapter 2, the nearshore discharge location was selected because of the limited size of the mixing zone required under Alternative C. The minimal necessary dilution should be available despite the presence of nearshore eddies. If Alternative C is selected, the final location of the outfall and extent of any mixing zone will be determined during the NPDES permitting process. If a mixing zone was not granted by the State, additional treatment comparable to the mine drainage treatment system under Alternatives B and D would likely be necessary to meet NPDES permit limits.

Table 4-21. Marine Discharge Quality Under Alternative C

Parameter	Background, Lynn Canal (μg/L)[a]	Predicted Marine Discharge Quality, Outfall 002 (μg/L)[b]	Average Monthly Limits (μg/L)[c]	Dilution Factor (μg/L)
Ag	0.001	0.12	1.88	NA
As	1.48	2.07	<3.0[d]	NA
Cd	0.2	ND[e]	7.61	NA
Cr	0.2	ND[e]	40.94	NA
Cu	0.85	8.85	2.37	4.26:1
Hg	0.0007	ND[e]	0.02	NA
Ni	0.08	0.41	5.81	NA
Pb	0.17	1.27	4.59	NA
Se	NA	0.01	10.0	NA
Zn	1.2	12.95	47.49	NA

a. EPA, 1994.
b. Derived from combining flow-weighted projected untreated mine drainage and DTF effluent concentrations as discussed in Section 4.4 and Table 4-17.
c. See the *Technical Resource Document for Water Resources* (SAIC, 1997a).
d. As discussed in Section 4.4, the method detection limit for arsenic is 3.0 μg/L. Compliance with permit limits would be demonstrated by reporting concentrations less than 3.0 μg/L. Because the projected arsenic concentration at outfall 001 is less than 3.0 μg/L, no dilution would be required to meet permit limits.
e. Non-detected values represent characterization data for multiple streams; see SAIC (1997a) for detection limits for each stream.
NA = Not Applicable.
ND = Non-Detect.

Exposure of aquatic organisms to the effluent plume within the mixing zone would pose the greatest potential for acute or chronic toxicity. Due to the size of the mixing zone and the nature of the effluent, however, exposure to the effluent plume is not expected to produce significant effects.

The potential for bioaccumulation of effluent-derived metals also is small. The greatest potential for tissue bioaccumulation of metals would be for bottom-dwelling invertebrates, which could ingest effluent particles deposited on the seafloor. Because the magnitude of expected changes in sediment metal concentrations attributable to the effluent discharge is small, the potential for significant increases in bioaccumulation is considered negligible.

Sedimentation

The potential impacts from sediment in the effluent discharge under Alternative C would be comparable to Alternative A, because both discharges would not exceed the monthly average TSS limit of 20 mg/L and daily maximum limit of 30 mg/L required by the NPDES permit. Alternative C, therefore, would not affect the passage of light.

4.6.5 Effects of Alternative D (Modified DTF Design)

The potential effects on marine aquatic resources from Alternative D would be similar to those described for Alternative B in Section 4.6.3.

4.6.6 Summary

Table 4-22 presents the differences among the four alternatives in regard to marine resources. Only Alternatives A and C propose a marine discharge for process wastewater, although domestic wastewater would be discharged to Lynn Canal under all alternatives. Effluent generated under Alternative A would be piped to one-half mile offshore Lynn Canal and would require a mixing zone of approximately 13,700 cubic feet (a cube 24 feet on a side) to meet the water quality-based permit limit for cyanide. Under Alternative C, the discharge to Lynn Canal would be nearshore and require a mixing zone of 825 cubic feet (a cube 9 feet on a side) to the water quality-based permit limit for copper. Because fuel and process reagents would be shipped to the site by barge, a spill to the marine environment would be possible under each alternative. Section 4.13 discusses the probabilities of spill under each alternative.

4.7 AQUATIC RESOURCES – FRESH WATER

All alternatives would affect fresh water aquatic resources within the Sherman Creek and Ophir Creek drainages. Impacts could result from the diversion of existing channels, the withdrawal of water for the milling process, and changes to water quality associated with construction-and operation-related discharges. The following indicators were used to compare the potential impacts of each alternative:

- Integrity of fresh water habitat
- Water withdrawal
- Water quality
- Sedimentation.

4.7.1 Effects of Alternative A (No Action)

The potential impacts associated with Alternative A would occur within the Sherman Creek drainage, including the Ophir Creek sub-basin. Stream diversions and the tailings impoundment would affect habitat directly; withdrawals and discharges within Sherman Creek could also affect water quantity and quality in Sherman Creek (see Section 4.6).

Table 4-22. Factors Associated With Potential Impacts to Marine Aquatic Resources

Alternative	Discharge Location	Primary Spill Concerns	Mixing Zone
A (No Action)	Marine	LPG, cyanide, chlorine, diesel	Yes
B (Proposed Action)	Fresh Water/Marine	Diesel	No
C (Marine Discharge)	Marine	Diesel	Yes
D (Modified DTF Design)	Fresh Water/Marine	Diesel	No

Integrity of Fresh Water Habitat

Alternative A would directly affect three stream courses: upper Sherman Creek above the confluence with Ivanhoe Creek, Ophir Creek, and South Fork Sherman Creek. These drainages would be impacted physically by the construction of the tailings impoundment and diversion of the streams around the impoundment.

Upper Sherman Creek and South Fork Sherman Creek would be routed through a buried pipeline approximately 1 mile in length. Water would be discharged back to the natural stream channel of Sherman Creek below the tailings dam. Ophir Creek and Ivanhoe Creek would be diverted for approximately 2,950 feet and discharged down a concrete spillway to lower Sherman Creek.

These diversions would eliminate approximately 6,000 feet of stream habitat. This would be fatal to 400 to 500 resident Dolly Varden residing within the natural stream channels. All fish in this section would be lost as a result of this action, with the exception of a few near the lower end that could escape when flows were cutoff. Any fish mortality associated with the Ophir Creek diversion would be less than in the Sherman Creek drainage.

Stream temperatures in lower Sherman Creek during summer would not be expected to be altered detrimentally from the diversions.

Water Withdrawal

Alternative A would require water withdrawal from upper Sherman Creek. The withdrawal would consist of approximately 0.42 cfs and would comply with required instream flow requirements developed by ADF&G and permitted by ADNR. Withdrawals could often be restricted during periods of critical flow. To address potential water supply shortages to the mill circuit and for domestic purposes, the operator would use treated mine drainage to supplement water supply during critical periods, if it were necessary to meet instream flows. The restrictions on water withdrawal and the development of alternative sources should minimize adverse effects associated with flow reductions to aquatic habitat.

In addition, the tailings impoundment would be a source of reduced flows in lower Sherman Creek because it represents approximately 10 percent of the drainage area within the Sherman Creek drainage. Rather than passing through to Sherman Creek, drainage from this area ultimately would be discharged to Lynn Canal through the marine discharge. The flow intercepted by the tailings impoundment is not expected to produce a significant effect on stream flow below the impoundment.

Water Quality

Under Alternative A, a seepage collection facility would be located immediately downstream of the dam to protect lower Sherman Creek from contamination by tailings seepage. All seepage from the impoundment would be pumped back as recycle water under the proposed plan. If this system was to fail, some water could pass downstream. Although such material would be expected to be relatively low in metal concentrations, downstream monitoring could be conducted to ensure that background metal levels would not be exceeded. Should levels increase over time, additional measures would be required to prevent further contamination.

The worst-case scenario for leakage would be a dam failure. A dam failure is projected to result in a peak flow release of approximately 17,000 cfs and about 215,000 tons of solids transported from the tailings and embankment. Such a flow of water and sediment would severely disrupt the lower Sherman Creek environment. The streambed would be destabilized and the gravel substrate scoured. Existing habitat structure associated with large woody debris would be destroyed. Slides or slumps along some areas of the stream could be triggered, bringing in new material, including both sediment and trees. As stream flow rapidly declined, sediment would be deposited in some areas of the stream. Fish and aquatic invertebrates would be reduced to very low levels as a result of these events, although they probably would not be eliminated. Subsequently, the stream would be expected to recover over a period of several years. As discussed in Section 4.2, the likelihood of a dam failure is very low.

Following project termination, the Sherman Creek channel would be reconstructed through the upper portion of the tailings impoundment to the Ophir Creek diversion near the dam, and the Sherman Creek diversion would be closed off. Both Ophir and Sherman Creeks would be routed through the tailings structure. All flows would be routed to lower Sherman Creek downstream of the dam. Permanent erosion control measures would be implemented to protect surface waters from siltation originating on disturbed areas or the roads.

The effectiveness of the proposed plan for making the site suitable for fish production would depend on site stability and water quality. The highest priority for the reclamation effort would be ensuring channel stability, followed closely by recreating viable populations of resident fish. The conceptual reclamation plan for the tailings impoundment would provide an opportunity to evaluate the design and reclamation methods for these types of projects. Given natural low densities of resident Dolly Varden in Sherman Creek, habitat could be created to produce more fish than currently exist. Stock from the upper reaches of Sherman Creek upstream of the proposed diversion would be used to rebuild the population in the area to be reclaimed. Utilizing stock from the same stream would facilitate the maintenance of genetic integrity for the population.

4.7.2 Effects Common to Alternatives B Through D

Integrity of Fresh Water Habitat

Under Alternatives B through D, the south tributary of Ophir Creek would be diverted into Ivanhoe Creek during the life of the mine, which would result in a temporary loss of approximately 2,450 feet (0.5 miles) of natural stream channel (SRK, 1996h). All fish in this section would be lost as a result of this action, except for a few near the lower end that could escape when flows were cut off. Fish densities are low in this region; however, direct estimates are not available. The estimate for the middle section of Sherman Creek (approximately 15 feet wide) is approximately one fish per 500 square feet of water surface. This probably exceeds the densities in the south tributary of Ophir Creek, which has intermittent flow. Using the Sherman Creek densities as a worst-case assessment, between 125 and 170 resident Dolly Varden could potentially be lost because of the Ophir Creek diversion.

In addition, the DTF would impact six small stream systems. Storm water and drainage would be collected and routed through the diversions. These stream systems do not appear to support fish populations and might be ephemeral. Invertebrate populations probably are sparse and transitory. Loss of these drainages probably would have a negligible impact on aquatic populations within the project area.

Five stream crossings would be required by the haul road. All road construction activities would be timed to avoid critical periods for anadromous fish. The Forest Service and ADF&G would coordinate to identify these periods.

One haul road crossing of an unnamed tributary to lower Sherman Creek would be required below the explosives storage area (see Figures 2-2 through 2-4). Because this tributary is usually dry and only flows as a result of precipitation events, this crossing would not impact aquatic habitat. Appropriate Forest Service BMPs for construction would be used during culvert installation to minimize erosion, and installation would not be conducted during a period when the tributary was flowing (SRK, 1996h).

A bridge would be constructed over South Fork Sherman Creek above the stream channel. Construction could create temporary erosion of sediments to the stream; however, sedimentation impacts from the bridge or its construction to spawning gravels or aquatic habitat would not be expected to be significant. Appropriate Forest Service BMPs would be implemented during construction to minimize erosion and potential impacts.

Under Alternatives B and C, the remaining three stream crossings would be constructed using long-span, low-profile bottomless arch conduits to route creek flows (SRK, 1997c). Two road crossings would be required on upper Sherman Creek, 180 feet and 300 feet along the channel, respectively. In addition, one road crossing 180 feet in stream length would be required on Ivanhoe Creek.

The bottomless conduits proposed for these crossings are designed to minimize impacts by maintaining the natural creek bed and the immediately adjacent flood plain. Potential impacts to aquatic habitat, however, could still occur from potential channelization, erosion of bed materials, and channel grade changes. These impacts, discussed in Section 4.3.2, would degrade aquatic habitat in the reach. Specifically, channelization within the conduit could increase flow velocities, potentially affecting fish passage in the reach during moderate to high stream flows. The worst-case scenario would be that fish would be eliminated from 660 feet of stream as a result of these crossings. Fish mortality, however, is expected to be low because individuals residing in these reaches would be allowed to escape during construction. The crossings could also result in a slight reduction of primary productivity due to a reduction in sunlight reaching the stream. These impacts, however, are expected to be minimal because these crossings would cover only a small percentage of the entire drainage system. Stream channel stability in upper Sherman Creek is primarily controlled by bedrock and large boulders. The reduction in recruitment of large woody debris from the 660 feet of crossings, therefore, should not compromise channel stability below the crossings.

As mitigation, riprap would be required to armor all footings and minimize erosion. The conduits would also be located in reaches where the potential for channelization during extreme flows would be employed during construction to minimize impacts, including removal of debris that could impede flows and placement of riprap within the main flow path to stabilize the flow channel (SRK, 1996h). Appropriate Forest Service BMPs would be applied during construction to minimize the number of times that equipment crosses the stream bed and to limit the area and time of disturbance. ADF&G would coordinate with the Forest Service to identify Critical periods for anadromous fish in lower Sherman Creek to minimize impacts during in-water construction activities.

Water Withdrawal

Water withdrawal under Alternatives B through D would require approximately 0.52 cfs from upper Sherman Creek during periods of non-critical flow. The withdrawals would follow instream flow requirements developed by ADF&G and permitted through ADNR (see Table 4-16, presented previously). Withdrawals could often be restricted during periods of critical instream flows. The restrictions on water withdrawal should minimize adverse effects associated with flow reductions.

Alternatives B and D would increase flows in lower Sherman Creek because additional mine drainage would be discharged as the mine was fully developed. As discussed in Section 4.3.3, these flows are estimated to be between 1.3 and 2.2 cfs (600 and 1,000 gpm) on upper Sherman Creek below the sediment detention pond and 1.1 and 1.3 cfs (500 to 600 gpm) on lower Sherman Creek below the Ivanhoe Creek confluence. The potential impacts from these increased flows would not be significant.

Sedimentation

Under Alternatives B through D, sediment resulting from construction and, to a lesser extent, mine operation could be carried into Sherman Creek. The effectiveness of BMPs would determine the extent of impacts to water quality, habitat, and stream biota from erosion and sedimentation. Strict adherence to BMPs would minimize impacts, as long as weather patterns were seasonable during windows of time stipulated for sensitive work. Unseasonable rainfall patterns could overwhelm siltation control systems, however, and cause levels of impacts higher than expected. For the process area and DTF, the settling ponds are designed to collect all settleable materials. Remaining suspended sediments in settling pond effluents would not be expected to result in significant impacts to spawning gravels or aquatic habitats.

Minimal levels of impact to the biota that could occur probably would be undetectable with any form of biological monitoring. Greater levels of impact, resulting from side slope failures and excessive siltation, could reduce salmonid egg survival, juvenile salmonid overwintering survival, and benthic invertebrate abundance (Peterson et al., 1985). Incubating salmon eggs can be particularly sensitive to increases in fine sediments, especially from increased levels that occur late in the incubation phase (i.e., in late winter). Impacts from sedimentation could be of relatively short duration (i.e., 1 to 2 years). Such impacts are not expected to be significant.

4.7.3 Effects of Alternative B (Proposed Action)

Water Quality

Stream Discharges

Under Alternative B, the mine drainage and mill site runoff would be discharged to Sherman Creek at outfall 001. Water from the DTF settling pond would be discharged to Camp Creek at outfall 002. Available data indicate that the concentrations of metals in these discharges would be below applicable aquatic life criteria. Each of these discharges would need to meet water quality criteria-based discharge limits established under the NPDES permit. Because the discharge limits are established to protect aquatic life, adherence to these criteria should avoid impacts to organisms inhabiting Sherman Creek.

The discharge from the mine drainage treatment system is expected to be as high as 2.2 cfs (1,000 gpm) during the salmon migration period. Stream flow from Sherman Creek averages 35.6 cfs during this period (see Table 3-4 in Chapter 3). The undiluted discharge, therefore, would represent approximately 6 percent of the Sherman Creek flow during the migration period. Because this discharge rate is low compared to the flows in Sherman Creek, the discharge would not affect salmon migrations.

Evidence indicates that elevated metals exist in the tissues of Dolly Varden downstream from the current sediment pond outfall to the Ophir Creek tributary (Konopacky Environmental, 1996a) (see Section 3.9.4). It is not clear whether this higher level of metals concentration in the tissues is from contamination from the existing settling ponds, recent exploration activity in that portion of the drainage, a higher level of historic mining activity in that portion of the drainage relative to other portions of Sherman Creek, or naturally occurring higher levels of metals in that portion of the drainage relative to other sub-drainages. Evidence from water quality studies indicates that the new discharge at outfall 001 would have lower levels of metals than the existing discharge (SRK, 1996d). Therefore, the new discharge should not lead to levels of metals in Dolly Varden tissue above those currently detected. In addition, no adverse impacts associated with fish tissue are expected in lower Sherman Creek, where metals levels are expected to be lower than in upper Sherman Creek downstream of the discharge. Fish have not been observed in Camp Creek (Konopacky, 1996a).

Accidental Spills

Spills of material potentially toxic to aquatic life in project streams could occur during transportation of fuel and process chemicals between the laydown area and the process area. Since fuel, process chemicals, and tailings would be transported by truck throughout the operation, the extent of a spill would be limited to the amount of material contained within the truck. Section 4.13 discusses the probabilities of an accident involving a spill.

Although spill containment equipment would be located at several sites and available for rapid deployment, chemicals or fuel could enter Sherman Creek or a tributary very quickly in the event of a major spill. Such an event could result in significant numbers of mortalities of fish or embryos within the stream. Process chemicals or fuel spilled in Sherman Creek would not be expected to persist for a long period of time, because a majority of the contamination would be transported downstream and discharged to Lynn Canal. However, small concentrations of spilled chemicals or fuel could persist in stream sediments for longer periods. This could continue to affect fish beyond the period immediately following the spill. The extent of long-term contamination resulting from a spill would be determined by the size and location of the spill and the effectiveness of cleanup. Over the long-term, fish populations would likely recover.

Tailings spilled into Sherman Creek would cause impacts similar to those caused by an increase in fine sediment. Spilled tailings would not be expected to produce acute water quality changes. Increases in the suspended solids and sediment deposition could affect feeding behavior and spawning gravels until being flushed from the system.

4.7.4 Effects of Alternative C (Marine Discharge)

Integrity of Fresh Water Habitat

Alternative C contains the same Ophir Creek diversion and type of haul road stream crossings as Alternative B; therefore, the potential impacts are the same.

Water Withdrawal

Under Alternative C, locating the outfall in Lynn Canal would reduce Sherman Creek flows relative to the potential flows from Alternatives B and D. Treated mine drainage would be discharged directly to Lynn Canal rather than to Sherman Creek, as in Alternatives B and D. Effects on stream flows under this alternative, described previously in Section 4.3.4, would not significantly impact fish in Sherman Creek.

Water Quality

Stream Discharges

Under Alternative C, the DTF effluent and mine drainage would be discharged to Lynn Canal rather than Sherman Creek (see Section 4.4.4). The potential for water quality changes to Sherman Creek and Camp Creek, therefore, would be minimized.

Accidental Spills

Under Alternative C, a pipeline would be used to transport fuel between the storage facilities at Comet Beach and the process area. Process chemicals and tailings would be transported by truck, as discussed previously. Section 4.12.4 provides more detail on the probabilities of an accident involving a spill. The probability of a spill from the pipeline is greater than that of an accident involving a tanker truck, and the potential size of a spill under Alternative C would be greater than under the other alternatives.

4.7.5 Effects of Alternative D (Modified DTF Design)

Integrity of Fresh Water Habitat

Alternative D contains the same Ophir Creek diversion as Alternative B; therefore, the potential impacts are the same.

Under Alternative D, bridges would be used for the two haul road crossings on upper Sherman Creek and one on Ivanhoe Creek. Potential scouring and erosion could occur around the footings (i.e., abutments) for the bridges during high stream flow events. Scouring could increase sedimentation downstream, potentially affecting spawning gravels and feeding behavior of anadromous fish until the sediment were naturally flushed from the system. This potential, however, would be less than that associated with the conduit crossings proposed under Alternatives B and C because the footings would be installed, at a minimum, above the 50-year, 24-hour flood plain. The use of bridges would reduce the potential for channelization, bed erosion, and downcutting in the crossings. This would reduce the potential for degradation of aquatic habitat at these road crossings.

Appropriate Forest Service BMPs would be applied during bridge construction to minimize erosion, minimize the number of times that equipment crosses the existing creek bed, and limit the area and time of disturbance. ADF&G would coordinate with the Forest Service to identify critical periods for anadromous fish in lower Sherman Creek to minimize impacts during in-water construction activities.

Water Withdrawal

The water withdrawal under Alternative D would be the same as under Alternative B.

Water Quality

Stream Discharges

Under Alternative D, the mine drainage would be discharged to Sherman Creek, and DTF effluent would be discharged to Camp Creek, as in Alternative B. The potential impacts of Alternative D, therefore, are the same as those for Alternative B.

Accidental Spills

Under Alternative D, tailings would be transported between the process area and the DTF through a slurry pipeline. The potential for a spill from the pipeline to reach Sherman Creek is small because the pipeline would be located adjacent to the haul road. If a spill were to reach Sherman Creek, the potential impacts would be similar to those for Alternative B. Trucks would transport fuel and process chemicals. The potential for a spill of diesel fuel or process chemicals would be the same as that for Alternative B.

4.7.6 Summary

Table 4-23 summarizes the potential impacts resulting from the construction and operation of the alternatives under consideration.

4.8 SOILS, VEGETATION, AND WETLANDS

This section discusses the potential impacts on soils, vegetation, and wetlands from the four project alternatives.

4.8.1 Soils

There are no substantive differences in terms of soils among the alternatives considered under this analysis compared to the analyses conducted in the 1992 FEIS. As indicated previously, Alternative A in this Final SEIS corresponds to Alternative F in the 1992 FEIS; Alternatives B through D in this Final SEIS correspond to Alternative E (Site B) analyzed in the 1992 FEIS. Pages 4-57 and 4-58 in the 1992 FEIS analyze the potential impacts to soil.

4.8.2 Vegetation

This section discusses the potential impacts to vegetation resources using the extent of vegetation disturbed as the indicator. The section is structured differently than other sections of this document because of the similarity of impacts across all alternatives. The primary difference among alternatives relative to vegetation is reflected in the total acreage disturbed.

Under all alternatives, vegetation would be cleared for construction of roads, tailings disposal areas, and facilities. These areas would remain devoid of vegetation for the life of the mine, except for the areas that could be revegetated on an interim basis. As shown in Table 4-24, the total amount of surface disturbance varies for each alternative.

Table 4-23. Summary of Fresh Water Impacts by Alternative

Indicator	Alternative			
	A	B	C	D
Habitat Loss From Diversion (linear feet)	6,000	2,450	2,450	2,450
Fish Mortality	400-500	Up to 125-170	Up to 125-170	Up to 125-170
Water Withdrawal (cfs)	0.42	0.52	0.52	0.52

Table 4-24. Vegetation Disturbance by Alternative (acres)

General Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D
Hemlock/Spruce Forest	44.1	61.2	62.0	64.0
Hemlock Forest	124.2	75.7	76.0	78.0
Low Sites (mixed conifer, muskeg and forb/grass/sedge)	102.9	108.3	110.0	123.0
Muskeg Forest	0.8	0	0	0
Recurrent Slide Zones (alder)	5.3	3.4	3.4	3.4
Recurrent Snowslide Zone	0	0.5	0.5	0.5
Alpine	1.1	1.1	1.1	1.1
Brush	3.6	0	0	0
Total	282.0	250.2	253.0	270.0

Source: ACZ, 1991a.

