Pogo Mine EIS

Executive Summary

Introduction

The Applicant, Teck-Pogo Inc., has applied to the U.S. Environmental Protection Agency (EPA) for a National Pollutant Discharge Elimination System (NPDES) permit to discharge waste waters from the Pogo mine project to the Goodpaster River (see list of acronyms at end of summary). Because the proposed project has the potential to significantly affect the quality of the human environment, the decision on issuance of the NPDES permit is considered a "major federal action." The National Environmental Policy Act (NEPA) (Title 40, U.S. Code of Federal Regulations [CFR], Parts 1500-1508) requires preparation of an environmental impact statement (EIS) for all major federal actions. This Executive Summary presents a synopsis of the final EIS (FEIS). The FEIS itself, as well as additional information about the Pogo Mine EIS process, including baseline reports and technical documents, can be found on the Web at http://www.pogomineeis.com. A compact disk (CD) or a bound paper copy of the FEIS may be obtained by contacting:

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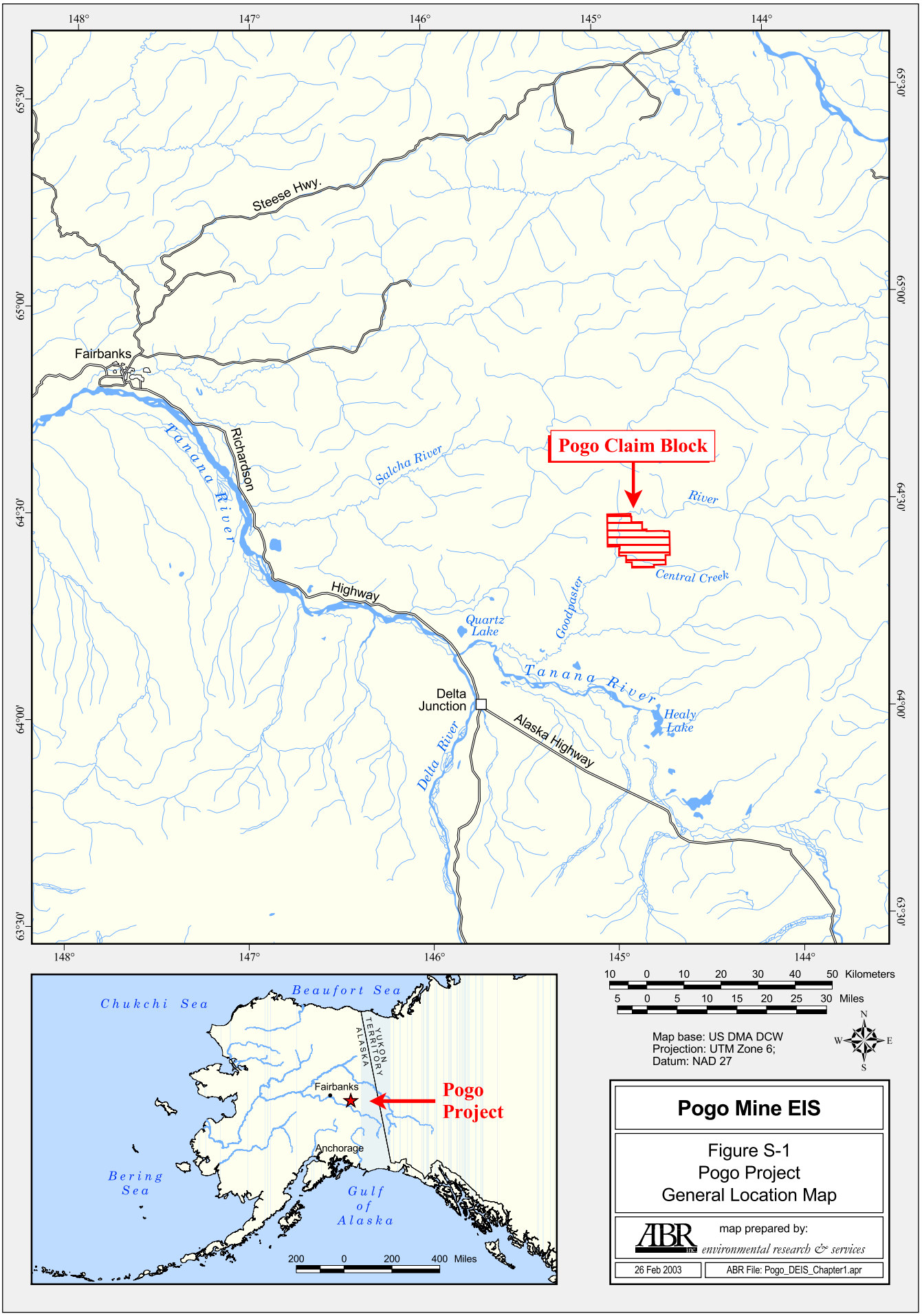
S.1 Summary of Proposed Action