Upon closure of the mine, disturbed areas would be stabilized and reclaimed according to a reclamation plan approved by the Forest Service. Reclamation activities would be expected to reestablish vegetation on all areas disturbed by mining. At present, vegetation in the project area exists on a wide range of soil types. While reclaimed soils would not necessarily resemble the original soil types, the abundance of rainfall is expected to facilitate the rapid reestablishment of vegetation on stabilized reclaimed areas. Long-term effects on vegetation resources are not anticipated.

Timber

Table 4-25 lists the estimated volume of timber that would be removed from the site under each alternative. Timber would be harvested prior to initiation of mining activities rather than treated as slash material. The values presented in Table 4-25 differ from those presented in the 1992 FEIS and were calculated using the high end of projected timber production ranges established for particular forest types in the Tongass National Forest (ACZ, 1991a). Timber harvested as a result of any of the alternatives would not change the amount of marketable timber in the region because the site was not included in the calculation in the allowable sale quantity for the Tongass National Forest. This was because of the previous LUD II designation.

Table 4-25. Timber Removed by Alternative

Alternative	Vegetation Impacted (acres)	Timber Removed (million board feet)
A (No Action)	164.9	3.30
B (Proposed Action)	137.0	2.68
C (Marine Discharge)	138.0	2.71
D (Modified DTF Design)	137.6	2.70

Old Growth Forest

Timber harvesting activities on Federal forest lands must address the presence of old-growth forest. The acres presented in Table 4-26 were derived by overlaying areas mapped as old growth within the Tongass National Forest with the footprint of each alternative. The results indicate the extent of potential impact to old growth timber.

The Tongass Land and Resource Management Plan (USFS, 1997b) designates the area around Independence Lake as an Old Growth Habitat Area. An Old Growth Habitat Area is a contiguous unit of a particular habitat type, usually old growth, to be maintained or managed to perpetuate that habitat, generally by protecting it from future alteration. This area is located north of the Kensington Gold Project and would be outside the area of disturbance. Consequently, this Old Growth Habitat Area would be protected from alteration.

Summary

Each alternative would affect vegetation resources in the project area. Alternative A would disturb 282 acres, Alternative B would disturb 250 acres, Alternative C would disturb 253 acres, and alternative D would disturb 270 acres. Disturbed lands would be revegetated upon closure of the mine, which would start the process of succession, thereby allowing natural vegetation communities to become reestablished. Timber would be harvested from the site prior to the start of mining activities and would be expected to regenerate following reclamation. The amount of old growth on the site is limited due to historic mining activities. None of the alternatives would result in the loss of more than 90 acres of old growth.

4.8.3 Wetlands

Each alternative would affect wetlands, which is an important resource in the project area. Activities that could affect wetlands are subject to various regulations. Section 404 of the Clean Water Act governs any activity that would result in the placement of dredged or fill material into a wetland. The Corps of Engineers permits activities subject to Section 404 (see Appendix A). Prior to permit issuance, the project must demonstrate compliance with the Section 404 (b)(1) guidelines (see Appendix B), as described in a memorandum of agreement between the Corps of Engineers and EPA. The guidelines require that the parties responsible for projects in jurisdictional wetlands 1) avoid impacts, 2) minimize impacts, and/or 3) provide compensation for unavoidable impacts (Section 404(b)(1) guidelines).

Table 4-26. Old Growth Forest Removed by Alternative

Alternative	Disturbance (acres)
A (No Action)	86.5
B (Proposed Action)	71.6
C (Marine Discharge)	72.7
D (Modified DTF Design)	73.2

Avoidance and minimization of impacts are components of project design and operation. The predominance of wetlands within Southeast Alaska, particularly at elevations where construction of mine-related facilities would be possible, precludes avoidance of all wetland impacts. Impacts could be minimized by designing facilities to fit within the smallest possible disturbance footprint, constructing facilities outside of wetlands to the extent possible, and employing Forest Service BMPs during construction to minimize additional direct or indirect impacts.

The Corps of Engineers will determine the extent of compensatory mitigation based on the project as a whole and comments from the public and other agencies. The Corps of Engineers will finalize compensatory mitigation requirements, if any, upon issuance of the Section 404 permit.

This section discusses the potential impacts to wetlands using net loss as the indicator. In assessing the potential impacts, both direct and indirect impacts were considered.

Effects of Alternative A (No Action)

Alternative A would affect 271 acres of wetlands during operation of the project. The development of the process area, tailings impoundment, diversions, and roads would produce both direct and indirect impacts. Upon closure, wetlands would be reestablished at the site to the extent possible, although 51 acres of wetlands filled during construction of the tailings dam would be permanently lost.

The extent of direct wetland loss was determined by overlaying the jurisdictional wetland delineation map (SRK, 1997a) with the footprint of Alternative A (Coeur, 1996c). The affected acreage would be concentrated in the forested wetlands that form the riparian habitat along the main channel of Sherman Creek. Palustrine emergent wetlands (muskeg) would be affected to a lesser extent. Important functions and value provided by these wetlands include moderate to high values for surface hydrologic control, low to high values for sediment retention, moderate values for wildlife diversity, and high to moderate values for riparian support (ACZ, 1991a). The ability of wetlands within the disturbed areas to perform these functions and values would be lost or reduced during the operation of the mine. Other direct impacts include deposition of construction-related sediment into wetlands and storm water discharges. Although these activities might not eliminate the presence of a particular wetland, they could impair the ability of the wetland to perform particular functions at a given level. This situation should not occur if the outfalls were operated as permitted and Forest Service and EPA BMPs used, as described in Section 4.3.

Indirect impacts could include alterations of site hydrology and long-term changes in the ability of wetlands to perform particular functions. Construction activities could modify surface and subsurface flow, which could result in changes to downgradient wetlands. In these cases, alterations to wetland hydrology probably would be localized. Most of the dominant plant species within the site’s wetlands are facultative species (i.e., they occur equally in wetlands and uplands) (ACZ, 1991a). Because these species are adapted to both wet and dry conditions, localized changes in hydrology probably would not affect overall species composition significantly. Any indirect impacts to wetland hydrology would be expected to be only minor and limited in duration, therefore.

Upon final closure, scrub-shrub or forested wetlands could be established on the reclaimed tailings impoundment. The design of the tailings dam would preclude the development of wetlands and result in the permanent loss of 51 acres. Final reclamation would include regrading the site to approximate natural contours, which should support the redevelopment of much of the forested wetlands impacted during operations. Page 4-58 of the 1992 FEIS indicates that previously disturbed wetland areas within the Sherman Creek drainage had reestablished themselves, for the most part, to the extent of meeting the criteria for jurisdictional wetlands. This situation lends support to the concept that wetlands likely would be reestablished successfully following final reclamation.

Effects Common to Alternatives B Through D

Alternatives B through D each would result in a similar extent of direct loss of wetlands at the site. These losses would not affect riparian wetlands along Sherman and Ivanhoe creeks as much as Alternative A, however. The development of the process area, the DTF, borrow areas, diversions, and roads would have both direct and indirect impacts. The primary difference among all alternatives is the type of wetlands that would be impacted during the development of the tailings disposal facilities. The DTF proposed under Alternatives B through D would mainly affect palustrine emergent and scrub-shrub wetlands (USFWS, 1979). As mentioned previously, the tailings impoundment proposed under Alternative A primarily would impact forested wetlands. Both permanent and temporary impacts to wetlands are anticipated under Alternatives B through D. Permanent losses would include portions of the process area and the DTF.

Construction of roads and the process area would directly impact forested wetlands within the Sherman Creek drainage. Construction of the DTF and, to a lesser extent, the borrow areas, would affect palustrine scrub-shrub wetlands. Important functions provided by these wetlands include moderate to high values for surface hydrologic control, low to high values for sediment retention, and moderate to high values for riparian support. The ability of wetlands within the disturbed areas to perform these functions and values would be lost or reduced during the operation of the mine. Impacts resulting from construction of the roads and process area would be temporary for the most part, because final reclamation would restore drainage patterns and approximate original contours where possible. Impacts from permitted storm water discharges should not produce significant changes in wetland function if the outfalls were operated as permitted and Forest Service BMPs used, as described in Section 4.3.

Indirect impacts would be similar to those described for Alternative A. Even though wetland hydrology could be affected indirectly, substantive changes in species composition or function are not expected.

Final reclamation would include regrading the site to approximate natural contours, which should support the redevelopment of forested wetlands impacted during operations. The palustrine scrub-shrub wetlands impacted by the DTF would be lost, because the configuration of the DTF would preclude reestablishment of wetlands on the site. Forested wetlands filled during construction of the process area also would be lost permanently. Fill placed during construction of the personnel camp and growth media stockpile would be removed as part of reclamation, which would facilitate the reestablishment of palustrine scrub-shrub wetlands in these areas. The palustrine scrub-shrub wetlands excavated in the development of the borrow areas would be reclaimed as bodies of open water. These shallow aquatic beds would provide similar functions and values in the post mining landscape. The sediment ponds also would be left as open water and perform similarly in the post-mining landscape. The open water wetlands would provide a habitat type not currently at the site. These open water wetlands likely would fill with sediment and organic material over time and eventually resemble palustrine emergent or scrub-shrub wetlands.

Summary

The primary difference among the type and extent of wetlands disturbed is between Alternative A and the other alternatives. Table 4-27 presents both short-term (i.e., life of the project) and long-term (i.e., beyond the life of the project) wetland disturbance. Alternative A would disturb 271 acres of wetlands, including palustrine forested wetlands adjacent to Sherman Creek. The loss of these wetlands would correspond to a loss in the functions they provide, including sediment trapping and surface hydrologic control. These functions contribute to the maintenance of the riparian corridor and enhance the downstream fishery by reducing the magnitude of peak flows associated with flood stages, sustaining stream flows during dry seasons, reducing bank erosion and channel scour, and reducing the amount of sediments moving downstream (ACZ, 1991a; Adamus Resource Assessment, 1987). Following closure, palustrine wetlands would be allowed to develop on the reclaimed tailings impoundment, although the physical alteration of the reclaimed channel would preclude the complete restoration of the forested wetlands.

Alternatives B through D each would disturb between 243 and 262 acres of wetlands during operation. While these alternatives would also result in the loss of forested wetlands, much of the impact would be to palustrine scrub-shrub wetlands located off the main channel of Sherman Creek. Although these wetlands provide important functions, including sediment trapping and nutrient transformation, they are associated with upland areas and are removed from Sherman Creek (ACZ, 1991a; Adamus Resource Assessment, 1987). Upon closure, the DTF would be reclaimed as an upland, which would result in the permanent loss of between 113 (Alternatives B and C) and 130 (Alternative D) acres. The final configuration of the process area would also result in the permanent loss of 34 wetland acres. These upland areas would support

Table 4-27. Direct Wetland Loss by Alternative

	Wetland Disturbance (acres)	
Alternative	**Short-Term**	**Long-Term**
A (No Action)	271	51
B (Proposed Action)	243	147
C (Marine Discharge)	246	147
D (Modified DTF Design)	262	164

would also result in the permanent loss of 34 wetland acres. These upland areas would support the development of Sitka spruce forest, a habitat type not well represented at the site. In addition, approximately 55 acres of open water would be left at the site as reclamation of the borrow areas and sedimentation ponds. These aquatic habitats would support wetlands along their fringes and provide functions and value similar to those provided by the palustrine wetlands that presently occupy the site. These wetlands would provide a habitat type not currently in the area. Although wetlands would be permanently lost at the site, the upland and aquatic habitat provided following reclamation would increase habitat diversity.

4.9 CULTURAL RESOURCES

The actions analyzed in this Final SEIS are the same substantively to those analyzed in the 1992 FEIS for cultural resources. Alternative A in this Final SEIS corresponds to Alternative F in the 1992 FEIS; Alternatives B through D correspond to the area analyzed under Alternative E (Site B) in the 1992 FEIS. The 1992 FEIS (pages 4-82 and 4-83) identifies potential direct and indirect impacts on cultural resources in the project area and outlines measures for mitigating potential impacts. The following discussion summarizes the 1992 FEIS and presents the results of a survey conducted subsequent to publication of the Draft SEIS.

Significant cultural resources are unlikely to be present within the area to be affected directly by construction of the Kensington Gold Project. Historic mining resources at the project site have been well-documented and determined ineligible for listing on the National Register of Historic Places. In addition, two historic structures at the old Kensington adit camp, which is located on the mountainside at an elevation of 2,000 to 2,050 feet, might require removal to comply with Federal safety regulations regarding stabilization and use of this opening to the mine shaft. Preliminary evaluation of these two structures indicates that they are not eligible for the National Register of Historic Places (Hall, 1991). If determined eligible, mitigation would be accomplished by documentation and data recovery prior to removal, according to standards and procedures established through consultation among the Forest Service, State Historic Preservation Office, and the operator.

No other cultural resources are known or reported within the area of construction, and the potential for cultural remains representing earlier resource exploitation is considered to be low. This evaluation is based on consideration of three factors: extensive disturbance by historic mining activities; steep landforms impairing access; and natural barriers to Sherman Creek that limit its aquatic resource potential (Hall, 1991). The 1992 FEIS (page 4-82) identifies the need to ensure that construction activities do not affect cultural remains representing earlier resource exploitation that could be present at the Kensington mill site, even though the potential is low. The 1992 FEIS (page 4-89) identifies the potential for such resources to be present, notes that the potential is considered low, and outlines mitigation measures to be followed to eliminate the potential for negative impacts to cultural resources. Mitigation measures include testing and evaluation of archaeological remains in the unlikely event that such remains were located, followed by data recovery if the remains were determined to be significant. A qualified archaeologist would monitor construction below the 100-foot elevation to identify any previously undiscovered archaeological remains. This monitoring would be performed according to procedures to be established by the Forest Service, Native Alaskans, the State Historic Preservation Office, and the operator.

Previous studies identified three locations with a high potential for archaelogical remains within the area of potential indirect effects from increased site visitation (Hall, 1988; Hall, 1991). The 1992 FEIS identified the potential for indirect effects to such resources and outlined the mitigation measures that would be followed to ensure their protection. Additional archaeological survey and subsurface testing have been conducted at these locations (SAIC, 1997b), subsequent to the 1992 FEIS. No evidence of archaeological sites was located, other than historic remains and features associated with gold mining activities, which have been determined ineligible for listing on the National Register of Historic Places. Therefore, there is no potential for indirect effects on archaeological resources under the selected alternative in the Forest Service ROD.

Based on consultation with Alaska Natives in Juneau, Haines, and Klukwan, the Forest Service identified a potential traditional cultural property within walking distance of the Kensington Gold Project site. Any potential indirect effects on this resource through increased visitation would be mitigated by restricting access of mining camp personnel, in accordance with mitigation measures identified in the 1992 FEIS, and by addressing issues of confidentiality through an agreement among Alaska Natives, the Forest Service, the operator, and the State Historic Preservation Office. Alaska Native concerns focus on the potential effects of the Kensington Gold Project on marine water quality. Sections 4.6 and 4.7 of this Final SEIS address the potential impacts on marine and fresh water fisheries.

4.10 VISUAL RESOURCES

Activities occurring within the Tongass National Forest are permitted on the basis of a visual quality objective (VQO), which is used as the indicator for evaluating potential impacts to visual resources, for a specific area. The applicable VQO is determined based upon the scenic variety in the landscape, the distance between the landscape and the people viewing it, and the importance of the scenic quality to the people viewing it. Pages 3-70 through 3-74 of the 1992 FEIS provide more specific information on defining VQOs.

The study area is primarily seen in the middleground from the Alaska Marine Highway and cruise ship routes between Juneau, Skagway, and Haines. Viewers are typically 1 to 2 miles offshore. The landscape can be broken into three general landscape components: the water; the lower rounded forested foothills on the canal banks and islands; and the steep, often ice-clad taller peaks behind the foothills to the east and west of Lynn Canal.

4.10.1 Effects of Alternative A (No Action)

Page 4-88 of the 1992 FEIS discusses the potential impacts on visual resources associated with Alternative A (Alternative F in the 1992 FEIS).

4.10.2 Effects Common to Alternatives B Through D

The potential effects from Alternatives B through D would be the same for each alternative for all practical purposes. The use of pipelines under Alternatives C and D would not reduce the width of the roads. Changes to the DTF proposed as part of Alternative D would not change the overall size of the till borrow pits, and the larger footprint would not substantially change the visual impact of the facility. This section, therefore, describes the potential impacts to visual resources for all three alternatives during operations and after closure. Appendix C presents excerpts from a draft reclamation plan.

Facilities

Structures

Alternatives B through D would create additional disturbances in the Comet Beach area. A temporary personnel camp would be constructed adjacent to the water and become a storage area for ore containers upon completion of the permanent camp. In addition, the helicopter landing area and hangar would be located fronting on Comet Beach.

The 1992 FEIS described the impacts from the personnel camp and refining operations as being screened by the approved tailings dam. Alternatives B through D include a DTF, which would be located southeast of the Comet Beach structures. The process area facilities that would be hidden under Alternative A would be visible under Alternatives B through D. The use of containers to ship the ore offsite for processing would create an additional impact. The impacts from these structures would be in an area with a VQO of Maximum Modification during the life of the mine. Given the distance from Lynn Canal and the application of mitigation measures as outlined in Chapter 2, the impact should not be substantial. The containers would not be made of a highly reflective material and, if possible, their color would blend in with the surroundings to minimize impacts (i.e., dark green or brown).

Borrow Pits

Under Alternatives B through D, four borrow pits would be used: two near the processing area and two on a slope facing Lynn Canal. The till borrow pits would be located in an area with a VQO of Maximum Modification during the life of the mine and reverting to Modification after mine closure. The two facing directly onto Lynn Canal represent a substantial change from the 1992 FEIS. These pits would be visible from Lynn Canal. The use of mitigation, such as constructing and planting benches along the side walls, should diminish the visual impacts.

These pits would conform with the VQO established in the 1997 Forest Plan during operation. With revegetation and slope stabilization, the area could be returned to conformance with the post-mining objective of Modified Landscape.

Dry Tailings Facility

The DTF would be a substantial change to the existing landscape. With appropriate contour design, the finished facility could replicate the existing landforms to conform to the VQO of Modification following mine closure. The operator would grade and seed the facility concurrently with construction, which would assist in mitigating the visual impacts. Plantings should replicate as closely as possible typical Southeast Alaska vegetation patterns (e.g., Sitka spruce and hemlock with an understory of blueberry and deer cabbage).

Roads

Under Alternatives B through D, a longer road segment would be visible compared to Alternative A because the tailings dam would not screen the roadway. Also, the lack of the dam would no longer present a more glaring contrast to draw viewers' attention away from the road. The color of existing road surface materials is a light gray, which contrasts with the surrounding landscape, making it difficult to hide the road. End-hauling slash and seeding side slopes should diminish the impacts, however. During closure, roads would be ripped, contoured to blend with surrounding terrain, and seeded to accelerate the return of naturally occurring vegetation.

Emissions

The change in fuel from LPG under Alternative A to diesel under Alternatives B through D would increase the amount of particulate discharge. Section 4.1 discusses the potential visual impacts from emissions from the generators.

4.10.3 Summary

The tailings dam proposed under Alternative A and the DTF under Alternatives B through D would be visible from vessels in Lynn Canal, as well as from air traffic. The tailings dam would screen visual impacts resulting from process area activities from observers in Lynn Canal; the DTF would not. Under Alternatives B through D, impacts would specifically be expected from the till borrow area. The DTF would likely be mitigated to a lower level of impact following successful reclamation compared to the tailings dam. Overall, the potential impacts from all of the alternatives for the Kensington Gold Project would result in a similar level of disturbance to visual resources and be consistent with the Land Use Prescription of Modified Landscape with a Minerals Overlay.

4.11 SOCIOECONOMIC RESOURCES

This section describes the potential effects of the project alternatives on socioeconomic resources using the following indicators:

- Population
- Employment and payroll (both direct and indirect effects)
- Housing

- School enrollment
- Health and social services
- Public safety
- Public utilities
- Revenues and expenditures.

Population growth can be projected by examining employment trends, because a close relationship has traditionally existed between changes in employment and changes in population. State government employment has strongly influenced Juneau's economy since statehood. At present, about half the local economy depends either directly or indirectly on the State government. Employment projections for the next decade or more call for modest reductions in State government employment. These would be offset and perhaps exceeded by increases in private sector employment. Projected increases in private sector employment are based largely on increases in cruise line ship capacity, numbers of port calls, and passenger arrivals. Capacity increases of cruise ship lines are programmed at 7 percent per year through 1999 (Alaska Visitors Association, 1996).

Based on 1991 to 1995 historical data, net in-migration likely would be slightly positive through the end of the century, with increases estimated at 0.19 percent average annual rate of growth (AARG). Further, based on 1991 to 1995 historical data, a natural increase is expected to follow recent historical patterns also, rising at a decreasing rate from 1.2 percent AARG in 1997 to 1.0 percent AARG in 1999. The current population for the City and Borough of Juneau is estimated by the CBJ Community Development Department at 30,209 in 1996. Using this figure as the base, the population of the city and borough is projected to increase to 31,730 in 2000 and 34,091 in 2013.

Employment multipliers aide economists in projecting the potential effects that basic economic activity, including mining and manufacturing, could have on a community. An employment multiplier estimates the number of new jobs in service or other sectors that could result from each basic industry job created. The economic multiplier for the City and Borough of Juneau is estimated at 1.75 (i.e., for every 100 new basic industry jobs in the community, 75 support and service sector jobs would also be created).

Employment multipliers are developed based on the availability of goods and services required by the industry to operate. They include the portion of the total payroll that is projected to be actually spent in the area. The lack of manufacturing industries in the area results in a reliance on purchases of goods and services from other regions. The more dollars spent on goods and services obtained outside the local economy, the smaller the size of the multiplier and the associated benefits to spin-off industries. Consequently, the employment multiplier for Juneau is smaller than that of metropolitan areas with greater industrial capacity.

Executive Order 12898 focuses on environmental justice by requiring Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their activities on minority and low-income populations. The project area is not located within an area where it could disproportionately affect minority or low-income populations. Alaska natives are among the fishers that use the Point Sherman area. However, the project would not adversely affect this fishery. Compliance with Executive Order 12898 is considered satisfied for the purpose of this Final SEIS.

4.11.1 Effects of Alternative A (No Action)

City and Borough of Juneau

Population

Under Alternative A, the peak operations population would be 346 persons or about 36 percent greater than estimated for Alternative B. The operator would build a 250-person camp to accommodate construction workers at the mine, which would substantially reduce the number of construction workers and dependents relocating to the community during the construction phase of the project. Most construction workers, especially single or unaccompanied workers, probably would reside at the construction work camp and, during periods not working, return to the location of permanent residence. It is anticipated that 20 percent of construction workers would be accompanied by family members and, consequently, would establish residences in Juneau. A higher proportion of production workers would be accompanied by family members and, because they would they would have the opportunity for long-term employment during the operational phase, it is assumed that 75 to 80 percent would choose to reside in Juneau. All operator management staff are expected to reside in the community. Other workers would likely reside in Haines, Skagway, and other Southeast Alaskan communities.

The average household size for in-migrating production workers is estimated at 2.5, based on 1996 estimates for Juneau (CBJ Community Development, 1996). This translates to a family size of 2.75 for married workers. Because of lower family accompaniment rates, construction worker household size is estimated at 1.4 persons per household. In addition to workers and dependents, a number of unemployed job seekers likely would be attracted to the area. In total, the Kensington Gold Project would increase Juneau's population by approximately 894 people when the mine is in full operation. Table 4-28 compares the annual estimates of mine-related population for Alternative A to the baseline population estimated for the City and Borough of Juneau (CBJ).

Direct Employment and Payroll

The development schedule for Alternative A calls for three phases over a 16-year period. The construction of surface and underground facilities is planned for the first 2 years, followed by an operational phase of 12 years and a 2-year period of decommissioning. Table 4-29 presents annual estimates of direct, indirect/induced, and total employment for each year of the project.

Alternative A would directly increase employment by 92 workers compared to Alternatives B through D. Similarly, employment during the construction phase would be higher under Alternative A (575 person years versus 502 person years for Alternatives B through D). The associated increase in payroll during the 12-year operations phase under Alternative A would

Table 4-28. Kensington Gold Project Population Effects Under Alternative A

Year	Baseline Population	Kensington Gold Project Population	Percent of Baseline Population
1997	30,605	501	1.63
1998	30,983	606	1.95
1999	31,352	836	2.67
2000	31,540	903	2.86
2001	31,730	901	2.83
2002	31,920	902	2.82
2003	32,112	898	2.79
2004	32,304	895	2.77
2005	32,498	901	2.77
2006	32,693	894	2.73
2007	32,889	894	2.71
2008	33,087	894	2.70
2009	33,285	894	2.68
2010	33,485	898	2.68
2011	33,686	394	1.16
2012	33,888	131	0.38
2013	34,091	–	0
2014	34,292	–	0

Table 4-29. Kensington Gold Project Employment Under Alternative A

Year	Direct Employment	Indirect Employment	Total Employment
1997	289	96	385
1998	286	147	433
1999	335	227	562
2000	347	253	600
2001	345	252	597
2002	345	252	597
2003	346	253	599
2004	343	252	595
2005	341	252	593
2006	345	252	597
2007	340	252	592
2008	340	252	592
2009	340	252	592
2011	343	252	595
2011	150	111	262
2012	50	37	87
2013	0	0	0

be about $4.3 million per annum. The increase in payroll during the 2-year construction phase would amount to about $2.3 million overall.

Indirect Employment and Payroll

Local purchase of supplies and services, as well as the respending of earnings by direct construction worker households, related to the Kensington Gold Project would result in an increase in indirect/induced employment during operations of about 65 workers more than Alternatives B through D. During the construction phase, indirect/induced employment under Alternative A also would be higher than Alternatives B through D by about 54 workers. Indirect earnings would increase by approximately $2.5 million annually during operations and by approximately $1.4 million during the 2-year construction phase.

Housing

The extremely low vacancy rate and generally tight housing market indicated for the City and Borough of Juneau would be exacerbated by Alternative A. The total requirement for housing would increase to approximately 96 and 143 units during the first 2 years of construction, respectively, and from 217 to 292 units during the 12 years of operations. The project-related demand resulting from the Alternative A would exceed the total supply of vacant housing units in 1996; however, baseline population growth during the next 5 years also would readily absorb existing vacancies. Thus, implementation of Alternative A would increase pressure on the community to address the pre-existing shortage in housing availability.

School Enrollment

Alternative A would result in additional pupils for the Juneau School District. If mine-related enrollment followed the existing pattern in enrollment, by year 3 of the Kensington Gold Project, 83 new pupils would be added in grades K through 5, 43 in middle school, and 54 in the high school grades.

The additional enrollment associated with the Kensington Gold Project would not result in capacity problems at the elementary grade level. At present, the middle school experiences modest capacity deficiencies (48 spaces). With the mine-related enrollment under Alternative A, however, the deficits would increase by about 35 spaces during operations. The capacity problem could be addressed by using portables as is being done within the school system. The current deficit in high school classroom space is 453 spaces and would rise to 500 spaces under baseline population conditions forecast to 2013. The mine-related enrollment under Alternative A would exacerbate this condition by adding another 53 pupils during the operations phase.

Health and Social Services

Under Alternative A, the operator would provide emergency medical equipment at the mine and would contract with a local group to provide ambulance service to the site.

Bartlett Memorial Hospital would experience greater increases in admissions due to accidents and illnesses occurring in the mine-related population under the Alternative A, but the increases would not affect the hospital's ability to accommodate in-patient needs.

The City and Borough of Juneau, U.S. Indian Health Service, and Lakeside Recovery Corporation provide substance abuse services in the Juneau area. If the age and sex ratios of the mining population were the same as current Juneau ratios, then there would be no disproportionate increase in the demand for chemical dependency services. Alcohol and drugs would not be allowed at the personnel camp, and individuals applying for work would be tested for alcohol and drugs. The support sector population probably would require treatment at about the average rate in the Juneau population and, because of the population increase associated with Alternative A, the numbers requiring treatment would be greater than currently exist.

The Juneau Alliance for the Mentally Ill, the CBJ's Juneau Mental Health Clinic, and private sector organizations provide mental health services. Limited mental health services are available to Alaska Natives through the southeast Alaska Regional Health Corporation. The Mental Health Clinic has a long waiting list currently, but this list could be reduced if the clinic were staffed fully. Implementation of Alternative A would increase the demand placed on mental health services.

Public Safety

Under Alternative A, police services would increase by a modest amount. The fire department likely would provide fire response and EMS/MEDIVAC services under a cost reimbursement program. The increase in population under Alternative A would not create a greater need for additional fire department personnel or equipment. Although more homes would be occupied and constructed, the fire department has sufficient staff and equipment to meet the potential increase in demand estimated for Alternative A.

Public Utilities

Alternative A would not draw upon the water utilities of the City and Borough of Juneau, because an onsite water supply would be established. Population growth associated with development of the mine would result in additional residential and commercial demand for water from the municipal system. According to municipal utility officials, the downtown and valley areas have water capacity in excess of demand and sufficient to handle any service demand related to the Kensington Gold Project.

The operator would install an onsite wastewater treatment facility for its operations that would be separate from any facilities within the CBJ. New residential development is expected to occur primarily in the Mendenhall Valley and North Douglas where the most land is available. The Mendenhall Valley treatment plant is operating at about 25 percent of capacity and can handle increased residential loads. Some additional commercial development, primarily in the downtown area, likely would occur as a result of the projected population growth. The Juneau-Douglas treatment plant has adequate treatment capacity available for additional commercial customers, according to CBJ utility officials.

An onsite incinerator is planned at the mine to dispose of burnable materials. A licensed contractor would haul non-burnable materials from the site to other locations for disposal at permitted facilities.

Electric power for mine construction and operation would be generated onsite, and mining operations would not directly impact power consumption or electric rates. Current electrical demand is about 291 million kilowatts. Alaska Electric Light and Power and Alaska Power Authority generated a total of 319.3 million kilowatts in 1995 for the Juneau area. The population growth attributable to the Kensington Gold Project would increase total demand only marginally.

CBJ Revenues and Expenditures

The proposed development under Alternative A would result in increases in both revenues and expenditures for the City and Borough of Juneau compared to Alternative B. One major problem for municipal finance is related to the low property tax mil rate applied by the municipality in roadless areas, along with reductions in State school foundation support levels because of the distribution formula that requires the offsetting of property tax collections on the first four mils levied. As indicated in the 1992 FEIS, the City and Borough of Juneau could experience fiscal deficiencies during most of the mine life, even though the assessed value of the mine would be high. In addition, funding of community services would add to the imbalance between revenues and expenditures.

Property tax revenues would increase due to the value of new residential and commercial construction, as well as the value of the mine and its improvements. Property is assumed to be assessed at its market value or construction cost in the year it is built, but revenues are not received until the following year. This does not include property tax revenues generated from the rise in property values associated with increased demand.

Sales tax revenues would accrue to the CBJ from supplies purchased locally during the construction and operation of the mine. As mentioned previously, only 5 percent of the annual non-personnel operating budget is estimated to be spent locally. The current tax rate of 4 percent, including any voter-approved increases (or decreases), would be applied to this amount to calculate the total CBJ revenue contribution. The sales tax revenue would also be collected from the personal expenditures by mine-related households. Enterprise funds from sewer and water utilities are supported by user fees and probably would not be impacted fiscally by the mine project.

Revenues from State sources, such as municipal assistance, revenue sharing, health and social service grants, and chemical dependency grants, would increase in proportion to population and, thus, would rise as a result of mine-related population growth, as well as property valuation increases.

No additional capital facilities projects have been identified for the City and Borough of Juneau that would be attributable to the Kensington Gold Project under Alternative A when compared to Alternative B. Specific staffing needs might be greater for permitting and oversight under Alternative A, however, because of the development of the tailings impoundment, which would add to the workload and related costs for the CBJ Community Development Department and, perhaps, the Engineering and Public Works.

More generally, the City and Borough of Juneau is anticipated to experience modest deficits, primarily owing to the anomaly of State foundation support, which subtracts revenues generated from property taxes collected from the first 4 mils of the local property tax levy. In the case of a large mine project located in a roadless area where the total levy is about 5 mils, the major share of property taxes collected would offset the State's school foundation support level, thereby resulting in substantially lower revenues to the school district than would occur in an urban service area where the millage is substantially higher (currently 12.49 mils). This could result in a deficit between revenues and expenditures experienced by the City and Borough of Juneau under Alternative A compared to Alternative B, which would generate revenue surpluses.

City of Haines, Borough of Haines, and City of Skagway

Under Alternative A, the potential socioeconomic impacts on the City of Haines, Borough of Haines, and City of Skagway compared to Alternative B would be modest and insignificant.

4.11.2 Effects Common to Alternatives B Through D

There is little variation in socioeconomic effects among Alternatives B through D because the primary differences are related to the physical design of mine operations. The following discussion, therefore, presents the potential effects from implementing any of these alternatives.

City and Borough of Juneau

Population

Under Alternatives B through D, the peak population during the operational phase would be 253 persons; total employment at the site would peak at approximately 338 in the second year of construction. Table 4-30 presents the annual estimates of mine-related population for Alternatives B through D, as well as the baseline population estimated for the City and Borough of Juneau, and dependents, a number of unemployed job seekers likely would be attracted to the area.

The operator would build a 250-person camp to accommodate construction workers under Alternatives B through D, substantially reducing the number of construction workers and dependents relocating to the community during the first 2 years of the project. As discussed previously, 75 to 80 percent of the production workers would choose to reside in Juneau and be accompanied by family members. All operator management staff probably would reside in the community. In addition to workers and dependents, a number of unemployed job seekers would likely be attracted to the area.

Table 4-30. Kensington Gold Project Population Effects Under Alternatives B Through D

Year	Baseline Population	Kensington Gold Project Population	Percent of Baseline Population
1997	30,605	242	0.79
1998	30,983	618	2.00
1999	31,352	665	2.12
2000	31,540	665	2.10
2001	31,730	665	2.09
2002	31,920	665	2.08
2003	32,112	665	2.10
2004	32,304	665	2.05
2005	32,498	665	2.04
2006	32,693	665	2.03
2007	32,889	665	2.02
2008	33,087	665	2.00
2009	33,285	263	0.79
2010	33,485	263	0.79
2011	33,686	–	0
2012	33,888	–	0

The operator has made a commitment to provide transportation to workers residing in Haines. It is anticipated that up to 40 production workers would be employed from that area. At present, one or two Coeur Alaska employees are residents of Haines. Other workers from Southeast Alaska communities are also likely to obtain work at the mine. Indeed, the potential for hiring Southeast Alaska workers is considerable. The operator has made a commitment to hire from within the Southeast Alaska region. In addition, the Berners Bay Consortium's (a Native Alaskan organization) Human Resource Development Corporation (BBC-HRDC), which is headquartered in Juneau, has begun training shareholders and their families in Southeast Alaska to take advantage of the employment opportunities that would be provided by the Kensington Gold Project. The BBC-HRDC has also developed a region-wide employment skills data bank with the names of more than 250 potential employees from Southeast Alaska. The operator has supported the Consortium's efforts to expand the employment opportunities of Alaska Native workers through information exchange, funding, and assistance in organizing the HRDC.

In total, implementation of Alternative B, C, or D would increase Juneau's population by approximately 665 people with the mine in full production. Table 4-30 compares the annual estimates of mine-related population under Alternatives B through D to the baseline population estimated for the City and Borough of Juneau.

As shown in the table, mine development contributes modestly to population growth in the City and Borough of Juneau during all years of the project. By 1999, an additional 1,996 people would be expected to reside in the community with modest population growth through 2008, at which point a total population increase of 3,543 persons above 1996 levels would be achieved. Shutdown of the mine would begin in 2009 with 586 people projected to out-migrate from the area. An additional 70 direct workers and associated population for a total of 263 people probably would out-migrate following the final 2 years of decommissioning and reclamation. This amounts to Juneau losing 2 percent of its population over a 3-year period, which is a modest impact. Upon closure of the mine, approximately 3,882 additional people are projected to reside in Juneau compared to the 1996 population.

Direct Employment and Payroll

Alternatives B through D would result in increased employment and income to the Juneau area. The proposed development is scheduled to take place in three phases over a period of 15 to 16 years. Surface and underground facilities would be constructed during the first 2 years, followed by an operational phase of 10 years and a 2-year period of reclamation and decommissioning. Table 4-31 presents annual employment estimates for the Kensington Gold Project under Alternatives B through D.

The direct construction workforce includes both construction and production workers employed by the operator. The average workforce amounts to 164 workers during the first year of construction and 338 workers during the second year of construction. The average wage for construction workers is estimated at $61,667, based on $26.13 per hour, 47 hours per week and 50 work weeks per year (Alaska Department of Labor, 1996). Production worker wages are estimated at $45,000 per annum, based on operator planning data. Total wage payments during the construction phase of the project are estimated at $28.2 million; annual wage payments during the operational phase is projected to be approximately $11.3 million. These estimates do not include onsite living expenses paid for by the operator.

Table 4-31. Kensington Gold Project Employment Under Alternatives B Through D

Year	Direct Employment	Indirect Employment	Total Employment
1997	164	35	199
1998	338	128	466
1999	253	187	440
2000	253	187	440
2001	253	187	440
2002	253	187	440
2003	253	187	440
2004	253	187	440
2005	253	187	440
2006	253	187	440
2007	253	187	440
2008	253	187	440
2009	30	22	52
2010	30	22	52
2011	100	74	174
2012	100	74	174
2013	0	0	0

Indirect Employment and Payroll

Outlays for construction of the mine are estimated at $190 million, and annual non-personnel operating costs are likely to exceed $20 million. The McDowell Group (1990) estimated that only 5 percent of the materials and subcontracted labor included in these figures would come from local sources. This translates into $9.5 million of purchases during the 2-year construction phase, followed by annual expenditures of $1.0 million during operation. Although a large portion of the construction and operating budget would not be captured by the local economy, spending by mine workers and family members on personal consumption would contribute to local economic activity.

Applying the employment multiplier of 1.75 to project induced/indirect employment created by the mine results in a peak of 187 induced/indirect jobs during the first year of mine operations. Employment gains would be realized in trade and service industries and finance, insurance, and real estate businesses, among others, as the effect of the mining operations stimulated the economy. Additional local government jobs also would be required to respond to a higher level of demand for public services.

Housing

Vacancy rates provide an indication of the potential for housing development and an estimate of the number of housing units available at a particular point in time. The most recent vacancy rates for Juneau area (November 1996) are as follows: single family dwellings – 1.69 percent, multifamily dwellings – 3.25 percent, and mobile homes – 0.96 percent. These percentages translate to approximately 243 vacant housing units available for new residents. The vacancy rate for all housing has declined from a high of 10 percent in 1986 to the current rate of 1.9 percent.

The extremely low vacancy rate is indicative of a very tight housing market. Consequently, if all of the housing demand generated by development of the Kensington Gold Project is assumed to translate into the need for additional housing units, the total requirement would amount to 36 and 127 units during the first 2 years of construction, respectively, and 230 units during operations. The project-related demand would approximate the total supply of vacant housing units in 1996; however, baseline population growth during the next 5 years would easily absorb existing vacancies. Like the situation described under Alternative A, implementation of Alternative B, C, or D would increase pressure on the community to address the pre-existing shortage in housing availability.

Coeur Alaska and Goldbelt, Incorporated (a Native Alaska corporation), recently announced that they have an agreement to construct 102 units of new housing in and around Juneau for use by local residents. Goldbelt would construct the housing, which could be a mix of single family and multifamily units. Coeur Alaska would provide financial assurance, and mining employees would receive priority for the purchase of the homes built under the agreement. The additional housing to be provided under the agreement would help address the housing shortages, particularly for families of in-migrating workers to the Kensington Gold.

Housing needs for workers indirectly associated with the development of the mine would be more difficult to address because of the shortage of affordable housing in the area.

As a consequence of the lack of housing availability in Juneau, particularly rental units and affordable for-sale units, the increase in demand would be reflected in higher prices in the short term. Both rental rates and purchase prices would be expected to increase along with property assessments. Some in-migrating families could be forced to accept low-quality housing; existing residents might not be able to afford competitively higher housing prices, particularly for rental units.

School Enrollment

Alternatives B through D would result in additional pupils for the Juneau School District. At full production in year 3 of the Kensington Gold Project, 63 new pupils would enter grades K through 5, 30 would enter the middle school grades, and 39 the high school grades. The project-related total of 133 pupils represents a 2.4-percent increase over the present enrollment of 5,578 students.

The additional enrollment associated with the Kensington Gold Project would not result in capacity problems at the elementary grade level. With the opening of the Riverbend Elementary School during the 1997–98 school year, available capacity (without portables) would exceed enrollment by 445 spaces without the project and by about 380 spaces with the project. The middle school currently experiences modest capacity deficiencies (48 spaces). With the mine-related enrollment, however, the deficits would increase by an estimated 30 spaces or slightly less than one standard design classroom. This capacity problem could be addressed through the use of portables. The current deficit in high school classroom space, excluding the use of former Marie Drake Junior High School, amounts to about 453 spaces and would rise to 500 spaces under baseline population conditions forecast for 2013. The mine-related enrollment would exacerbate this condition by adding another 39 pupils during the operational phase.

Health and Social Services

Under Alternatives B through D, the operator would provide emergency medical equipment at the mine and would contract with a local group to provide ambulance service to the site. Additional staffing could be required if the department would continue to provide these services throughout the life of the mine.

Bartlett Regional Hospital would experience an increase in admissions due to accidents and illnesses occurring in the mine-related population. During 1987 through 1989, the metal mining industry incurred injuries and illnesses at 2.2 times the State’s industrial average (derived from information provided by Wilson, 1990). Hospital occupancy resulting from the influx of mine employees could be expected to increase at a higher rate than that of population growth. The estimated 2- to 3-percent increase in occupancy rates as a result of the mine development would leave the hospital well below capacity limits.

Substance abuse services in Juneau are provided by the City and Borough of Juneau, the U.S. Indian Health Service, and Lakeside Recovery Corporation, a private organization. If the age and sex ratios of the mining population were the same as current Juneau ratios, then there would be no disproportionate increase in the demand for chemical dependency services. In addition, there would be no alcohol or drug use allowed at the personnel camp and applicants for work would be tested for alcohol and drugs. The support sector population would likely require treatment at about the average rate in the Juneau population. If additional substance abuse services were required, CBJ's Chemical Dependency Division would be the only entity expected to incur additional net costs because it provides charitable allowances for low-income patients.

Public Safety

For purposes of this study, the estimated 2.1 percent population increase from development of the Kensington Gold Project can be expected to require a modest increase in Juneau police services. Police protection for the mine site itself would be in the jurisdiction of the Alaska State Troopers.

The population increase under Alternatives B through D would not create a need for additional fire department personnel or equipment. Although more homes would be occupied and constructed, the fire department has sufficient staff and equipment to meet the estimated 4-percent increase in demand.

Public Utilities

Alternatives B through D would not draw upon the water utilities of the City and Borough of Juneau because an onsite water supply would be established. Population growth associated with development of the mine would result in additional residential and commercial demand for water from the municipal system. According to municipal utility officials, the downtown and valley areas have water capacity in excess of demand and sufficient to handle any service demand related to the Kensington Gold Project.

The operator would install an onsite wastewater treatment facility for its operations that would be separate from any facilities within the CBJ. New residential development is expected to occur primarily in the Mendenhall Valley and North Douglas where the most land is available. The Mendenhall Valley treatment plant is operating at about 25 percent of capacity and can handle increased residential loads. Some additional commercial development, primarily in the downtown area, likely would occur as a result of the projected population growth. The Juneau-Douglas treatment plant has adequate treatment capacity available for additional commercial customers, according to CBJ utility officials.

An onsite incinerator is planned at the mine to dispose of burnable materials. A licensed contractor would haul non-burnable materials from the site to other locations for disposal at permitted facilities.

Electric power for mine construction and operation would be generated onsite, and mining operations would not directly impact power consumption or electric rates. Current electrical demand is about 291 million kilowatts. Alaska Electric Light and Power and Alaska Power Authority generated a total of 319.3 million kilowatts in 1995 for the Juneau area. The population growth attributable to the Kensington Gold Project would increase total demand only marginally.

CBJ Revenues and Expenditures

The proposed development under Alternatives B through D would increase both revenues and expenditures for the City and Borough of Juneau. Property tax revenues would increase due to the value of new residential and commercial construction, as well as the value of the mine and its improvements. The mine property would be subject to a relatively low millage rate of just more than 5 mills, compared to the current millage rate of 12.49 applied against the value of new residential and commercial construction.

Sales tax revenues would accrue to the CBJ from supplies purchased locally during the construction and operation of the mine. As mentioned previously, only 5 percent of the annual non-personnel operating budget is estimated to be spent locally. The sales tax revenue would also be collected from the personal expenditures by mine-related households. Currently, half of sales tax revenues are committed to roads and other major capital improvements; the other half is divided between general government purposes and a reserve fund. Enterprise funds from sewer and water utilities are supported by user fees and are not likely to be impacted fiscally by the mine project.

No additional capital facilities projects have been identified for the City and Borough of Juneau that would be attributable to the Kensington Gold Project. Specific staffing could be required for permitting and oversight, which would add to workload and related costs for the CBJ Community Development Department and, perhaps, the Engineering and Public Works.