The proposed action is a plan by the Applicant to develop the underground Pogo Mine on State of Alaska land in the Goodpaster River Valley approximately 38 miles northeast of Delta Junction, in east-central Alaska (Figure S-1). The project would require 25 to 33 months to construct and would have an operating life of approximately 11 years, based on current ore reserves. Its life could be extended if additional reserves were found. The capital cost of the project is estimated at $200 million to $250 million. The mine would operate 365 days a year with an initial workforce of approximately 288. The proposed action would include a mill and camp complex, a dry-stack tailings pile and recycle (water) tailings pond (RTP), an airstrip, gravel pits, laydown and fuel storage areas, and a local network of roads. Gold would be recovered by gravity separation, flotation concentration, and cyanide vat leaching. Approximately half of the tailings would be returned underground as a paste backfill. Surface access to the mine would be provided by an all-season 49.5-mile road. Power would be supplied from the regional grid through a 50-mile power line.



Pogo Mine EIS

Figure S-1
Pogo Project
General Location Map

map prepared by:
ABR, Inc. environmental research & services

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S.2 Purpose and Need for Action

Need for Action

The need for the proposed action is to allow Teck-Pogo Inc. to develop an underground mine in its nonfederally owned Pogo claim block in order to produce gold and to make a reasonable profit.

Purpose for Action

The purpose of the proposed action is to provide the federal authorizations needed for Teck-Pogo Inc. to construct and operate an underground gold mine and associated facilities in and near its Pogo claim block, which is located in a currently roadless area 38 miles northeast of Delta Junction, Alaska, near the Goodpaster River. The mine would process between 2,500 and 3,500 tons per day of ore for at least 11 years to supply an on-site mill, which would produce up to approximately 500,000 ounces of gold per year through gravity recovery, froth flotation, and cyanide leaching of concentrate. The proposed action would meet the objectives for construction and operation of the mine by providing:

- An efficient, on-site mill and gold extraction process
- Safe, stable, long-term disposition of 11 million tons of tailings with sufficient capacity to contain potential additional ore reserves
- An adequate water supply to meet mill process and camp complex requirements, and safe discharge of water
- 10 to 14 megawatts of electrical energy needed to construct and operate the mine and mill
- A comfortable on-site camp complex capable of supporting 250 to 700 personnel needed to construct and operate the mine and mill
- Reliable and safe access to the mine for delivery of materials, including approximately 2 million to 3 million gallons of fuel and 25,000 to 38,000 tons of nonfuel supplies per year, and the 250 to 700 personnel needed to construct and operate the mine and mill on a cost-efficient basis
- Timely project development
- Development of the project in a technically and economically feasible manner

S.3 Agency Involvement

EPA has assumed lead federal agency responsibility for preparation of the EIS. In order to construct and operate the mine, many other federal and state permits are needed, and the U.S. Army Corps of Engineers (COE) and State of Alaska Department of Natural Resources (ADNR) have participated as cooperating agencies for the EIS.

S.4 Scoping

EPA provided for an early and open scoping process to determine the scope of issues to be addressed and to identify the significant issues related to the Pogo Mine project. On August 11,

2000, EPA published a Notice of Intent to prepare an EIS for the Pogo Mine project in the Federal Register. Simultaneously, EPA distributed the Scoping Document for the Pogo Mine Project Environmental Impact Statement that described the proposed project, the EIS process, and a document preparation schedule. Distribution of the scoping document began a 60-day public and agency review and comment period that ended on October 10, 2000. EPA hosted two scoping open houses during that period in Delta Junction and Fairbanks.