The Kensington Gold Project would generate an overall cumulative surplus of $5.8 million when considered over the 17-year period of construction, operations, and reclamation (CBJ, 1997). The overall net present value of the fiscal balances produced by the project would amount to a surplus of $3.9 million, based on a 3-percent real discount rate. If computed over the first 5 years, however, the net present value of the fiscal balances would amount to a deficit of $160,000.

Effects of Early Closure

Early closure of the Kensington Gold Project would not result in major impacts to the City and Borough of Juneau because the mine-related population is projected to be a small percentage (about 2 percent) of the overall CBJ population. Closure would lead to some out-migration, increased housing availability, and less school capacity shortfalls. In addition, social service providers could be affected as mine-related households adjust to the realities of job losses and seek to transition to other employment opportunities. The City and Borough of Juneau government could have an opportunity to mitigate some of the potential adverse impacts of an early mine closure, given the projected net revenue surplus generated by the City and Bureau of Juneau government (CBJ, 1997). Although Federal law requires that a 60-day notice be given to employees subject to reduction in force or termination for reasons beyond their control, the operator might be required to support specific mitigation measures (e.g., job training and placement outreach) to help workers and their families adjust to job losses resulting from temporary or permanent mine closure.

City of Haines, Borough of Haines, and City of Skagway

The operator only would provide employee transportation from a Juneau location, except that employees might have the opportunity to commute from Haines at the operator's expense. Residents of Skagway seeking employment at the mine would commute at their own expense. The operator has indicated that it would make every effort to hire locally. The company made a commitment to hire 13.8 percent of the construction workforce and 25 percent of the operations workforce from Alaska Native groups, including individuals who are so designated or their spouses. The operator agreed with Goldbelt, Inc., Klukwan, Inc., and Kake Tribal Corporation, all of which are Alaskan Native Corporations, to use them to the greatest extent possible on the mine workforce. In addition, the operator indicated that it would be amenable to providing air transportation to Juneau for the purpose of connecting with the employee shuttle operating between Juneau and the mine. It is estimated that perhaps 40 potential workers would be qualified and hired from Haines. Workers living in Haines would be shuttled to the site via Juneau.

Unemployment in Haines in November 1995 was 13.7 percent, reflecting seasonal slowdown. The Kensington Gold Project could have a significant beneficial impact on the Haines economy. Assuming that a large number of Haines residents become employed at the mine, the Haines economy would become less dependent on the tourism and fisheries industries. Spreading the economic base over more industries would help stabilize the economy.

Employment and Payroll

The operator indicated that up to 40 Haines residents could be employed directly during the operational phase of the Kensington Gold Project. An additional 20 to 30 jobs could be supported by local expenditures of mine employees. The increase in total employment would be substantially less than the annual fluctuation of approximately 500 jobs represented by the difference between annual average and peak summer employment. Based on an estimated annual income of $45,000 for the mine employees and $25,000 for the indirectly supported jobs, Haines residents could earn an additional $2.58 million annually.

Only as many as seven project employees would be expected to reside in Skagway. This is less than 2 percent of the annual average employment in the community. One or two additional jobs could be supported by expenditures of earnings from the long-term mining jobs. The increase in total employment is insignificant compared to the seasonal employment pattern, which results in a summer employment level at least twice that of winter.

Because the operator made a commitment to provide transportation to workers residing in Haines, it is anticipated that up to 40 production workers would be employed from that area.

Population

Under Alternatives B through D, only modest population growth would be expected as a result of increased employment at the Kensington Gold. It is assumed that most workers would be drawn from the existing labor pool, given existing relatively high unemployment rates. Perhaps a third of the workers taking jobs related to the Kensington Gold Project would in-migrate or be replaced by in-migrating workers, suggesting a population increase of 58 persons (assuming 2.5 persons per worker household). This represents about a 2.5-percent increase in the present population. The minor growth expected as a result of the proposed development is dwarfed by the seasonal population growth and demand on social services regularly observed in the community.

The total population associated with the Kensington Gold Project could reach 23 people if all potential employees were new residents of Skagway. Given the present high unemployment rate in Skagway, it is more likely that the project would employ mostly current residents. The minor increase in population would not have discernible impacts on community services.

4.12 TRANSPORTATION

4.12.1 Effects of Alternative A (No Action)

Material Offsite Transport

Under Alternative A, the potential impacts associated with transportation of materials to the Kensington site would be the same as those described on page 4-110 of the 1992 FEIS. Materials, equipment, and fuel would be transported to the Kensington site by barge to a landing site at Comet Beach. During the operation phase, approximately 600 tons of freight, 150,000 gallons of diesel fuel, and 1 million gallons of LPG fuel would be shipped to the site monthly. This would require on average one freight barge and one LPG fuel barge per month (see the following discussion in this subsection related to diesel fuel). The two additional barges per month would amount to a 1-percent increase in Lynn Canal traffic during the summer months and an 11-percent increase during the winter months. The larger percentage increase during winter months would have a minimal impact because the total number of vessels would be small.

During the commercial fishing season, the project's barge traffic could affect commercial gillnet fishing in the vicinity of Point Sherman. To minimize the potential impacts, barges would be scheduled into the site on non-fishing days to the maximum extent possible. If necessary during non-fishing days, time within the fishing areas would be minimized by having the barge approach the shoreline in a perpendicular fashion from the middle of Lynn Canal.

As a condition of the C-Plan, the operator would be required to work with the local fishermen prior to opening of the fishing season to establish schedules for fuelings. Fuel transfer would not occur when waves were higher than 3 feet.

Under Alternative A, as well as the other alternatives, diesel fuel would be supplied to the Kensington Gold Project by regularly scheduled barges that supply diesel to facilities throughout

Southeast Alaska. Spill contingency plans for the three major oil terminals in Haines and Skagway show a combined annual throughput of 42.5 million gallons per year. Each barge typically contains about 80,000 barrels (3.2 million gallons) of oil. At present, about 85 transfers occur per year. Under Alternative A, approximately 2 millions gallons of diesel fuel would be used annually at the mine, potentially increasing diesel transport by 5 percent, or less than one barge per year. Page 4-47 of the 1992 FEIS provides data on oil pollution events in Lynn Canal from 1986 through 1990. No events were associated with fuel barge sinkings or damage during this period or have occurred since then (USCG, 1996). Under Alternative A, therefore, the risk associated with barge transport of fuel to the Kensington site is minimal.

The transfer of diesel fuel from the supply barge to the marine terminal at Comet Beach presents the risk of a diesel fuel spill into Lynn Canal during transfer operations. Under all alternatives, the diesel fuel would be pumped from transport containers on the barge to a storage tank at Comet Beach using a flexible transfer hose. To prevent spillage of diesel fuel during transfers, the transfer hose would be pressure tested annually and inspected for integrity prior to each transfer. Fuel transfers would be controlled by a tanker operator on the barge who was trained in spill prevention and control. A second individual must be present on shore during all fuel transfers. If a leak occurred during transfer, the tanker operator would take immediate action to stop the leak by shutting down the transfer pump. The perimeter of each barge would be designed to contain spills, and spill containment also would be provided at the header, transfer points, and under the shore-side hook-up location.

Based on the operating experience of a major barge supplier of diesel fuel, the frequency of spills during transfer operations is about once every 500 transfers (Petro Marine, 1997). Under Alternative A, the Kensington Gold Project would require approximately 12 barge shipments of diesel fuel per year. The risk of a spill during transfer operations would be about 0.024 per year. When projected over the 14-year life of the project, the cumulative risk is about 0.336 (about 1 in 3) that a single spill would occur during transfer operations. The transfer pump has a rated capacity of 750 gallons per minute. If a leak or spill occurred during transfer, the tanker operator would be able to shut down the transfer pump within 1 minute. Prompt action by the tanker operator would limit the spill to 750 gallons plus the volume of diesel fuel contained within the hose (about 130 gallons), resulting in a maximum spill of approximately 880 gallons. Engineered spill containment areas on the barge and shore-side would most likely prevent a major portion of such a spill from reaching the waters of Lynn Canal. In addition, the State spill contingency plan requires containment booms to be attached to a boat at the beach during all transfers. This would further expedite spill response and limit impacts. Section 4.6 discusses the potential impacts of such a release to local aquatic life.

Material Onsite Transportation

Under Alternative A, the existing access road at the project site would be upgraded and relocated to support construction, mining, and ore-processing activities. The access road would extend approximately 2.2 miles from the marine terminal at Comet Beach to the 800-foot adit at the upper site.

Vehicle traffic on the access roads would comprise the following:

- Personnel movement to and from the heliport to the housing camp and other facilities
- Haulage of supplies, process chemicals, and explosives
- Fuel trucks
- Waste rock for construction and reclamation activities
- Road maintenance and equipment maintenance vehicles.

Vehicles using the access road would include semi-tractor/trailers, flatbed trucks, buses, carryalls, half- and three-quarter ton trucks, diesel tanker truck, fire truck, ambulance, fork lifts, grader, snowplow and explosives vehicle, and other vehicles as required to support mine and mill operations.

Under Alternative A, approximately 4,800 vehicle trips per year are estimated for the access road. The risks of accidents associated with transportation on the access road were estimated using statistical data supplied by the Alaska Department of Transportation and Public Facilities for rural highways in the State of Alaska (ADOTPF, 1995a; ADOTPF, 1995b). These data are expected to establish an upper bound on the potential risk of accident because average vehicle speeds are anticipated to be much lower on the access road than the average vehicle speeds on rural highways.

In addition to the risks of injury and fatality to personnel, the onsite transportation of hazardous materials poses the risk of spills to the environment. Under Alternative A, as well as the other alternatives, the operator would be required to develop and implement a spill prevention, containment, and countermeasure plan. Diesel fuel and sodium cyanide would pose the greatest risk to the environment if spilled. All fuel tanks and transfer points would be located in areas with secondary containment. A 5,000-gallon tanker truck would transport diesel fuel from storage tanks at the marine terminal to the process area. Approximately 180 diesel fuel shipments per year would be required to supply fuel for mining vehicles and equipment. The accident rate for trucks on the access road is estimated to be about 2 per million miles (ADOTPF, 1995a). The length of the access road is approximately 2.2 miles. The probability that an accident would result in a diesel fuel spill is estimated to be 0.187 (Harwood and Russell, 1990). Combining these factors, the probability of an accident that would release the entire contents of a tanker truck is estimated to be about 0.00015 per year (about 1 in 7,000). Because the access road generally parallels Sherman Creek and would cross the creek or its tributaries in several places, any release of diesel fuel from a transportation accident could enter the waters of Sherman Creek. The maximum consequences of a diesel fuel transportation accident would be the release of 5,000 gallons of diesel fuel to Sherman Creek with potential for migration into Lynn Canal. Prompt spill response actions would likely prevent a major portion of the release from reaching the waters of Sherman Creek or Lynn Canal, however. In addition, much of the road is at least several hundred feet from the creek. Under all alternatives, spill response equipment would be located at the marine terminal and process area and along the road midway between the two areas. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

4.12.2 Effects Common to Alternatives B Through D

Material Offsite Transport

Materials, equipment, and fuel would be transported to the Kensington site by barge to a landing site at Comet Beach. During the operation phase, approximately 700 to 800 tons of freight and 540,000 gallons of diesel fuel would be shipped to the site monthly. In addition, the site would ship approximately 6,000 tons of processed ore each month for offsite gold recovery processing. This would require on average one freight barge and four to five processed ore barges per month (see the following discussion in this subsection related to diesel fuel). The six additional barges per month associated with the Kensington Gold Project operations would equal a 2-percent increase in Lynn Canal traffic during the summer months and a 33-percent increase during the winter months. The larger percentage increase during winter months would have a minimal impact because the actual number of vessels would be small.

As with Alternative A, the project's barge traffic could affect commercial gillnet fishing in the vicinity of Point Sherman during the commercial fishing season. To minimize the potential impacts, the barges would be scheduled into the site on non-fishing days, and barges would be requested to approach the shoreline in a perpendicular fashion from the middle of Lynn Canal.

Under Alternatives B through D, approximately 6.5 million gallons of diesel would be used, which could increase diesel transport by about 15.3 percent or about two barges per year. Page 4-47 of the 1992 FEIS provides data on oil pollution events in Lynn Canal from 1986 through 1990. No events were associated with fuel barge sinkings or damage during this period or have occurred since then (USCG, 1996). Therefore, the risk associated with barge transport of fuel to the Kensington Gold Project is minimal under Alternatives B through D.

Under Alternatives B through D, the increased number of diesel fuel barge shipments results in a higher risk of a diesel fuel spill during barge-to-shore fuel transfer operations compared to Alternative A. Under Alternatives B through D, the Kensington Gold Project would need about 52 barge transfers of diesel fuel per year. The risk of a spill during transfer operations would increase to about 0.104 per year. Projected over the 14-year life of the project, the cumulative risk would increase to about 1.5, indicating that 1 to 2 spills would be expected to occur during the life of the project. The maximum diesel fuel spill (about 880 gallons) and its consequences would be the same as those described under Alternative A.

Material Onsite Transport

Under Alternatives B through D, tailings slurry would be pumped to the backfill plant, and return water would be pumped back to the mill. Underground containment and check valves at the mine portal would limit the potential for any underground spills associated with a rupture to reach the surface. Therefore, the primary risk to water resources would be a spill in the 1,500-foot surface component of each pipeline. U.S. Department of Transportation (DOT) data on diesel pipeline failures were used to project the probability of a rupture. According to DOT, the annual probability of rupture is about 0.888 failures per thousand miles of pipeline. For each pipeline, this would result in an annual probability or rupture of about 0.03 in 100. The surface sections of the pipelines would be located in containment ditches to minimize any potential spill impacts.

4.12.3 Effects of Alternative B (Proposed Action)

Material Onsite Transport

Under Alternative B, approximately 37,000 vehicle trips per year are estimated for the onsite haul road, which is nearly an eight-fold increase over Alternative A. The large increase in shipments is due primarily to truck shipments of dewatered tailings from the upper site to the DTF. Truck shipments of processed ore and increased diesel fuel shipments also account for a portion of the increase.

The increase in shipments results in a higher probability for transportation accidents, injuries, and fatalities under Alternative B. The risks for accidents, injuries, and fatalities during vehicle transportation were based on statistical data supplied by the State of Alaska (ADOTPF, 1995a; ADOTPF, 1995b). The risk of vehicle accident is estimated to be 0.36 per year (i.e., a probability of about 1 in 3 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is about five vehicle accidents during the life of the project. The risk of personnel injury as a result of a transportation accident is estimated to be 0.033 per year (about 1 in 30), with a cumulative risk of 0.47 (about 1 in 2) of a single transportation injury during the life of the project. The risk of personnel fatality as a result of a transportation accident is estimated to be 0.0047 per year (about 1 in 200), with a cumulative risk of 0.065 (about 1 in 15) for the life of the project.

In addition to the risks of injury and fatality to personnel, the transportation of hazardous materials poses the risk of spills to the environment. Under Alternative B, diesel fuel and lead nitrate would pose the greatest risk to the environment if spilled. Ore would not be processed onsite for gold recovery under Alternative B; therefore, sodium cyanide and other hazardous chemicals used for gold recovery processing and cyanide destruction would not transported or used onsite.

All fuel tanks and transfer points would be located in areas with secondary containment. A 5,000-gallon tanker truck would transport diesel fuel from storage tanks at the marine terminal to the upper site. Approximately 1,300 diesel fuel shipments per year would be required to supply fuel for power generation, mining vehicles, and equipment. The probability of an accident that would release the entire contents of the tanker truck is estimated to be about 0.0011 per year (about 1 in 900). The maximum consequences of a diesel fuel transportation accident would be the same as those described for Alternative A in Section 4.12.1. The risk of a major spill during truck transport of diesel fuel would be reduced by the low speed of trucks on the access road, trained drivers, and prompt spill response actions. Much of the access road is at least several hundred feet from Sherman Creek. Spill response equipment would be located at the marine terminal and process area, as well as along the road midway between these two areas.

Trucks would transport lead nitrate from the marine terminal to the upper site. Lead nitrate contained in 1-ton Flo-bins would be off-loaded from barges at the marine terminal. If it is assumed that five 1-ton Flo-bins would be transported per truck, about two truck shipments per year would be required to supply lead nitrate for ore processing. The probability of an accident that would release the entire contents of five Flo-bins is estimated to be about 8.1×10^{-7} per year (about 1 in a million). Because the haul road generally parallels Sherman Creek and would cross the creek or its tributaries in several places, any release of lead nitrate from a transportation accident could enter the waters of Sherman Creek. The maximum consequences of a lead nitrate transportation accident would be the release of 5 tons of lead nitrate to Sherman Creek with potential for migration into Lynn Canal. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

In addition to hazardous materials, large quantities of dewatered tailings would be transported over the haul road. A transportation accident involving shipment of dewatered tailings was also evaluated. If it is assumed that 50 tons of dewatered tailings would be transported per truck, about 28,600 truck shipments per year would be required to transport tailings from the mine to the DTF. The accident rate for trucks on the access road is estimated to be about 2 per million miles (ADOTPF, 1995a). The length of the access road is approximately 2.2 miles. The probability that an accident would result in a spill of dewatered tailings is estimated to be about 0.091 (Harwood and Russell, 1990). Combining these factors, the probability of an accident that would release the entire contents of the truck is estimated to be about 0.012 per year (about 1 in 80). Because the haul road generally parallels Sherman Creek and would cross the creek or its tributaries in several places, any release of tailings from a transportation accident could enter the waters of Sherman Creek. The maximum consequences of a dewatered tailings transportation accident would be the release of 50 tons of tailings to Sherman Creek. The risk of a major spill during truck transport of dewatered tailings would be reduced by the low speed of the trucks on the access road and trained drivers. Prompt spill response actions would likely prevent a major portion of the release from reaching the waters of Sherman Creek or Lynn Canal, however. In addition, much of the road is at least several hundred feet from the creek. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

4.12.4 Effects of Alternative C (Marine Discharge)

Material Onsite Transport

Under Alternative C, approximately 36,000 vehicle trips per year are estimated for the onsite access road. This is about a seven-fold increase over Alternative A and is slightly less than Alternative B because of the elimination of diesel fuel shipments. Under Alternative C, a pipeline would transport diesel fuel from the marine terminal to the upper site.

The risk of vehicle accident is estimated to be 0.35 per year (i.e., a probability of about 1 in 3 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is about five vehicle accidents during the life of the project. The risk of personnel injury as a result of a transportation accident is estimated to be 0.032 per year (about 1 in 30), with a cumulative risk of 0.45 (about 1 in 2) of a single transportation injury during the life of the project. The risk of personnel fatality as a result of a transportation accident is estimated to be 0.0045 per year (about 1 in 200), with a cumulative risk of 0.063 (about 1 in 16) for the life of the project.

In addition to the risks of injury and fatality to personnel, the transportation of hazardous materials poses the risk of spills to the environment. Under Alternative C, diesel fuel and lead nitrate would pose the greatest risks to the environment if spilled.

Under Alternative C, diesel fuel would be transported by pipeline instead of truck. Based on data compiled by DOT, the average failure rate of petroleum pipelines resulting in oil spills in excess of 10,000 gallons is about 0.888 failures per thousand miles per year (Hovey and Farmer, 1993). For the 2.2-mile pipeline proposed under Alternative C, the annual probability of a large spill would be about 0.002 per year (1 in 500). The pipeline would be equipped with leak detection sensors, and pipeline fuel transfers would be stopped automatically upon detection of a leak. Any fuel contained in the pipeline upgradient from the leak would be available for spillage to the environment, however. The maximum spill would release the entire volume of the pipeline, about 17,000 gallons. Because the pipeline generally would parallel Sherman Creek, any release of diesel fuel from a pipeline spill could enter the waters of Sherman Creek. Therefore, the maximum consequences of a diesel fuel pipeline spill would be the release of 17,000 gallons of diesel fuel to Sherman Creek with potential for migration into Lynn Canal. Prompt spill response actions would prevent a major portion of the release from reaching surface waters, however. In addition, much of the pipeline would be located at least several hundred feet from the creek. The pipeline would be double-walled to minimize the potential impacts of any failure. Sections 4.6 and 4.7 discuss the potential impacts of a diesel fuel release to local aquatic life.

Under Alternative C, mine drainage and tailings effluent would also be piped to Lynn Canal for discharge. The probability of an effluent pipeline rupture and spill is assumed to be similar to the probability of diesel fuel pipeline failure (0.888 failures per thousand feet per year). Under Alternative C, this would represent 0.002 spills per year (1 in 500).

The probability and consequences of a transportation accident involving a shipment of lead nitrate would be the same as those described for Alternative B in Section 4.12.3.

In addition to hazardous materials, large quantities of dewatered tailings would be transported over the haul road under Alternative C. The probability and consequences of a transportation accident involving a shipment of dewatered tailings would be the same as those described for Alternative B.

4.12.5 Effects of Alternative D (Modified DTF Design)

Material Onsite Transport

Under Alternative D, approximately 8,400 vehicle trips per year are estimated for the onsite haul road. This is about a 75-percent increase over Alternative A and is considerably less than Alternatives B and C because of the elimination of truck shipments of dewatered tailings. Under Alternative D, tailings slurry would be transported by pipeline to the DTF.

The risk of vehicle accident is estimated to be 0.074 per year (i.e., or a probability of about 1 in 14 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is about 1 vehicle accident during the life of the project. The risk of personnel injury as a result of a transportation accident is estimated to be 0.0069 per year (about 1 in 150), with a cumulative risk of 0.096 (about 1 in 10) of a single transportation injury during the life of the project. The risk of personnel fatality as a result of a transportation accident is estimated to be 0.00096 per year (about 1 in 1,000), with a cumulative risk of 0.014 (about 1 in 70) for the life of the project.

Under Alternative D, diesel fuel and lead nitrate pose the greatest risks to the environment if spilled as a result of a transportation accident. The probability and consequences of transportation accidents involving these materials would be the same as those described for Alternative B in Section 4.12.3.

An accidental spill associated with the tailings slurry pipeline was also evaluated. It is assumed that the average failure rate of the tailings slurry pipeline is the same as that determined for petroleum pipelines (i.e., 0.888 failures per thousand miles per year) (Hovey and Farmer, 1993). For the 8,500-foot (1.6-mile) pipeline proposed under Alternative D, the annual probability of a large spill would be about 0.0014 per year. The pipeline would be equipped with leak detection sensors, and pipeline transfers would be stopped automatically upon detection of a blockage or leak. Any slurry contained in the pipeline upgradient from the leak would be available for spillage to the environment, however. The maximum spill would release the entire volume of the pipeline, about 270,000 gallons. Because the pipeline generally would parallel Sherman Creek, it is assumed that any release of tailings slurry from a pipeline spill could enter the waters of Sherman Creek. Therefore, the maximum consequences of a tailings slurry pipeline spill would be the release of 270,000 gallons of slurry to Sherman Creek with potential for migration into Lynn Canal. The tailings slurry pipeline would be double-walled and equipped with leak detection sensors to minimize potential impacts from a failure. In addition, prompt spill response actions could prevent a release from reaching surface waters. Much of the pipeline would be located at least several hundred feet from the creek. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

4.12.6 Summary

Tables 4-32 and 4-33 summarize the frequency of annual truck shipments on the access or haul road and the annual barge shipments to the facility, respectively, for the alternatives. These tables outline the number of shipments required for waste rock, processed ore, tailings, fuel, and process chemicals, as well as the number of personnel shuttles that would be required.

Table 4-34 compares the annual and cumulative probabilities (i.e., the probability over the expected life of the project) of accidents, personal injuries, and fatalities that would be expected from trucking.

Table 4-32. Summary of Truck Shipments by Alternative

Materials	Annual Truck Shipments			
	Alternative A	Alternative B	Alternative C	Alternative D
Waste Rock	3,000	3,000	3,000	3,000
Processed Ore	0	1,500	1,500	1,500
Dewatered Tailings	0	28,600	28,600	0
Diesel Fuel	180	1,300	0	1,300
Process Chemicals	1,000	1,500	1,500	1,500
Personnel Shuttles	600	1,100	1,100	1,100
Total	4,780	37,000	35,700	8,400

Table 4-33. Summary of Barge Shipments by Alternative

Materials	Annual Barge Shipments	
	Alternative A	Alternatives B, C, D
Diesel Fuel	12	52
LPG	12	0
Processed Ore	0	52
Freight	12	12
Total	36	116

Table 4-34. Truck Accident Rates by Alternative

Alternative	Annual Accident Probability	Cumulative Probability (project life)
A (No Action)	2.89e-02	4.05e-01
B (Proposed Action)	3.59e-01	5.03e+00
C (Marine Discharge)	3.46e-01	4.84e+00
D (Modified DTF Design)	7.41e-02	1.04e+00

Under Alternatives B and D, the probability of a diesel fuel truck accident and spill is 0.0011 per year and 0.015 (1 in 67) over the project life. The maximum consequences of this spill would be 5,000 gallons of diesel fuel spilled into lower Sherman Creek. Under Alternative C, the probability of a pipeline accident and spill is 0.002 per year and 0.027 (1 in 37) over the project life. The maximum consequences of this spill would be 17,000 gallons of diesel fuel spilled into lower Sherman Creek, assuming the use of a 6-inch diameter pipeline.

Under Alternatives B and C, the probability of a tailings truck accident and spill is 0.012 per year and 0.168 (1 in 6) over the project life. The maximum consequences of this spill would be 50 tons of dewatered tailings spilled into lower Sherman Creek. Under Alternative D, the probability of a tailings pipeline accident and spill is 0.0014 per year and 0.02 (1 in 50) over the project life. The maximum consequences of this spill would be 270,000 gallons (2,650 tons) of tailings slurry spilled into lower Sherman Creek.

The construction of a diesel fuel pipeline under Alternative C would increase disturbance by 2 acres. The construction of the tailings and reclaim water pipelines under Alternative D would increase disturbance by approximately 3 acres. As discussed in Section 4.4, this could lead to increased sediment loadings to fresh water. However, these loadings would be minimized by adequate design and implementation of Forest Service and EPA BMPs. The construction of the tailings pipeline would not affect the specifications for the road due to the need to haul till and waste rock for DTF construction. Piping diesel fuel under Alternative C and tailings under Alternative D would slightly decrease transportation-related air emissions, as discussed in Section 4.1.

4.13 SUBSISTENCE

The potential effects of the Kensington Gold Project on subsistence resources and activities were analyzed in the 1992 FEIS on pages 4-113 and 4-114. The alternatives considered in this Final SEIS are similar in location and design to those considered in 1992 and would result in similar effects to subsistence.

The analysis indicated that none of the alternatives considered in the 1992 FEIS would affect access to or availability of subsistence resources. The project does have the potential to increase competition between subsistence and non-subsistence users for resources within the area around Juneau where sport and personal use harvesting occurs. This increase in competition would not exceed the increase in the Juneau population attributable to mine development and would be distributed throughout the area utilized by Juneau residents. The development of the Kensington Gold Project is expected to result in a 2-percent increase in the Juneau area population over the life of the mine. A 2-percent increase in sport use of the subsistence resources near Juneau would not result in a significant impact to neighboring subsistence users who utilize the same area.

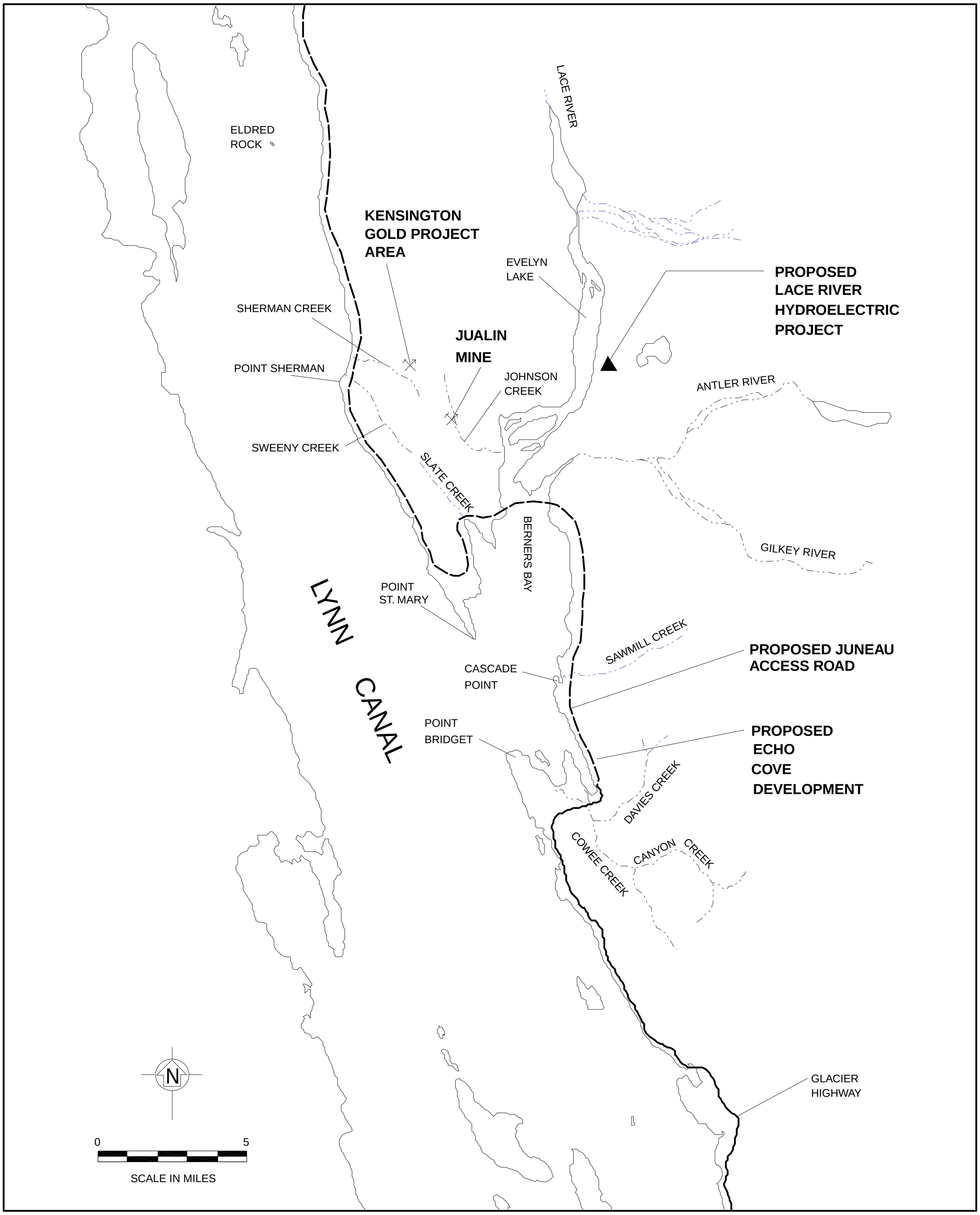
4.14 CUMULATIVE EFFECTS

This section discusses the cumulative effects associated with the Kensington Gold Project. Figure 4-4 depicts the other proposed and potential projects in the vicinity of the Kensington Gold Project: the Juneau Access Road, Echo Cove Road Easement to Cascade Point, Goldbelt Incorporated’s, Echo Cove development, Lace River Hydroelectric, and Jualin Mine Project. Section 4.14.1 briefly describes these projects, and Section 4.14.2 summarizes the cumulative effects on each resource.

4.14.1 Descriptions of Other Projects

Juneau Access Road

The Alaska Department of Transportation, in cooperation with the Federal Highway Administration, has released the Juneau Access Improvements Draft EIS. This document



214D-4.4

Figure 4-4. Projects Considered for Cumulative Effects

assesses the potential impacts associated with improving access to Juneau. The proposed action is a 65-mile, 2-lane highway on the east side of Lynn Canal from Echo Cove to Skagway, with ferry transport from Skagway to Haines. The Draft EIS indicates that road construction could begin as early as 2000 and be completed by 2005. Therefore, cumulative effects from the road construction and operation could overlap with the Kensington Gold Project.

From Echo Cove, the highway would follow the shore around Berners Bay. The road would cross the head of Berners Bay using a causeway and two bridges. North of Berners Bay, the highway would follow the Lynn Canal coastline to Skagway. The highway would cross Sherman and Sweeny Creeks in the vicinity of the Kensington Gold Project site. The proposed road alignment would be adjacent to the DTF under the Kensington Gold Project Alternatives B through D. The Draft EIS also considers a high-speed ferry alternative with four options. Two options would continue the existing ferry service supplemented by daily fast ferries. The other two options would replace the existing ferry service with all high-speed ferries. Two of these options also include extending the Glacier Bay highway 8 miles beyond Echo Cove to a new ferry terminal.

For the proposed action, the Draft EIS projects daily traffic averages of 618 cars through the year 2005 and 1,429 cars between the years 2005 and 2025. Traffic is expected to be highest during the summer months. The road would physically impact 8.25 acres (0.75 miles of road, assuming a 100-foot wide right of way) within the Kensington Gold Project permit area and would require crossings at Sherman Creek and the intermittent creeks draining the Terrace Area.

Echo Cove Development (Goldbelt)

Goldbelt, Incorporated, an urban native corporation, has begun to develop its private lands at Cascade Point in Echo Cove. In March 1996, Goldbelt issued a master plan for the land that involves development of approximately 10 percent of Goldbelt's 1,400 acres at Cascade Point. To access the private land, Goldbelt has applied to the Forest Service for a 2.5-mile road easement on a 100 foot wide strip of National Forest System lands (see the next subsection). Authorization for wetland fill activities would be required from the Corps of Engineers.

The proposal for initial development in the master plan includes construction of a staging area and equipment and log transfer facility at Cascade Point. Logging has taken place on Goldbelt's private land in the area with logs being removed by barge. No further removal of logs via barge is planned. The next phase of development is still in the planning stages but could include a lodge; convenience store/gas station; necessary utilities, such as an electric generation plant and water and sewage facilities; and a dock to facilitate the following:

- High-speed ferry service to Haines/Skagway
- Increased tourism, including excursion ships out of Cascade Point
- Increased support for Lynn Canal fisheries
- Access for miners and other personnel to the Jualin Mine if the mine were to be developed.

Initial construction of the Echo Cove facilities could be completed within the next 3 to 5 years. Construction of residential units could begin at some point in the future based on the local economics and housing demand within the City and Borough of Juneau. Goldbelt has entered into an agreement with the operator to construct housing for Kensington Gold Project workers. This housing would be constructed in Juneau, however, rather than as part of the Echo Cove development. Construction of later stages of the Echo Cove Project would not likely occur until late in the Kensington Gold Project's operation life, if at all.

Glacier Highway Extension to Cascade Point (Goldbelt)

Goldbelt has applied to extend Glacier Highway by 3.5 miles to access its holdings at Cascade Point. The proposed extension would require a 100-foot easement through National Forest System lands for a length of approximately 2.5 miles. A Draft EIS is currently being developed to address this action. The proposed Glacier Highway extension would be upgraded to become part of the Juneau Access Road if both projects were to be constructed. The Glacier Highway extension alone would not contribute cumulative effects to the Kensington Gold Project study area. For the purposes of the cumulative impact discussion, the extension is considered as part of the discussion of the Echo Cove development (see the previous subsection). The timeframe for completion of the road, if constructed, would likely be within the next 2 to 3 years.

Lace River Hydroelectric

According to a status report submitted on May 1, 1996, to the U.S. Federal Energy Regulatory Commission (FERC), the Lace River Hydroelectric project is in the proposal phase with feasibility studies still pending. FERC issued a preliminary permit on December 11, 1995, which is valid for 3 years or until the project's development application is filed. At this time, no application has been filed, and the status report indicates some preliminary investigations have been postponed by 1 year. The timeframe for construction of the project is speculative, but it is feasible that the project could be developed within the next 3 to 5 years.

The Lace River Hydroelectric project as proposed would be located 5.5 miles up the Lace River on an unnamed lake that feeds an unnamed Lace River tributary. Lace River is located at the head of Berners Bay, 40 miles north of Juneau.

The proposed hydroelectric facility would have either a siphon intake at the unnamed lake or a 20 foot high timber buttress dam downstream from the lake. In either case, about 7,600 feet of 21-inch pipe would direct water to a powerhouse, which would be located near Lace River. The powerhouse would contain one generating unit with a capacity of 4,900 kW and an average annual generation of 34.1 GWh. If a dam were built at the mouth of the existing 384-acre lake, the lake's surface area would be enlarged to 420 acres with a storage capacity of 8,400 acre-feet.

The Lace River Hydroelectric project would be located 23 miles (by water) and 6.5 miles (by air) from the Kensington Gold Project. Proponents of the Lace River Hydroelectric project had planned to supply power to the Kensington Gold Project mine via a 5 mile long underwater and 6 mile long above ground transmission line. However, Coeur d'Alene Mining, Incorporated, sent a letter to the Forest Service indicating that Coeur Alaska would not purchase power from the Lace River Hydroelectric project (Coeur d'Alene, 1997). Although the discussion of cumulative impacts associated with the Kensington Gold Project includes the Lace River Hydroelectric project, therefore, it does not include construction of transmission lines to the mine.

The Lace River Hydroelectric project remains in the feasibility stage of development. Environmental studies, coordination with environmental agencies, optimization of logistics, and communications systems are still incomplete. Likewise, the design and financing of the project are incomplete. Therefore, there has not been a clear demonstration that the Lace River Hydroelectric project will be built, especially since Coeur Alaska has elected not to purchase power. In addition, Goldbelt has not committed to buying its power from Lace River Hydroelectric and proposes to use onsite generators until its long-term demand has been projected.

Since Coeur Alaska has stated that it will not buy power from the Lace River Hydroelectric Project and Goldbelt, Inc., has not committed to buying Lace River Hydroelectric power, it is unlikely that the project will be developed in the reasonably foreseeable future. At some future date, however, the operator could decide to buy power from Lace River Hydroelectric. In that case, the specifics of the project, such as effects on visuals and water quality, would undergo public review through the NEPA and FERC licensing processes. It is assumed that the project design would be similar to the proposal previously submitted to FERC.

Jualin Mine Project

The Jualin Mine property is located 40 miles north of Juneau and 2.5 miles southeast of the Kensington Gold Project in the Berners Bay Mining District near the north end of the Juneau Gold Belt. Gold was discovered at Jualin in 1895; production commenced in 1896. Operation of the mine was intermittent until 1920. The historic Berners Bay District recorded production of 61,100 ounces of gold between 1885 and 1920. About 136,500 tons were mined.

Jualin became active again in 1978 when Hyak Mining Company of Juneau restaked the core of the property. A succession of companies, including Hyak, Bear Creek Mining Company, International Curator Resources (Curator), and Placer Dome U.S., Incoropnated, conducted exploration activities at Jualin between 1978 and 1992. Curator also constructed a road from Slate Creek to the portal.

In June 1993, Coeur Alaska entered into a joint venture with Curator. This joint venture conducted limited exploration that year. Coeur Alaska acquired 100-percent interest in the property from Curator during 1994 and conducted additional, limited exploratory drilling. No exploration has occurred at the site since 1994.

In general, the estimated mineral resource is approximately one million tons, containing an estimated 200,000 to 400,000 ounces of gold (20 percent of the Kensington Gold Project reserves). Additional drilling, underground development sampling, resource modeling, mine planning, and engineering economics would be necessary to demonstrate that the project could be economically viable. In addition, significant environmental baseline studies have not been completed, and a Plan of Operations has not been developed for mining.

The Jualin Mine remains an exploration project. While exploration activities are scheduled to continue, the operator does not currently have plans to develop the Jualin Mine. It is unlikely that the additional exploratory work, baseline studies, NEPA compliance, permitting, and subsequent construction could be accomplished within the operational life of the Kensington Gold Project. This discussion presents a reasonably foreseeable possibility of developing the Jualin Mine within a timeframe that could contribute cumulative effects considered with the Kensington Gold Project, assuming that the Jualin ore body would be accessed from the Kensington Gold Project workings and that Kensington facilities would be used for processing and tailings disposal. The effect of this action could occur near the end of the operational life of the Kensington Gold Project and could extend the use of the facilities for an additional 4 to 5 years, considering the extent of proven reserves at Jualin.

4.14.2 Summary of Cumulative Effects

CEQ regulations implementing NEPA define cumulative effects as those that result from the incremental impact of the action added to other past, present, and reasonably foreseeable future actions. This section describes the potential cumulative effects on individual resources.

The Kensington Gold Project site is not located within the Berners Bay watershed and, for most resources, is not expected to produce either direct or indirect impacts on the Berners Bay area. This cumulative impact analysis considers existing and reasonably foreseeable projects occurring within the Berners Bay watershed. However, it only addresses effects of these projects where the Kensington Gold Project would contribute to such impacts. An analysis of the potential impacts of other projects to resources in Berners Bay that are not affected by the Kensington Gold Project is beyond the scope of this Final SEIS and by definition do not contribute to the cumulative effects of the Kensington Gold Project.

Air Quality

Air pollution concentration increases resulting from the Kensington Gold Project would be very localized and confined to the vicinity of the site. Annual average NO_x concentrations would decrease to below significant levels within 0.6 miles of the project boundary. Similarly, PM_{10} and SO_2 modeled concentrations are less than 1 $\mu g/m^3$ within 0.6 miles of the project boundary. The only projects that would contribute to cumulative air quality impacts would be projects in the immediate proximity to the Kensington Gold Project. The discussion of cumulative effects on air quality, therefore, is limited to the Juneau Access Road and the use of Kensington facilities to access and process ore from the Jualin Mine.

The Draft EIS for the Juneau Access Road projects a maximum carbon monoxide concentration of 9 ppm (approximately 550 $\mu g/m^3$) from road traffic. As a result, the air quality emissions of the combined Kensington Gold and Juneau Access Road Projects would be well below the National Ambient Air Quality Standards. There would be minimal air quality impacts if the high-speed ferry alternative were selected instead of the road.

Exploration activities conducted at the Jualin Mine involve the use of diesel-powered vehicles and small diesel generators, both of which produce negligible pollutant emissions. Exploration activities, therefore, contribute very little in terms of cumulative effects to air quality. Using Kensington facilities to access and process ore from the Jualin Mine could contribute to cumulative effects to air quality by extending the life of the Kensington facilities. The extended use of the Kensington facilities would not produce emissions any different than those discussed in Section 4.1 of this Final SEIS. Therefore, no significant cumulative effects related to air quality are anticipated.

Geotechnical

The Draft EIS for the Juneau Access Road indicates that the proposed action would cross 58 avalanche paths between Echo Cove and Skagway. None of these avalanche paths are within the Kensington Gold Project area. There are no other aspects of the Juneau Access Road that would create additional geotechnical concerns for the Kensington Gold Project; therefore, the road does not contribute to cumulative effects.

The primary geotechnical concerns are associated with the use of Kensington Gold Project facilities to access and process Jualin Mine ore, as well as dispose of the resulting tailings. The DTF is designed to hold approximately 20 million tons of tailings. The size of the DTF site analyzed in this Final SEIS assumes that none of the Kensington Gold Project tailings would be backfilled. This approach was used to be conservative in discussing potential impacts. The currently identified mineral resource at Jualin consists of 200,000 to 400,000 ounces of gold (compared to more than 2 million ounces at Kensington). Assuming similar ore grades and mining methods, the production of 400,000 ounces of gold from the Jualin Mine would produce approximately 4 million tons of tailings, or about 20 percent of the design capacity of the DTF. Since the operator would backfill at least 25 percent of the Kensington tailings, the DTF could contain the 4 million tons of Jualin Mine tailings without changing any of the design parameters or footprint used for analysis in this Final SEIS. Although the use of Kensington facilities would extend the Kensington Gold Project's operational life, the disposal of Jualin Mine tailings would be unlikely to produce any geotechnical concerns other than those discussed in Section 4.2 of this Final SEIS. Therefore, no significant cumulative effects related to geotechnical concerns are expected.

Surface Water Hydrology

Because the Kensington Gold Project would affect surface water hydrology only in the Sherman Creek and Terrace Area watersheds, the potential cumulative effects on surface water hydrology are only considered for these areas. The projects that could contribute to cumulative effects within these areas would be the Juneau Access Road and use of Kensington facilities to access and process Jualin Mine ore.

The Juneau Access Road would include crossings of Sherman Creek and each of the intermittent streams below the DTF. The potential for impacts to surface water hydrology would only occur during construction of the stream crossings. These impacts would not be significant because the Alaska Department of Transportation would have to minimize impacts on stream flows, provide for fish passage, and implement water resource BMPs. Any contribution to cumulative impacts on surface water hydrology from the Juneau Access Road would be minimal. As discussed previously, accessing and processing Jualin Mine ore using Kensington facilities would likely extend the period of impacts on surface hydrology described in Section 4.3 of this Final SEIS for 3 to 5 years. These impacts would last only for the duration of the mining and processing operations and would not contribute to long-term effects to Sherman Creek. The cumulative impact following mine closure would be the same as that of the Kensington Gold Project alone on the intermittent creeks within the Terrace Area drainage basin.

Water Quality

The Juneau Access Road would cross Sherman and Sweeny Creeks, as well as the intermittent creeks that drain the Terrace Area. Increased sediment loadings could occur, especially during construction. The Juneau Access Improvement Draft EIS describes the BMPs that would be used during construction to minimize the extent of erosion and potential impacts on anadromous fish. Assuming that these BMPs were properly designed and implemented, sediment loadings would presumably be minimized. The road could also require the use of salt (primarily magnesium chloride [MgCl]) or sand. If salt MgCl or sand were used, there could be elevated TDS or sediment loadings to fresh water streams, including Sherman, Camp, and Sweeny Creeks. The use of such chemicals would have to be evaluated and mitigated, as necessary, to ensure compliance with water quality standards. The implementation of BMPs should preclude impacts to creeks from these sources. Impacts resulting from the road would only occur within the creeks from the road downstream to Lynn Canal. In most, if not all, cases, this translates to a relatively small portion of each creek. There would be no cumulative effects on water quality if one of the high-speed ferry options were selected instead of one of the road construction alternatives.

Cumulative effects could also arise if the Kensington Gold Project facilities were used to access and process Jualin Mine ore. Any effects from the extended use of Kensington facilities would arise from the longer period of time that sediment could enter the creeks and the increased duration of discharges from the permitted discharge points. Any potential effects would be an extension of the effects discussed in Section 4.4 of this Final SEIS. The only potential additive effects would be the accumulation of sediments within the creeks or the accumulation of metals in fish tissue. Since these possibilities have been acknowledged in the preceding analysis, are minimized under each alternative, and would be monitored during operations, it is unlikely that they would contribute to cumulative effects. The contributions to cumulative effects from the Kensington Gold Project, with or without processing Jualin Mine ore, would only continue until the site were reclaimed.

If, at a future date, Coeur Alaska proposed to buy power from the Lace River Hydroelectric Project, the project as proposed would be located 5.3 miles up Lace River and would not be visible from Berners Bay. Based on previously submitted initial plans by Lace River Hydroelectric, Inc., a 5 mile long underwater and a 6 mile long above-ground transmission line would be required. The underwater line would start at the hydroelectric plant along Lace River and run down Lace River to Berners Bay. Depending on the location and type of underwater construction, there could be short-term construction-related impacts to water quality.

Ground Water Hydrology and Quality

The only other project that could affect local ground water hydrology at the Kensington Gold Project site would be the Jualin Mine. Activities at the Jualin Mine could create a drawdown that would combine with that created by the Kensington Gold Project. Information available at this time is not sufficient to define the workings necessary to access the Jualin Mine ore or the extent of drawdown that would be associated with developing the mine. However, the low permeability of the aquifer and the steep surficial topography indicate that cumulative effects related to drawdowns from the Kensington and Jualin workings would likely be minimal.

Aquatic Resources – Marine

The Kensington Gold Project would not impact marine resources as a part of mining operations, except for the dredging necessary to construct the marine terminal. There would be a potential for impacts to marine resources during the life of the project that could result from a spill of fuel or hazardous materials. As discussed in Section 4.12 of this Final SEIS, the potential for barge accidents and spills is very low. The increase in barge traffic associated with the project alone is not expected to impact aquatic life. If Kensington facilities were used to access and process Jualin ore, the period of risk would be extended for all of the marine impacts described in Section 4.6 of this Final SEIS, including impacts from barge transport and transfer, as well as marine discharges. The extension would not increase the level of risk.

The construction of landing facilities as part of Goldbelt's Echo Cove development could slightly increase boat traffic in Lynn Canal. These facilities would more likely change the marine traffic patterns within Lynn Canal, however, rather than significantly increase traffic volume. The change in traffic patterns is not expected to affect marine resources within Lynn Canal in the vicinity of the project area and, therefore, would not contribute to cumulative effects on marine aquatic resources resulting from the Kensington Gold Project. Discharge from the Echo Cove development associated with sanitary waste and storm water would have to comply with State and Federal requirements. Considering the volume of water within Berners Bay and Lynn Canal, the extent of any such discharges is not expected to contribute to cumulative effects to marine water quality in the vicinity of the Kensington Gold Project.

Construction and operation of the Lace River Hydroelectric project is not expected to impact marine aquatic resources, unless an underwater cable were used to transmit power. If an underwater cable needed to be placed within Lynn Canal or Berners Bay, there would be a potential for minor impacts to the organisms inhabiting the immediate area of the cable. Such an impact would result in minimal, if any, contributions to cumulative effects associated with the Kensington Gold Project.

Aquatic Resources – Fresh Water

Cumulative impacts to fresh water resources associated with the Kensington Gold Project are limited to the Sherman Creek watershed and the Terrace Area affected by the DTF. The only projects considered with the Kensington Gold Project for cumulative impacts for fresh water resources are the Jualin Mine and the Juneau Access Road.

The use of Kensington facilities to process Jualin Mine ore would delay final reclamation of the site and extend the projected impacts on fresh water aquatic resources, which are described in Section 4.7 of this Final SEIS, including temporary loss of habitat and potential spill effects. The Juneau Access Road would cross Sherman Creek and the intermittent creeks draining the Terrace Area. The road crossings could contribute sediment to the creeks downstream of the crossings during construction, although this effect would be limited in duration. BMPs would be used to minimize impacts related to road construction, and all crossings would have to be constructed to allow fish passage. Snow removal and de-icing operations associated with maintenance and operation of the road could also result in the addition of sediments or salts (MgCl) to the lower reaches of the creeks. If such material entered the creeks, it would be near the bottom of the watershed, which would maximize the dilution and flushing capability. The amount of material potentially added through this pathway would be limited and is not expected to produce significant cumulative effects when considered with the effects of the Kensington Gold Project.

Wildlife

On a regional basis, there is concern about a wide range of commercial activities affecting overall moutain goat populations in northern Southeast Alaska. Pages 4-63 through 4-70 of the 1992 FEIS describe the effects that the Kensington Gold Project would have on local mountain goat populations. This analysis indicates that the project could have a small impact on the Lions Head goat herd during the life of the mine. This impact would be additive when considered with the impacts to other mountain goat populations in northern Southeast Alaska. Because the impacts from the project are expected to be short term and localized to the Lions Head herd, these impacts would not result in a viability issue for mountain goats within northern Southeast Alaska. In addition, at the Jualin and Kensington sites, the operator has been required to mitigate and monitor wildlife impacts during exploration. Although not intended to measure small changes, ongoing monitoring of mountain goats at the Jualin and Kensington Gold Project sites has generally shown stable populations.

Table 4-23 in the 1992 FEIS documents the modeled Kensington Gold Project impacts on other wildlife habitat. With the exception of the Juneau Access Road, none of the other proposed projects are located in the same watershed, unless Jualin ore were accessed and processed using Kensington facilities. In this case, the modeled effects described in the 1992 FEIS would be extended in time rather than increased in magnitude. Overall, the loss of habitat associated with the Kensington Gold Project would be relatively minor during operation of the mine and insignificant upon final reclamation.

The Juneau Access Road would parallel the DTF. Since wildlife sensitive to noise and human activity would be displaced by mining operations, the road would be unlikely to contribute to further displacement within the project area. This displacement would only occur while the project was active; distributions are expected to recover upon final reclamation. At that point, the Juneau Access Road could influence wildlife distributions within the project area. Outside the project area, the road would also be likely to influence wildlife distributions for those species sensitive to noise and human activity. Considering the distribution of habitat within Southeast Alaska, these impacts would be unlikely to influence wildlife populations on a regional basis.

Within the Kensington Gold Project area, mine employees would not be allowed to hunt while on their duty tours. Therefore, any project-related cumulative effects from hunting would correspond to the Kensington Gold Project's contribution to the general population increase (approximately 2 percent). The overall growth in Juneau is projected to be 9 percent during the life of the Kensington Gold Project. Therefore, the project would be responsible for about 20 percent of the increase in population over the life of the mine. The population increase would likely produce a corresponding demand for hunting, fishing, and other recreational opportunities. The increase in Juneau area population over the next 20 years would likely result in changes to the existing recreational experience. These changes could include more encounters with other recreationists and a possible decline in hunting and fishing success in some areas as competition for these resources increased.

Vegetation

The cumulative effects discussion for vegetation is based on the area within the Sherman Creek and Terrace Area watersheds. The types of vegetation that would be temporarily lost at the Kensington Gold Project site exit throughout Southeast Alaska; therefore, this loss would have no regional significance on plant communities or habitat values over the long term. During the operational life, the project would affect 243 acres (Alternative B) of forest and muskeg plant communities. Reclamation would reestablish vegetation on all disturbed surfaces, with the exception of rock faces and other areas where the establishment of vegetation would be impossible. Ultimately, reclamation should fully offset the vegetation loss created by the Kensington Gold Project.

The Juneau Access Road and the use of Kensington facilities to access and process Jualin Mine ore are the projects that could contribute to cumulative effects to vegetation within the two watersheds. If the road were constructed as proposed, it would result in the loss of approximately 8.25 acres of forest and muskeg vegetation within the Kensington Gold Project area. This loss would be permanent due to the physical presence of the road.

The extended use of Kensington Gold Project facilities would delay reclamation, although the concurrent reclamation of the DTF would continue as it was developed. As discussed previously in the cumulative effects associated with geotechnical concerns, the DTF could accommodate the volume of tailings that is currently expected to be produced by developing the Jualin deposit. Therefore, the size of the DTF would not have to be increased.

Processing Jualin Mine ore using Kensington facilities would simply delay the point in time when final reclamation would begin.

As discussed in Section 4.8.2, *Platanthera chorisiana*, a Forest Service Region 10 sensitive species, was identified in the project area. Mitigation measures have been identified to minimize potential impacts. These mitigation measures are expected to alleviate any long-term threat to populations of this species within the Sherman Creek and Terrace Area watersheds.

Wetlands

Cumulative effects to wetlands associated with the Kensington Gold Project are considered on a watershed basis because the functions and values they provide are typically realized within a watershed. Therefore, the boundaries for the cumulative effects analysis are the Sherman Creek and Terrace Area watersheds. The two projects that would affect wetlands within this area are the Juneau Access Road and use of the Kensington facilities to process Jualin Mine ore.

Construction of the Juneau Access Road as proposed would result in the permanent loss of approximately 8.25 acres of palustrine forested and palustrine scrub-shrub wetlands within the Sherman Creek and Terrace Area watersheds, assuming that the entire length of road impacted wetlands. This 8.25-acre loss would be in addition to the 243-acre wetland loss caused by mining operations (Alternative B) if the road were constructed while the Kensington facilities were still active. The duration of the 243-acre loss would be extended if the Kensington facilities were used to process Jualin Mine ore. Upon the completion of mining activities (with or without the use of Kensington facilities to process Jualin Mine ore), at least 96 acres of wetlands would be restored as part of reclamation. A portion of reclaimed wetlands would include shallow open water. The open water wetlands would provide a habitat type not currently present at the site and relatively uncommon within the region. The reclaimed wetlands would provide functions and values similar to those lost. Within the two watersheds, there would be a permanent loss of 155.25 acres of wetlands (147 acres associated with the Kensington Gold Project and 8.25 acres associated with the Juneau Access Road). The loss of 155 acres of palustrine scrub-shrub and palustrine forested wetlands is not expected to contribute to a significant loss of wetland function within the watersheds, and the types of wetlands present on the site would be more diverse following reclamation.

The types of wetlands present at the Kensington Gold Project site are abundant throughout Southeast Alaska. The loss of wetlands associated with the Kensington Gold Project combined with the minor losses resulting from other projects would not result in a significant reduction in wetland habitat or function at the regional level.

Cultural Resources

The Kensington Gold Project is not expected to directly or indirectly impact cultural resources. Therefore, no cumulative effects on cultural resources are anticipated.

Visual Resources

The Kensington Gold Project would not generate visual impacts on the Berners Bay viewshed. Impacts are anticipated in Berners Bay from other activities occurring within the viewshed. These projects are scattered and would affect discrete areas, leaving the observer with alternating views of development and natural appearing landscape.

Projects that in conjunction with the Kensington Gold Project could contribute to cumulative effects to the Lynn Canal viewshed are the Goldbelt development at Echo Cove, the Lace River Hydroelectric project, the Juneau Access Road, and the use of Kensington facilities to process ore from the Jualin Mine.

If, at some future date, the Lace River Hydroelectric Project were built as proposed, it would be located 5.3 miles up Lace River and would not be visible from Berners Bay. Based on previously submitted initial plans, a 5 mile long underwater and 6 mile long above-ground transmission line would be required. The above-ground line would start near Johnson Creek on the north side of Berners Bay and run west approximately 3 miles and then north along Lynn Canal to the Kensington Gold Project. The above-ground corridor would most likely be visible from Berners Bay and Lynn Canal.

Goldbelt's proposed development plans include a vegetative screen that would be retained along the shore such that structures at the end of the Glacier Highway extension would be visible only minimally. A log transfer facility for barges was developed in the Echo Cove area as part of the initial site development. The visual effects from this facility are similar to those seen throughout Southeast Alaska.

The proposed location for the Juneau Access Road through the Kensington Gold Project site is adjacent to the DTF. The view of the DTF from the Juneau Access Road would meet the Modified Landscape Visual Quality Objective following reclamation. From Lynn Canal, the proposed road would create a change in the texture of the vegetation. The roadbed should not be visible from Lynn Canal because it is proposed to be low on the slope, parallel to the shoreline and would retain a vegetative buffer. The road combined with the DTF would not create any greater impacts than the DTF alone to viewers in Lynn Canal.

If ore from the Jualin Mine were to be accessed and processed using Kensington facilities, impacts to the Lynn Canal viewshed would be longer in duration due to the extended period of operation of the mining facilities. This would specifically include the DTF, and it could affect the size of the unit. None of the impacts would substantially add to the effects discussed previously in Section 4.10.

The existing landscape in the Lynn Canal and Berners Bay viewsheds would change if all the proposed developments were to occur within a short timeframe. Viewers from the Visual Priority Travel Routes and Use Areas identified in Berners Bay and Lynn Canal would see alternating views of a development and a natural appearing landscape. Considering mitigation measures and timing, impacts to the scenic quality would be consistent with the Visual Quality Objectives for the assigned Land Use Prescriptions.

Socioeconomics

The scope of the cumulative effects analysis for socioeconomics is the area encompassed by the City and Borough of Juneau. Except for the Lace River Hydroelectric Project, each of the projects described could potentially contribute to cumulative effects within the area.

Section 4.11 of this Final SEIS indicates that the Kensington Gold Project is expected to represent about 2 percent of growth in the Juneau area population during the life of the mine. As noted previously, the overall Juneau population is projected to increase by about 9 percent during this period. Because it is already in the development stage, the effects of the Goldbelt development are assumed to be included in the overall Juneau growth projection and, therefore, considered in the analysis in Section 4.11.

It should be noted that while construction may be initiated, it is unclear whether the Juneau Access Road would be completed during the 14-year life of the Kensington Gold Project and whether the full extent of potential socioeconomic effects would be observed within that timeframe. The draft Juneau Access Improvement EIS indicates that road construction would provide approximately 200 jobs during construction. Based on a multiplier of 1.75 (estimated by the City and Borough of Juneau), road construction would also create about 150 indirect jobs. After completion, the road would also produce a wide range of socioeconomic effects on the Juneau, Haines, and Skagway area. For example, non-resident spending solely due to a road itself would create more than 200 jobs in Juneau (USDOT and ADTFP, 1997).

Assuming similar economic conditions, the use of Kensington facilities to access and process ore from the Jualin Mine would likely extend, rather than increase, the period of socioeconomic impacts associated with the Kensington Gold Project. The impacts associated with the extension would contribute to cumulative effects until closure of the project. Impacts related to the loss of employment opportunities following closure would be relatively short-lived.

Transportation

The scope of the transportation analysis is the project site and Lynn Canal. As discussed previously, transportation to and from the Kensington Gold Project site would not affect Berners Bay.

Goldbelt has completed all logging activities at the Echo Cove development site that would require barge transport. Under the current Goldbelt master plan, the only cumulative effects to transportation that could arise would be from construction of a high-speed ferry terminal. The master plan projects four north- and south-bound high-speed ferry trips per day from Echo Cove to Haines/Skagway.

While there is no current proposal or indication that personnel or supplies would be shipped out of Goldbelt's Echo Cove facilities to the Kensington Gold Project, the operator could choose to use the facility at some future date. Because much of the barged supplies would come from outside sources and in large quantities, it would be unlikely that supplies would be trucked to Echo Cove and then barged to Comet Beach. The most likely scenario would be that the Echo

Cove facilities could be used for transporting employees. In that case, an option would be to ferry workers from Echo Cove to Slate Creek Cove and then by road or tunnel to the Kensington mine site. This could lead to two to three roundtrip ferry trips across Berners Bay per day thereby increasing traffic in the area. Due to the need for a road or a tunnel, additional NEPA analysis with public review would be required. If a daily commute were implemented, it would most likely be added after operations have begun. In that case, miners would already have housing and would not be as likely to utilize housing at Echo Cove if it were available. Due to weather conditions in Lynn Canal, it is highly unlikely that a ferry would commute daily from Echo Cove to Comet Beach.

Transportation to Lace River Hydroelectric would likely be via helicopter and would be very limited, except during construction. The contribution to cumulative effects related to transportation would be minimal.

The Juneau Access Road would likely affect transportation in Lynn Canal in general and the Kensington Gold Project in particular. Personnel, supplies, fuel, and other reagents could be transported to the Kensington Gold Project by vehicle rather than by barge or helicopter. For the proposed action, the draft Juneau Access Improvements EIS projects daily traffic averages of 618 cars through the year 2005 and 1,429 cars between the years 2005 and 2025. If a high-speed ferry alternative were selected, there would be an increase in marine traffic similar to the marine terminal proposed under the Goldbelt development at Echo Cove. This increase would not be significant compared to existing traffic in Lynn Canal.

If Kensington facilities were used to access and process Jualin ore, the extended effects would be comparable to those described in Section 4.12 of this Final SEIS, with the only cumulative effect being the extension of the barge and helicopter traffic increases in Lynn Canal. The 1992 FEIS indicates that the increased marine and aircraft traffic around Lynn Canal associated with the Kensington Gold Project would not be significant compared to the existing traffic. If the Juneau Access Road were built, there would likely be a shift from helicopter and barge traffic to vehicular traffic during the project life.

Noise

As documented on pages 4-117 through 4-123 of the 1992 FEIS, none of the onsite operations at Kensington Gold Project would be audible in Berners Bay. Similarly, noise from Jualin, Goldbelt, and Lace River would be unlikely to be audible at the Kensington Gold Project site. The 1992 FEIS indicates that the additional marine traffic and helicopter flights associated with all alternatives for the Kensington Gold Project would not add significantly to existing marine traffic and aircraft flights around Lynn Canal and Berners Bay. Therefore, the Kensington Gold Project is not expected to significantly increase noise levels in the area, and there would be no significant cumulative effects on noise related to the mine. Construction and operation of the Juneau Access Road is not expected to contribute additional noise-related impacts because noise-sensitive species would likely already be displaced by mining activities. If the road were constructed, the noise associated with helicopter traffic to the Kensington Gold Project site would likely be reduced because the site would be accessible by vehicle.

4.15 EFFECTS OF SHORT-TERM USES ON LONG-TERM PRODUCTIVITY

Section 102 of NEPA requires that EISs include "the environmental impacts of alternatives including…the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity." Under all alternatives, the Kensington mine site would be restored to pre-mining conditions and productivity. Surface water hydrology and aquatic habitat, as well as wildlife habitat, would generally be reestablished after closure. Revegetation would occur throughout the site and should eventually approximate pre-mining conditions. Under all alternatives, there would be some permanent wetland loss. Reclaimed wetlands should provide similar functions and values to those lost. Overall, the reclamation of the site would create a wider diversity of habitat types (wetland and upland) than currently present.

4.16 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources applies to the loss of non-renewable resources (e.g., minerals or cultural resources) and to resources that are only renewable over a long period of time (e.g., soil productivity). Irretrievable commitments apply to losses of renewable resources and to situations in which a resource can be irretrievably (temporarily) lost, but the action is not irreversible. Table 4-35 presents the irreversible and irretrievable commitment of resources for the Kensington Gold Project.

4.17 THREATENED AND ENDANGERED SPECIES AND BALD EAGLES

The 1996 Revised Plan of Operations does not result in a major change in the area of disturbance or potential wildlife disturbance impacts from construction and operation of the Kensington Gold Project. Neither the list of threatened and endangered species for animals nor the Forest Service Region 10 sensitive species list for animals has changed since 1992 for the species that could occur in the project area. Therefore, the analysis completed for the 1992 FEIS is still valid. This analysis concluded that the proposed project would not adversely impact any threatened or endangered animal species or their critical habitat.

The Region 10 sensitive plant list has been modified since completion of the analysis for the 1992 FEIS. Therefore, a new analysis was conducted and is discussed in detail in the *Biological Evaluation For Plants* (USFS, 1997a). This analysis concludes that one species on the sensitive plant list is found in the project area and could be impacted by the project. This plant, the Choris bog orchid (*Platanthera chorisiana*), is likely to be found in the area that would be covered by the DTF. Because of other similar habitat along Lynn Canal extending from Juneau to Skagway, the determination resulting from the Biological Evaluation is that the project, as proposed, could impact individuals but would not likely cause a trend to Federal listing or loss of viability of the Region 10 sensitive plant taxa.

Because the potential impacts to beach fringe habitat and potential disturbance from helicopter traffic have not changed from the analysis in the 1992 FEIS, the impact analysis for bald eagles in that document is still valid. This analysis concludes that with the implementation of protection guidelines outlined in the U.S. Fish and Wildlife Service and Forest Service Interagency Agreement (May 15, 1990), impacts to nesting bald eagles should be minimal.

Table 4-35. Irreversible and Irretrievable Commitment of Resources

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Air Quality	No foreseeable or predicted irreversible or irretrievable commitments. Project would comply with Alaska State implementation plan and ADEC air quality regulations.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Topography	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Geology	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Geotechnical Considerations	Irreversible and irretrievable commitments by mining approximately 20 million tons of ore and 1.2 million tons of waste rock. Associated irreversible and irretrievable commitment of borrow materials for construction. The precious metals would be committed to the market. The resultant tailings and waste rock have no use in the foreseeable future.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Surface Water Hydrology	Project would comply with stream restoration goals established by the Forest Service under the appropriate land use designation and by Alaska State agencies. No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Surface Water Quality	Project development would be required to comply with all applicable State and Federal water quality regulations. No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Ground Water Hydrology	Project development would be required to comply with all applicable State and Federal water quality regulations. No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Ground Water Quality	No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Aquatic Resources, Marine	Minor irretrievable losses of intertidal habitats and organisms associated with Comet Beach terminal.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

Table 4-35. Irreversible and Irretrievable Commitment of Resources (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Aquatic Resources, Fresh Water	Irretrievable loss of aquatic organisms in diverted portions of Sherman and Ophir Creeks. Irreversible loss of Ophir and Sherman Creek habitats that would not be reconstructed.	Irretrievable loss of aquatic organisms in diverted portions of Ophir Creek during project life.	Same as Alternative B.	Same as Alternative B.
Soils, Vegetation, and Wetlands	Irreversible commitment of 86.5 acres of old growth forest and 51 acres of wetlands. Irretrievable commitment of 282 acres of soil productivity, including 220 acres of wetlands during operations.	Irreversible commitment of 72 acres of old growth forest and 147 acres of wetlands. Irretrievable commitment of 250 acres of soil productivity, including 96 acres of wetlands during operations.	Irreversible commitment of 73 acres of old growth forest and 147 acres of wetlands. Irretrievable commitment of 253 acres of soil productivity, including 99 acres of wetlands during operations.	Irreversible commitment of 73 acres of old growth forest and 165 acres of wetlands. Irretrievable commitment of 270 acres of soil productivity, including 98 acres of wetlands during operations.
Socioeconomic Resources	Irretrievable decrease in housing availability during project construction.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Wildlife	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Recreation	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Cultural Resources	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Visual Resources	Irretrievable and irreversible commitments of form, line, color, and texture contrast of a tailings structure constructed across Sherman Creek. Reclamation and natural succession of vegetation would be expected to eventually mitigate most long-term visual impacts.	Irretrievable and irreversible commitments of form, line, color, and texture contrast from DTF. Irretrievable commitments from borrow areas, roads, and structures. Reclamation and natural succession of vegetation would be expected to eventually mitigate most long-term visual impacts.	Same as Alternative B.	Same as Alternative B.
Subsistence	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Land Use	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.
Noise	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.	See 1992 FEIS.

CHAPTER 5

LIST OF PREPARERS

5. LIST OF PREPARERS

The lead agency for preparation of this Supplemental Environmental Impact Statement (SEIS) for the Kensington Gold Project was the U.S. Department of Agriculture, Forest Service, Tongass National Forest. Science Applications International Corporation (SAIC) assisted in the preparation of this SEIS under a third-party agreement between the U.S. Environmental Protection Agency and Coeur Alaska, Incorporated, and has used several subcontractors during preparation of various sections. Table 5-1 lists the individuals by company or agency that contributed to this document, as well as their degrees, years of experience, and project role.

Table 5-1. Preparers, Experience, and Project Role

Preparer	Degrees/Years of Experience	Project Role
Science Applications International Corporation		
Ron Rimelman	B.S., Chemical Engineering Years of Experience: 10	SEIS Project Manager
Tom Enyeart	M.S., Environmental Engineering M.S., Nuclear Engineering B.S., Physics Years of Experience: 20	Transportation Specialist
Robert Henke	M.S., Wildlife Biology B.S., Fisheries and Wildlife Management Years of Experience: 14	Wildlife Biologist
John Gunn	M.S., Oceanography B.S., Physics Years of Experience: 25	Oceanographer
John Nuckles	B.S., Mechanical Engineering Years of Experience: 8	Air Quality Analyst
Charlie Phillips	M.A., Marine Biology B.A., Biology Years of Experience: 20	Marine Biologist
Tim Reeves	M.S., Range Watershed Hydrology B.S., Range Management Years of Experience: 13	Hydrologist
Thomas J. Vigliotta	B.S., Civil Engineering Years of Experience: 2	Analyst
Gene Weglinski	M.S., Horticulture B.S., Botany Years of Experience: 8	Botanist
Margaret Siriano Weiler	B.A., Political Science Years of Experience: 10	Technical Editor
Klohn-Crippen		
Harvey McLeod	M.S., Soil Mechanics B.A.S.E., Applied Engineering Years of Experience: 25	Engineer

Table 5-1. Preparers, Experience, and Project Rule (continued)

Preparer	Degrees/Years of Experience	Project Role
MJM Research		
Larry Moulton	Ph.D., Fisheries Biology M.S., Fisheries Biology B.S., Fisheries Biology Years of Experience: 23	Fisheries Biologist
Consultant		
Reed Hansen	M.S., Public and International Affairs B.A., Political Science Years of Experience: 25	Economist
U.S. Department of Agriculture, Forest Service		
Roger Birk	B.S., Natural Resource Management Years of Experience: 19	SEIS Team Leader
Ronald Baer	B.S., Geology Years of Experience: 23	Geologist
Margaret Beilharz	B.S., Freshwater Ecosystems Years of Experience: 19	Hydrologist
Bruce Brunette	M.S., Civil Engineering B.S., Geology Years of Experience: 21	Geotechnical Engineer
Jennette de Leeuw	M.A., Geology B.S., Geology Years of Experience: 4	Minerals Management Specialist
Don Martin	M.S., Fisheries Management B.S., Wildlife Management Years of Experience: 8	Biologist
Kathleen Morse	B.S., Natural Resource Economics Years of Experience: 10	Economist
Eric Ouderkirk	M.L.A., Landscape Architecture M.U.P., Urban Planning Years of Experience: 7	Landscape Architect
Dennis Rogers	M.S., Geology B.S., Geology Years of Experience: 24	NEPA Coordinator
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Victor O. Ross	B.S., Mining Engineering Years of Experience: 19	NEPA Coordinator
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Rick Seaborne	M.P.A., Environmental Policy B.S., Environmental Science and Urban Planning Years of Experience: 20	NEPA Coordinator, Third-Party Contract Manager

CHAPTER 6

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6. REFERENCES

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CHAPTER 7

COORDINATION WITH OTHER GOVERNMENT AGENCIES, NON-GOVERNMENT ORGANIZATIONS, AND THE PUBLIC

7. COORDINATION WITH OTHER GOVERNMENT AGENCIES, NON-GOVERNMENT ORGANIZATIONS, AND THE PUBLIC

7.1 SCOPING

In scoping the Draft Supplemental Environmental Impact Statement (SEIS), the U.S. Department of Agriculture, Forest Service, Tongass National Forest, Chatham Area, actively solicited comments from a wide group of interested parties. The Forest Service published a Notice of Intent (NOI) in the *Federal Register* (60 *FR* 53583, October 16, 1995) announcing its intent to prepare an SEIS, as required under the National Environmental Policy Act. In response to issues raised during the scoping process and meetings with Federal, State, and local agencies and other interested parties, the operator submitted a Revised Plan of Operations to the Forest Service in June 1996. On July 22, 1996, the Forest Service published a new SEIS Notice of Intent for the 1996 Revised Plan of Operations. In addition, the NOI announced two scoping meetings to be held in August 1996 to accommodate requests from the public.

As a result of the scoping process, agency coordination activities, and information obtained during development of the 1991 Draft and 1992 Final EISs, the Forest Service developed its final coordination/mailing list of interested parties for distribution of the Draft SEIS. This list is presented at the end of this section.

7.2 PUBLIC COMMENT PERIOD ON THE DRAFT SEIS

The Council of Environmental Quality provides guidelines for the preparation of Environmental Impact Statements, including the review of EISs by the public and various government agencies. These guidelines direct agencies to “allow not less than 45 days for comments on draft statements” (Section 1506.10 of these guidelines). The comment period for the Kensington Gold Project Draft SEIS officially opened on February 21, 1997, with the Notice of Availability published in the *Federal Register* (February 14, 1997). More than 500 copies of the Draft SEIS were mailed out to the public and interested parties. The comment period closed on April 7, 1997.

7.3 PUBLIC INFORMATION MEETINGS

Two public information meetings were held in March 1997, one in Juneau and one in Haines. The meeting locations were selected to ensure the inclusion of a wide geographic representation of potentially interested parties within the affected areas to ensure maximum participation.

Volume II of this Final SEIS displays public comments on the Draft SEIS received and provides the Forest Service responses.

Comments received have been incorporated into this Final SEIS. All comments received on the Draft SEIS were considered in the preparation of this Final SEIS. The public comment process provided the Forest Service with an opportunity to receive input from Federal and state regulatory agencies and the public concerning the Draft SEIS. Public comments have enabled the Forest Service to improve the Final SEIS by expanding discussions in the document.

List of Agencies, Organizations, and Persons to Whom Final SEIS Sent

Steve Aaker

Alaska Marine Highway System
Attn: Port Captain

Alaskans for Juneau

Cynthia Allen

Dave Allison

Jeanie Allison

Cherie M. Andrew

Bob Andrews

Don Argetsinger, President
Klukwan, Inc.

AWRTA

Bruce Baker

Bill Ballard
ADOT&PF Southeast Region

Randolph Bayliss

Joe Beedle, President
Goldbelt, Inc.

Anissa Berry-Frick

Mike Bethers
Silver King Marine

Robert Betts
Vanguard Research, Inc.

La'Donna Blake

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Alaska Division of
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Steven C. Borell, P.E.
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E.O. Bracken

Aaron Brakel

Geff Bullock, Executive Director
United SE Alaska Gillnetters

Chris Burns, News Director
KINY AM

Capital City Weekly

Scott Carey

David Carlson

David Carnes
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Wayne Carnes

Pete Carran, News Director
KJNO/KTKU

Roy L. Carte

David Chambers
Center for Science in Public Participation

Chilkat Indian Village

Chilkat Valley News

City Manager
City of Skagway

Lee Clayton
Chilkoot Indian Association

Al Clough

Lee Coffman

Gershon Cohen
Alaska Clean Water Alliance

Greg Combs, Mayor
City of Haines

Cathy Connor

Bill Corbus

List of Agencies, Organizations, and Persons to Whom Draft SEIS Sent (continued)

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Senator Duncan

Michael J. Dunlap
Douglas Indian Association

Cheryl Easterwood
City and Borough of Juneau

Dennis Egan, Mayor
City of Juneau

Representative Elton

Bob Engelbrecht
Temsco Helicopters

Dick Farnell
Friends of Berners Bay

Federal Highway Administration

Dick Folta

H. Paul Friesema
Center for Urban Affairs and Policy Research
Northwestern University

Anne Fuller

Phillip Gray

Skip Gray

City of Haines
Planning Commission

Haines Public Library

Judy Hall

Ronald G. Hansen

Karla Hart
Alaska Rainforest Treks

Linda Hay

Tom Healy
City of Haines

Marilyn Heiman
Office of the Governer

Joe Henri

Don E. Hess

Karen M. Hess

Eric Holle
Lynn Canal Conservation, Inc.

Nevin Holmberg
US Fish and Wildlife Service

Dan Hopson

Leslie Howell
Dames and Moore

Marilyn Huitger
Haines Chamber of Commerce

Gordon Jackson
Kake Tribal Corporation

Eric Jorgensen
Sierra Club Legal Defense Fund

Tim June

Juneau Area State Parks
Citizen Advisory Board

Juneau Empire

Juneau Chamber of Commerce

KHNS Radio

KJUD-TV KSUP Radio

KTOO-TV and FM

Dale Kelley, Executive Director
Alaska Trollers Association

List of Agencies, Organizations, and Persons to Whom Draft SEIS Sent (continued)

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Alaska State Legislature

Scott Kelley

Chris Kent
Juneau Audubon Society

Ben Kirkpatrick
Alaska Department of Fish and Game

Bart Koehler
SEACC

Kootznoowoo, Inc.

Celia Kunz

Ray Kyle
National Bank of Alaska

Pamela La Bolle
Alaska State Chamber of Commerce

Jerry Lapp, Mayor
Borough of Haines

Bill Lawrence
Envirosolutions Plus

Stan Leaphart
Citizens' Advisory Committee
on Federal Areas

Bill Leighty

Deb Lessmeier

Joyce Levine

Bob Loeffler
DNR/Mining & Water

Robert Loescher
Sealaska Corporation

Craig Loomis
Upper Lynn Canal Fish & Game
Advisory Committee

Neil MacKinnon
Hyak Mining Company

Robert Marshall

Diane Mayer
Division of Governmental Coordination

Ray & Vivian Menaker

Berne C. Miller
Southeast Conference

Vincent Morasco

Sen. Frank Murkowski

Dick Myren

David Nanney
United Southeast Alaska
Gillnetters Association

Clint Nauman
Greens Creek Mining Company

Paul Nelson
Citizens for Progress

Jamie Parsons

Dick Pegues

Andy Pekovich
DNR

Steve Pennoyer
National Marine Fisheries

Joe Perkins
Guess & Rudd

Planning Commission
City and Borough of Juneau

Gary Pond

Matt Pranger
Skagway News

List of Agencies, Organizations, and Persons to Whom Draft SEIS Sent (continued)

Danny Pruhs

R&M Engineering, Inc

Jim Rehfeldt

Rick Richins
Coeur Alaska

Bob Robinson

Yereth Rosen
Reuters News Service

Victor Ross
Corps of Engineers

Paul Rusanowski
Alaska Miners Association

John A. Sandor

John J. Schnabel

Roger Schnabel
Southeast Alaska Roadbuilders, Inc.

Rick Seaborne
EPA

Albert Shaw

Burl Sheldon

Robert Smith

Steve Sorenson
Simpson, Tillinghast, Sorensen, & Lorensen

Scott V. Spickler

Sharmon Stambaugh
Alaska DEC

Senator Ted Stevens

Harold Stowell
Department of Geology
University of Alabama

John Swanson

Edward Thomas
Tlingit & Haida Central Council

Bob Tkacz
Alaska Fisherman's Journal

Steve Torok
EPA

U.S. Coast Guard
Attn: Commanding Officer
Marine Safety Office

UAS Library

Robert Valliant
Bartlett Regional Hospital

Leon Vance

Tyson Verse

Randy Wanamaker

Timothy Ward

Pat Whelan

Larry Widmark
Sitka Tribe of Alaska

Jim Wilson

Karen Woodstock
Colorado State University

Representative Don Young

Bill Zeman
ERA Helicopters

CHAPTER 8

ABBREVIATIONS AND ACRONYMS

8. ABBREVIATIONS AND ACRONYMS

ABA	Acid-base accounting
ac-ft	Acre-foot
ACMP	Alaska Coastal Management Program
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOTPF	Alaska Department of Transportation and Public Facilities
ADT	Average daily traffic
A-J	Alaska-Juneau (A-J Mine Project)
ANFO	Ammonium nitrate fuel oil
BACT	Best available control technology
BLM	Bureau of Land Management
BMP	Best management practice
C-Plan	Oil Discharge Prevention and Contingency Plan
CBJ	City and Borough of Juneau
Cd	Cadmium
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CIL	Carbon-in-leach
Cl	Chlorine
cm	Centimeter
CO	Carbon monoxide
Cr	Chromium
Cu	Copper
cu ft	Cubic feet
cu yd	Cubic yards
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DGC	Division of Governmental Coordination
DOT	U.S. Department of Transportation
DTF	Dry tailings facility
EIS	Environmental Impact Statement

EMT	Emergency medical technician
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FRP	Facility Response Plan
FEIS	Final Environmental Impact Statement
gpm	Gallons per minute
HDPE	High density polyethylene
Hg	Mercury
kg	Kilogram
KV	Kilovolt
kW	Kilowatt
LPG	Liquefied petroleum gas
LUD	Land Use Designation
mbf	Thousand board feet
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter (equivalent to parts per million)
ML	Modified Landscape
mmbf	Million board feet
MOU	Memorandum of understanding
MSHA	U.S. Mine Safety and Health Administration
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NaOH	Sodium hydroxide
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
Ni	Nickel
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Administration
NO_X	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NP:MPA	Neutralization potential:maximum potential acidity
NPS	National Park Service
NSPS	New Source Performance Standards

NWS	National Weather Service
PAH	Polycyclic aromatic hydrocarbon
Pb	Lead
PM_{10}	Particulate matter
PMF	Probable maximum flood
PMP	Probable maximum precipitation
ppb	Parts per billion
ppm	Parts per million
ppt	Parts per thousand
PSD	Prevention of significant deterioration
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
Se	Selenium
sec	Second
SCR	Selective catalytic reduction
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SIP	State implementation plan
SO_2	Sulfur dioxide
SO_X	Sulfur oxides
SPCC	Spill Prevention, Containment, and Countermeasure
STD	Submarine tailings disposal
SWPPP	Storm Water Pollution Prevention Plan
TAR	Technical Assistance Report
TDS	Total dissolved solids
Te	Tellurium
TOC	Total organic carbon
tpd	Tons per day
tpy	Tons per year
TSP	Total suspended particulates
TSS	Total suspended solids
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service

USGS	United States Geological Survey
VOC	Volatile organic carbon
VQO	Visual quality objective
Zn	Zinc
μg/L	Micrograms per liter (equivalent to parts per billion)

CHAPTER 9

GLOSSARY

9. GLOSSARY

Acid-base accounting (ABA)	A test method to predict acid mine drainage. The "static" test compares a waste rock's maximum potential acidity with its maximum neutralization potential.
Acid-generating potential	The long-term potential of a material or waste to generate acid, as related to acid mine drainage.
Acid mine drainage	Drainage of water from areas that have been mined for mineral ores. The water has a low pH because of its contact with sulfur-bearing material. Dissolved metals, including heavy metals, may be present. Acid mine drainage may be harmful to aquatic organisms and to drinking water supplies.
Acre-foot	The amount of water which covers an acre of land to a depth of one foot; (ac ft) equal to 325,827 gallons.
Adit	A horizontal or nearly horizontal access tunnel into a mine from the surface.
Adsorb	To take up and hold by the physical or chemical forces of molecules.
Airshed	An area of land over which the pattern of air movement is influenced by major topographic features.
Alaska-Juneau (A-J) Project	Echo Bay Exploration, Incorporated, was conducting exploration work at the old Alaska-Juneau Mine located near downtown Juneau.
Alkaline	Having the qualities of a base; basic (pH greater than 7.0).
Alkaline chlorination	A treatment method by chemical reaction used to break down by chlorination the toxic cyanide radical (NC) into non-toxic sodium bicarbonate, nitrogen, sodium chloride, and water. This method may be used to treat mill effluent and tailings.
Alkalinity	A measure of the alkali content of a sample occasionally expressed as the number of milliequivalents of hydrogen ion that can be neutralized.
Alluvium	Material, including clay, silt, sand, gravel, and mud, deposited by flowing water.

Alternatives For NEPA purposes, alternatives to the Proposed Action examined in an EIS. The discussion of alternatives must "sharply [define] the issues and [provide] a clear basis for choice...by the decision maker and the public" (40 CFR 1502.14).

Ameliorate To influence or alter conditions so as to cause improvement.

Anadromous Type of fish that migrate upstream from saltwater to freshwater to spawn (breed), such as salmon, some trout and char species, and shad. Also describes the fishery or habitat used for spawning by these species.

Ankerite A mineral; a ferroan variety of dolomite (i.e., iron replaces the magnesium) Ca (Fe, Mg, Mn)$(CO_3)_2$.

Aquatic Growing, living in, frequenting, or taking place in water. In this EIS, used to indicate habitat, vegetation, and wildlife in freshwater.

Aquifer A zone, stratum, or group of strata acting as a hydraulic unit that stores or transmits water in sufficient quantities for beneficial use.

Aspect The direction toward which a slope faces.

Attainment area A geographic region within which National Ambient Air Quality Standards (NAAQS) are met; three categories of attainment are defined—Class I, Class II and Class III—on the basis of the level of degradation of air quality which may be permitted.

Ball mill Equipment used to reduce ore particles to a finer size. It includes a large rotating cylinder partially filled with steel balls.

Barrel A U.S. unit of measurement equal to 42 gallons of petroleum.

Base drain A drain for water at the bottom of an impoundment or a storm runoff catchment.

Base flow A sustained or fair-weather flow of a stream.

Baseline data Data gathered prior to the proposed action to characterize pre-development site conditions.

Bathymetry The measurement of depths of water in an ocean, lake or sea.

Benthic All underwater bottom terrain from the shore line to the greatest deeps.

Berm An earthen embankment, dike.

Best available control technology Pollution control as defined by EPA for a specific emission or pollutant stream and required for meeting pollution control regulations.

Bioaccumulation Pertaining to concentration of a compound, usually potentially toxic, in the tissues of an organism.

Bioassay The study of living organisms to measure the effect of a substance, factor, or condition by comparing before-and-after exposure or other data.

Biodegradable Capable of being broken down by the action of living organisms such as micro-organisms.

Biomass The amount (weight or mass) of living material.

Biomonitoring The use of living organisms to test the suitability of effluents for discharge into receiving waters and to test the quality of such waters downstream from the discharge.

Biota All of the living material in a given area; often refers to vegetation.

Bond An agreed to sum of money which, under contract, one party pays another party under conditions that when certain obligations or acts are met, the money is then returned; such as mining reclamation. See reclamation guarantee.

Borough An area incorporated for the purpose of self government; a municipal corporation.

Borrow area Earthen construction material source area such as sand and gravel, till, or top soil taken from specific area for use in construction and/or reclamation.

Breakwater An offshore structure for breaking the forces of waves to protect a harbor or beach.

Cadmium A tin-white, malleable, ductile, toxic, bivalent metallic element: used in electroplating of iron and steel and in the manufacture of bearing metals.

Calcite A mineral, calcium carbonate ($CaCO_3$). One of the most common minerals; the principal constituent of limestone.

Canopy cover The spreading branchy layer of forest vegetation.

Carbon-in-leach	A chemical process used to concentrate/beneficiate and recover gold from ore.
Carbon monoxide	A colorless, odorless very toxic gas that is formed as a product of incomplete combustion of carbon.
Catchment area	The drainage area or basin which is drained by a river, stream or system of streams.
Cathode	The negative terminal on an electrolytic cell; the electrode at which electrons enter a device from the external circuit.
Cubic feet per second (cfs)	1 cfs equals 448.33 gallons per minute.
Char	Closely related to trout, the char genus (*Salvelinus*) comprises Dolly Varden in the project area.
Chlorite	A term used for a group of hydrous sheet-like silicates of aluminum, iron, and magnesium.
Climax plant community	The stabilized plant community on a particular site. The relative composition of species does not change so long as the environment remains the same.
Closure	The final stage of mining that involves closure of all mine openings, regrading, and reclamation.
Colluvial	Soil material that has moved downhill and has accumulated on lower slopes and at the bottom of a hill consisting of alluvium in part and also containing angular fragments of the original rocks, i.e. cliff and avalanche debris.
Concentrate	The ore that contains the mineral sought following the concentration process (e.g., flotation, gravity).
Conductivity (electrical)	An electrical measurement to determine the amount of salinity or total dissolved solids in soils or surface and ground water.
Cone of depression	The geometry or shape of an inverted cone on the water table or artesian pressure surface caused by pumping of a well. The cone of depression will disappear over time when well pumping ceases.
Conifer	A broad classification of trees, mostly evergreens, that bear cones and have needle-shaped or scale-like leaves; timber commercially identified as softwood.

Copper	A red, ductile, malleable native metal found in hydrothermal deposits, cavities of basic igneous rocks and in zones of oxidization of copper veins.
Council on Environmental Quality (CEQ)	A body established by the National Environmental Protection Act (NEPA) to draft regulations for implementing and monitoring NEPA. CEQ regulations are presented in 40 CFR 1500–1508.
Cover	Living or non-living material (e.g., vegetation) used by fish and wildlife for protection from predators and to ameliorate conditions of weather.
Criteria	Standards on which a judgment or decision can be based. Water quality criteria can be based on various standards, including aquatic life or human health.
Cumulative impacts	Combined impacts of the past, present and reasonably foreseeable future actions. For example, the impacts of a proposed timber sale and the development of a mine together result in cumulative impacts.
Cyanidation	A process of extracting precious metals such as gold by exposing prepared ore to a cyanide solution.
Cyanide solution	In commercial dissolution of gold from its ores, an alkaline aqueous solution of sodium or calcium cyanide.
Deciduous	Vegetation that sheds its leaves annually and replaces them following a period of dormancy.
Decommissioning	Suspension and/or closure of operations.
Deleterious	Hurtful, noxious, destructive.
Demography	A statistical study of the characteristics of human populations with reference to size, density, growth, distribution, migration and effect on social and economic conditions.
Depletion	Use of water in a manner that makes it no longer available to other users in the same system.
Deposit	A natural accumulation, such as precious metals, minerals, coal, gas, oil, dust, etc. that may be pursued for its intrinsic value; gold deposit.
Development	The work of driving openings to and into a proven ore body to prepare it for mining and transporting the ore.

Dewatering	The reduction of aquatic habitats by diversion of stream flow; removal of water from underground mine workings.
Diamond drilling	Rock drilling that makes use of a diamond tipped drill bit. Often used when recovering a core sample of rock.
Dilution	The act of mixing or thinning, and, therefore, decreasing a certain strength or concentration.
Diorite	A plutonic igneous rock composed of sodic plagioclase and hornblende, biotite, or pyroxene. Small amounts of quartz and orthoclase may be present.
Direct impacts	Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.7). Synonymous with direct effects.
Discharge	The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, million gallons per day, gallons per minute, or cubic meters per second.
Dispersion	The act of distributing or separating into lower concentration or less dense units.
Diversion	Removing water from its natural course of location, or controlling water in its natural course of location, by means of a ditch, canal, flume, reservoir, bypass, pipeline, conduit, well, pump, or other structure or device.
Dry tailings facility (DTF)	A geotechnically engineered embankment used for the disposal of dewatered mine tailings.
Earthquake	Sudden movement of the earth resulting from faulting, volcanism, or other mechanisms within the earth.
Effluent discharge	Disposal of water previously used, as in a milling process.
Environmental Impact Statement (EIS)	Environmental impact statement - Means a detailed written statement as required by section 102(2)(C) of the National Environmental Policy Act (40 CFR 1508.11).
Endangered species	Any species which is in danger of extinction throughout all or a significant portion of its range.
Ephemeral stream	A stream channel that is normally dry; stream flow will occur for short periods of time in response to storm events.

Erosion The wearing away of the land surface by running water, wind, ice or other agents.

Escapement The number of adult anadromous fish (e.g., salmon) that escape fishing pressure and enter their natal streams to spawn.

Estuarine Of, relating to, or formed in a place where an ocean tide meets the current of a fresh water stream.

Exploration The search for economic deposits of minerals, ore, gas, oil or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking and/or mapping.

Fault A displacement of rock along a shear surface.

Feasibility study As applied to mining, the feasibility study follows discovery of the mineral and is prepared by the mining company or an independent consultant. Its purpose is to analyze the rate of monetary return that can be expected from the mine at a certain rate of production. Based on this study, the decision to develop the ore body may be made.

Filter cake Resulting solids having a low moisture content following the extraction of water by filtering or a mechanical belt press.

Fines Fine particulate matter; specifically particles less than 0.4 mm in diameter.

Fishery All activities related to human harvest of a fisheries resource.

Flocculation The addition of an agent to a settling pond that causes suspended particles to aggregate and settle out more rapidly than they would under natural conditions.

FLOOD A computer model used to make independent estimates of storm rainfall and flood flows in ungauged (unmeasured) watersheds.

Flotation An ore concentration process that separates ground ore from waste in a mixture of ore, water and chemicals. When air is forced through the ore/water mixture, the chemicals cause certain minerals to adhere to the air bubbles and float to the top in a froth, thus effecting a separation.

Flotation circuit The portion of the milling process where the flotation process occurs. See flotation.

Flotation concentrate The layer of mineral-laden foam built up at the surface up a flotation cell.

Forest Plan Each of the National Forests administered by the USDA Forest Service is operated under a "Land and Resource Management Plan" as required by the National Forest Management Act of 1976. The 1976 Act was an amendment to the Multiple Use Sustained Yield Act of 1960 and the Forest and Rangeland Renewable Resources Planning Act of 1974. Forest Plans are prepared under the authority of these acts. For the Tongass National Forest, the existing Forest Plan is the Tongass Land Management Plan, as amended in 1986. This plan is currently being revised.

Friable Easy to break, or crumbling naturally. Descriptive of certain rocks and minerals.

Fry A recently hatched fish.

Fugitive dust Dust particles suspended randomly in the air from road travel, excavation and rock loading operations.

Fugitive emissions Emissions not caught by a capture system.

Furrow A trench or ditch in the earth which may act as a watercourse for drainage or irrigation.

Geomorphic Pertaining to the form of the surface of the earth.

Geotechnical A branch of engineering that is essentially concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.

Gill net A flat net suspended vertically in the water with meshes that allow the head of a fish to pass but entangle its gill covers upon withdrawal.

Glacial float Rock moved by glacial activity.

Glaciofluvial Of, relating to, or coming from streams deriving much or all of their water from the melting of a glacier.

Geotextile A synthetic fabric used in the construction of earthen structures, such as embankments, landfills, roads, etc.

Grade The content of precious metals per volume of rock (oz/ton).

Gradient The inclination of the rate of regular or graded ascent or descent (as of a slope, roadway, or pipeline).

Gypsum A naturally hydrated calcium sulfate, $CaSO_4 \bullet 2H_2O$, white or colorless, sometimes tinted grayish, reddish, yellowish, bluish, or brownish. Insoluble in water; soluble in ammonium salts, acids, and sodium chlorides.

Habitat The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions.

Hardness Quality of water that prevents lathering because of the presence of calcium and magnesium salts which form insoluble soaps.

Hazardous waste By-products of society than can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.

Heavy metals A group of elements, usually acquired by organisms in trace amounts, that are often toxic in higher concentrations; includes copper, lead, mercury, molybdenum, nickel, cobalt, chromium, iron, silver, etc.

Herbaceous Vegetation that lacks woody tissue.

Heterogeneous Not uniform in structure or composition.

Hydraulic barrier An abrupt change in geology or soil type that inhibits the flow of water.

Hydraulic conductivity A measure of the ability of soil to permit the flow of groundwater under a pressure gradient; permeability.

Hydrogen sulfide A colorless, flammable, poisonous gas.

Hydrologic system All physical factors, such as precipitation, stream flow, snowmelt, groundwater, etc., that affect the hydrology of a specific area.

Hydrophytic Pertaining to aquatic plants requiring an abundance of water for growth.

Impermeable Having a texture that does not permit the passage of fluids through its mass.

Impoundment The accumulation of any form of water in a reservoir or other storage area.

In situ A Latin term meaning “in place,” in the natural or original position.

Incised Cut into.

Increment The amount of change from an existing concentration or amount; such as air pollutant concentrations.

Indigenous Originating, developing, or produced naturally in a particular land, region, or environment; native.

Indirect impacts Impacts that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. (40 CFR 1508.8) Synonymous with indirect effects.

Infauna Aquatic animals living in and on soft bottom substrates.

Infiltration The movement of water or some other fluid into the soil through pores or other openings.

ISO container A container that conforms to criteria established by the International Standards Organization for the transport of hazardous materials.

Infiltration gallery A horizontal well or subsurface drain that intercepts the underflow in permeable materials or the infiltration of surface water.

Jurisdictional wetland A wetland area delineated or identified by specific technical criteria, field indicators and other information for purposes of public agency jurisdiction. The public agencies which administer jurisdictional wetlands are the Fish and Wildlife Service, Army Corps of Engineers, Environmental Protection Agency and the USDA Natural Resource Service.

Land management plan See forest plan.

Lime Calcium oxide. Sometimes used as an abbreviated name for any rock consisting predominantly of calcium carbonate minerals.

Long-term impacts Impacts that result in permanent changes to the environment. An example is a topographic change resulting from tailings disposal in a creek drainage.

Land Use Desigation (LUD II) LUD II compels the Forest Service to manage lands "in a roadless state to retain their wildland character, but permitting wildlife and fish habitat improvement and primitive recreational facility development." (Tongass Land Management Plan, amended 1986). Management implications for LUD II areas state that mineral development is subject to existing laws and regulations.

Marine discharge Disposal of mine water, treated sewage, and/or storm water bypass.

Marine outfall The mouth or outlet of a river, stream or pipeline where it enters the sea.

Median The value of the middle number of a data set such that half of the data values are greater than the median and half of the data values are less than the median.

Microclimate The local climate of a given area or habitat characterized by uniformity over the site.

Migratory Moving from place to place, daily or seasonally.

Milling The act or process of grinding, extraction, or mineral processing.

Mine drainage Gravity flow of water from a mine to a point remote from mining operations.

Mines Safety and Health Administration (MSHA) A Federal agency under the Department of Labor that regulates worker health and safety in mining operations.

Minimum stream flow requirement A set amount of water to be maintained in a water course for the purpose of reasonably maintaining the environment.

Mining plan See operating plan.

Mitigation measure There are several meanings of mitigate: Avoid the impact by not taking action. Minimize the impact by limiting the degree of magnitude of the action and its implementation. Rectify the impact by repairing, rehabilitating, or restoring the affected environment. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action. Compensate for the impact by replacing or providing substitute resources, or by enhancing the value of an adjacent existing environment.

Mixing zone An area between an effluent discharge point and the associated water quality compliance monitoring station.

Monitoring A continuing testing of specific environmental parameters and of project waste streams for purposes of comparing with permit stipulations, pollution control regulations, mitigation plan goals, etc.

Modified Landscape Modified landscape with a minerals overlay.

Multiple use	The management concepts under which National Forest lands are managed. It involves the management of resources in combinations that will best serve the public.
National Environmental Policy Act of 1969 (NEPA)	National charter for protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy. 40 CFR 1500–1508 are the regulations for implementing the act.
National Pollutant Discharge Elimination System (NPDES)	A program authorized by sections 318, 402 and 405 of the Clean Water Act, and implemented by regulations 40 CFR 122. NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.
National Register of Historic Places	A list, maintained by the National Park Service, of areas which have been designated as being of historical significance.
NEPA process	All measures necessary to comply with the requirements of section 2 and Title I of NEPA.
New Source Performance Standards	Standards set by EPA defining the allowable pollutant discharge (air and water) and applicable pollution control for new facilities; by industrial category (Clean Air Act and Clean Water Act).
Nonpoint pollution	Pollution caused by sources that are non-stationary. In mining, nonpoint air pollution results from such activities as blasting and hauling minerals over roads, as well as dust from mineral stockpiles, tailings, and waste dumps prior to mulching and/or revegetation.
100-year flood	A stream discharge that occurs on the average of once every 100 years.
Operating plan	Submitted by the mining operator, the operating plan outlines the steps the mining company will take to mine and reclaim the site. The operating plan is submitted prior to starting mining operations. Synonymous with the term mining plan (36 CFR, part 228).
Ore	Any deposit of rock from which a valuable mineral can be economically extracted.
Ore body	Generally, a solid and fairly continuous mass of ore, which may include low-grade ore and waste as well as pay ore, but is individualized by form or character from adjoining rock.
Ore reserve	Ore of which the grade and tonnage have been established with reasonable assurance by drilling and other means.

Organic Act The 1897 act contains the basic authority for management of National Forests.

Organic matter Matter composed of once-living organisms (carbon compounds).

Organism A living individual of any plant or animal species.

Orographic effects Pertaining to relief factors such as hills, mountains, plateaus, valleys, and slopes; usually used to describe weather patterns.

Outfall A structure (i.e., pipeline) extending into a body of water for the purpose of discharging a waste stream, storm runoff, or water.

Oxide A compound of oxygen with one or more elements or radicals.

Ozone Form of oxygen (O_3) found largely in the stratosphere; a product of reaction between ultraviolet light and oxygen, or formed during combustion of hydrocarbon fuels.

Palustrine Of, or relating to, shallow ponds, marshes, or swamps.

Palustrine forested A forested wetland dominated by woody vegetation over 20 feet tall.

Palustrine scrub-shrub A wetland area dominated by woody vegetation less than 20 feet tall.

Paste backfill The disposal of thickened mine tailings, after mixing with cement, in underground mines to provide wall or ground support.

Peak flow Highest flow; can be quantified as daily or instantaneous.

Permeability The capacity of a material for transmitting a fluid. Degree of permeability depends upon the size and shape of the pores, their interconnections, and the extent of the latter.

pH Symbol for the negative common logarithm of the hydrogen ion concentration (acidity) of a solution. The pH scale runs from 0 to 14, with a pH of 7 considered neutral. A pH number below 7 indicates acidity and a pH value above 7 indicates alkalinity or a base.

Phyllite A foliated metamorphic rock that is intermediate in composition and fabric between slate and schist.

Physiography A description of the features and phenomena of nature.

Piezometer A device for measuring moderate pressures of liquids.

Piezometric head	The level to which a liquid rises in a piezometer, representing the static pressure of a water body.
Piezometric surface	Any imaginary surface coinciding with the hydraulic pressure level of water in a confined aquifer, or the surface representing the static head of ground water and defined by the level to which water will rise in a well. A water table is a particular piezometric surface.
Plan of Operations	See operating plan.
Plate filter	A filter used to remove gold precipitate from solution.
Point source	Stationary sources of potential pollutants. In terms of mining, some examples of point sources are crushing and screening equipment, conveyor and pond outlet pipes.
Pollution	Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment producing undesired effects.
Polychaete	Any of a class of mostly marine, annelid worms, having on most segments a pair of fleshy, leg-like appendages bearing numerous bristles.
Portal	The entrance to a tunnel or underground mine.
Potable water	Suitable, safe, or prepared for drinking.
Potentiometric surface	Surface to which water in an aquifer would rise by hydrostatic pressure.
Precious metal	Any of the less common and highly valuable metals; gold, silver, platinum.
Precipitation	The process of removing solid or liquid particles from a gas or smoke; the process of forming a precipitate from a solution (flocculation); rain, mist, snow, etc.
Prescriptive mitigation	The rules or directive in-place giving precise instructions on the abatement or alleviation of certain issues.
Prehistoric	Relating to the times just preceding the period of recorded history.
Prevention of Significant Deterioration (PSD)	Under provisions of the Federal Clean Air Act, a proposed new source of air pollution may be required to apply for PSD permit if certain emission limits are expected to be exceeded.

Process area The area that encompasses the adit, mill, and processing facilities.

Process make-up water Water required to make up for losses within the closed mill system.

Project area The area within which all surface disturbance and development activity would occur.

Pristine Pertaining to pure, original, uncontaminated conditions.

Probable maximum flood (PMF) A flood calculated to be the largest probable under any circumstances.

Probable maximum precipitation (PMP) The theoretical physical maximum amount of precipitation which could occur at a given point or location.

Prospect A property in which the mineral value has not been proven by exploration.

Public scoping Scoping is an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

Pycnocline A steep vertical gradient of density.

Pyrite A common mineral consisting of iron disulfide (FeS_2) with a pale brass-yellow color and brilliant metallic luster. It is burned to make sulfur dioxide and sulfuric acid.

Pyritic Relating to or resembling pyrite, a common mineral; iron disulfide.

Quartz A mineral, silicon dioxide (SiO_2) that, next to feldspar, is the most common mineral, and occurs in usually colorless, transparent crystals, but may be yellow, brown, purple, pink, or green.

Receiving waters A river, lake, ocean, stream, or other watercourse into which wastewater or treated effluent is discharged.

Reclamation Returning an area to resemble pre-mining conditions by regrading and reseeding areas disturbed during mining activity.

Reclamation guarantee A binding commitment payable to a governmental agency in the event that decommissioning and reclamation of an operation is not completed according to an approved plan. See bond.

Record of Decision (ROD)	A document that discloses the decision on an environmental impact statement and the reasons why the decision was made; it is signed by the official responsible for implementing the identified action. The environmental consequences disclosed in an EIS are considered by the responsible official in reaching a decision (40 CFR, 1505.2).
Residence time	The amount of time a receptor organism or object is in contact with a source.
Resident	A species that is found in a particular habitat for a particular time period (i.e. winter resident, summer resident, year-round) as opposed to those found only when passing through on migration.
Resource Conservation and Recovery Act (RCRA)	A 1976 act that is the primary law governing the regulation of solid and hazardous waste, as opposed to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) which provides the government with the authority and funds to clean up active or abandoned sites when there is a release or substantial threat of a release of hazardous substance from a facility.
Richter Scale	A numerical (logarithmic) measure of earthquake magnitude.
Riparian	A type of ecological community that occurs adjacent to streams and rivers. It is characterized by certain types of vegetation, soils, hydrology and fauna and suited to conditions more moist than that normally found in the area.
Riprap	A layer of large rock placed together to prevent erosion of embankments, causeways, or other surfaces.
Riverine	Of, or relating to rivers, creeks, and streams.
Runoff	Precipitation that is not retained on the site where it falls, not absorbed by the soil; natural drainage away from an area.
Salinity	A measure of the dissolved salts in sea water.
Salmonids	Fish species (salmon, trout, and char) that belong to the same family; salmonidae.
Saturation	The extent or degree to which the voids in a material contain oil, gas, or water. Usually expressed in percent related to total void or pore space.

Section 10 Permit Section 10 of the Rivers and Harbors Act of 1899 requires a permit for any structure or work that may obstruct traditionally navigable waters. This permit is issued by U.S. Army Corps of Engineers.

Section 404 Permit Section 404 of the Clean Water Act specifies that anyone wishing to place dredged or fill materials into the waters of the United States and adjacent jurisdictional wetlands shall apply to the U.S. Army Corps of Engineers for approval. A permit issued by the Corps of Engineers for these activities is known as a 404 permit.

Sedentary organisms Not migratory; staying in one place; stationary.

Sediment Material suspended in liquid or air; also, the same material once it has been deposited.

Sediment basin A pond, depression, or other device used to trap and hold sediment.

Sediment loading The mass of solid erosion products deposited by or carried in water or air.

Sediment pond Structures constructed by excavation and/or by building an embankment whose purpose is to retain water and allow for settlement of fines (TSS) and reduction in turbidity.

Seepage The slow movement of gravitational water through the soil.

Selenium A non-metallic, toxic element related to sulfur and tellurium; a byproduct of the electrolytic refining of copper.

Sensitive species A plant or animal listed by a State or Federal agency as being of environmental concern; includes but is not limited to threatened and endangered species.

Sensitivity level A measure of viewer interest in the scenic quality of the landscape.

Settling ponds See sediment pond.

Short-term impacts Impacts occurring during project construction and operation, and ceasing upon project closure and reclamation.

Significant issues Of the issues raised during the scoping process for an environmental impact statement, certain of those issues are determined to be "significant" by the lead public agency. Determining which issues are significant, and thus meriting detailed study in the EIS, is the final step of the scoping process and varies with each project and each location. Significant issues are used to develop alternatives.

Slurry A watery mixture or suspension of insoluble matter, such as mud or lime.

Sodium hydroxide A common laboratory reagent; strongly alkaline when in solution with water.

Solid waste Garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.

Spawn To produce and/or deposit eggs or sperm; the eggs or sperm product (fish reproduction).

Spill Prevention, Containment, and Countermeasure (SPCC) Plan A plan that EPA requires of facilities storing more than a given threshold of fuel or hazardous material. It is a contingency plan for avoidance of, containment, of and response to hazardous materials spills or leaks.

Stockpiling Storage of soils and/or rock material.

Stope An excavation in a mine made for the purpose of extracting ore.

Stoping A process by which ore is excavated in an underground mine; removal of ore from an underground excavation (stope).

Storm water Overland flow generated as a result of a storm event.

Strata A tabular mass or thin sheet of earth of one kind formed by natural causes usually in a series of layers of varying make-up; sedimentary units.

Stream channel geometry The cross section of a stream channel (end view).

Stream flow The discharge (flow of water) in a natural channel.

Stream gradient The rate of fall or loss of elevation over the physical length of a segment or total stream usually expressed in feet per feet (%).

Study area The zone around the project area within which most potential direct and indirect effects to a specific resource would occur.

Subsidence A local lowering of land surface caused by the collapse of rock and soil into an underground void or by the removal of ground water; it can result in stability failures such as landslides and mine roof cave-ins.

Subsistence use Section 803 of the Alaska National Interest Lands Conservation Act defines subsistence use as: "The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of the non-edible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

Substrate An underlayer of earth or rock.

Succession Changes in the plant communities composing an ecosystem as the ecosystem evolves from one type to another, e.g. wetlands becoming grassy meadows.

Sulfide A compound of sulfur with more than one element. Except for the sulfides of the alkali metals, the metallic sulfides are usually insoluble in water and occur in many cases as minerals.

Sump In the case of an underground mine, an excavation made underground to collect water, from which water is pumped to the surface or to another sump nearer the surface.

Surficial Characteristic of, relating to, formed on, situated at or occurring on the earth's surface; especially, consisting of unconsolidated residual, alluvial, or glacial deposits lying on the bedrock.

Synchronous Recurring or operating at exactly the same periods.

Tailings The non-economic constituents of the ground ore material that remains after the valuable minerals have been removed from raw materials.

Taxa (taxon) Any group of organisms, populations, or taxa considered to be sufficiently distinct from other such groups to be treated as a separate unit.

Terrestrial Of or relating to the earth, soil, land; an inhabitant of the earth or land.

Thermistor	A resistor made of semiconductors having resistance that varies rapidly and predictably with temperature.
Threatened species	A plant or wildlife species officially designated by the U.S. Fish and Wildlife Service as having its existence threatened and is protected by the federal Threatened and Endangered Species Act.
Tideland	Land that is overflowed by the tide but exposed during times of low water.
Till	Non-sorted, non-stratified sediment carried or deposited by a glacier.
Timber slash	Non-economic timber refuse that is cut but remains in the area after timber harvest.
Topography	The physical configuration of a land surface.
Toxicity tests	Refers to predescribed laboratory analysis generally used to determine the degree of danger posed by a substance to animal or plant life.
Trace metals	Metals present in minor amount in the earth's crust (trace elements).
Transect	A sample area in the form of a long narrow continuous strip that is used for the tabulation of data.
Transmissivity (coefficient of)	A measure of the ability of an aquifer to transmit water.
Turbidity	Reduced water clarity resulting from the presence of suspended matter.
Unavoidable effects	Many effects which could occur from the project can be eliminated or minimized by management requirements and constraints and mitigation measures. Effects that cannot be eliminated are identified as unavoidable.
Understory	A foliage layer lying beneath and shaded by the main canopy of a forest.
Vein	A mineralized zone having a more or less regular development in length, width, and depth. Commonly dipping at a steep angle to the horizontal.
Visual Quality Objective (VQO)	Objectives identified by the Forest Service for management of the visual resource.

Visual resources	The visual quality of the landscape. The Forest Service manages viewsheds as a resource, establishing specific management objectives for different areas of Forest Service land.
Waste rock	Also known as development rock, waste rock is the non-ore rock that is extracted to gain access into the ore zone. It contains no gold or gold below the economic cutoff level.
Water balance	A measure of continuity of water flow in a fixed or open system.
Watershed	The entire land area that contributes water to a particular drainage system or stream.
Waters of the United States	All waters that are currently or could have been used in interstate or foreign commerce, including waters that are subject to the ebb and flow of the tide; wetlands; and lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds.
Weathering	The process whereby larger particles of soils and rock are reduced to finer particles by wind, water, temperature changes, plant and bacteria action, and chemical reaction.
Wetlands	Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions.
Wilderness	Land designated by Congress as a component of the National Wilderness Preservation System.
Xanthates	A class of chemicals known as "collector" chemicals, which attach to floating minerals making them normally non- capable of adhering to the froth in a flotation circuit.

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