Scoping identified 17 major issues related to construction, operation, and closure of the proposed project. These issues served as the basis for development of criteria that were used to evaluate impacts of the various project options and alternatives. On January 30, 2001, EPA distributed a 55-page Pogo Mine EIS Scoping Responsiveness Summary that described the scoping process, identification of issues, evaluation criteria, the option screening process, and how alternatives were developed.

S.5 Government-to-Government Consultations

In addition to the EIS scoping effort, pursuant to Executive Order 13084 (Consultation and Coordination with Indian Tribal Governments), EPA undertook a concerted government-to-government consultation effort with the 13 Tribes considered to be potentially affected by the proposed Pogo Gold Mine by virtue of their location (1) within a 125-mile radius of the proposed Pogo Mine site, or (2) within the potentially affected Tanana River watershed.

S.6 Issues and Options Identification and Screening

For the following discussion, it is important that the reader understand the relationship between the terms "component," "option," and "alternative."

- Component. A complete mining project such as the Pogo Mine has several components, each a necessary part of an entire viable project; for example, the mill process, the tailings disposal system, and how the project location is accessed.
- Option. For each component, there are one or more options, or choices; for example, for the access component there are all-season road options (Shaw Creek Hillside and South Ridge) and winter road/trail options (Shaw Creek Flats and the Goodpaster Valley).
- Alternative. An alternative is a set of options (one for each component) that constitutes an entire functioning project; for example, one mill process, one tailings disposal location, one airstrip location, and one surface access route.

As a result of the public scoping process and agency input, 17 issues were identified to be addressed during the EIS process.

- Surface and groundwater quality
- Wetlands
- Fish and Aquatic habitat
- Wildlife
- Air quality
- Noise
- Safety
- Reclamation
- New industrial and commercial users
- Recreational resources and users
- Existing privately owned lands and existing recreational and commercial uses
- Subsistence and traditional uses
- Cultural resources
- Socioeconomics
- Cumulative impacts
- Technical feasibility
- Economic feasibility

Then, options and sub-options for each project component were developed, other than those proposed by the Applicant, that could address each of these issues. Because all the options and sub-options considered, including those proposed by the Applicant, totaled more than 100, it was necessary to reduce them to a more manageable number that still provided a reasonable range from which to identify full project alternatives. Thus, for each issue, a set of evaluation criteria was developed. These criteria were used to screen each of the options to determine those best able to address the issues and to be retained for detailed impacts analysis, and those to be dropped from further consideration. The options and sub-options retained for detailed analysis then were grouped into three action alternatives. Each action alternative contains a full set of options that would constitute a complete mining project.

S.7 Identification of Alternatives

NEPA requires that an EIS consider alternatives to the proposed action that address issues identified during the scoping process. To present these options and sub-options as part of the three action alternatives in the most understandable manner, they were divided into the following three groups of components, which are presented, respectively, in Tables S-1, S-2, and S-3. The alternatives are described in the following section (S.8).

1. Options and sub-options that are common to all three action alternatives
2. Options and sub-options that vary between the alternatives, but that *are not* related to surface access
3. Options and sub-options that vary between the alternatives, and that *are* related to surface access

S.8 Alternatives Description

Descriptions of the No Action Alternative and the three action alternatives are found below. Figure S-2 presents the options for each alternative that differ between the alternatives. Note that Figure S-2 does not contain those options that would be common to all alternatives (Table S-1) because, by definition, there would be no difference in impacts between the alternatives. These common option impacts, however, are presented with the impacts of all other options later in under environmental consequences.

Table S-1 Component Options and Sub-Options Common to All Action Alternatives

Milling Process
- Gravity / flotation / cyanide vat leach[1]

Tailings Disposal
- Underground paste backfill
- Surface dry stack and RTP in Liese Creek Valley

Mill and Camp Location
- Liese Creek Valley

Development Rock Disposal
- Mineralized rock encapsulated in dry stack
- Nonmineralized rock into dry stack, and for RTP dam and other construction

Gravel Source
- Expand existing pits; develop new pits in Goodpaster and Liese Creek valleys
- Crush nonmineralized development rock

Construction Camp
- At existing exploration camp below 1525 Portal in Goodpaster Valley

Laydown Area
- Permanent below existing 1525 Portal, adjacent to airstrip, and at mill

Water Supply

Industrial
- Mine drainage
- RTP
- Wells

Domestic
- Wells

Water Discharge

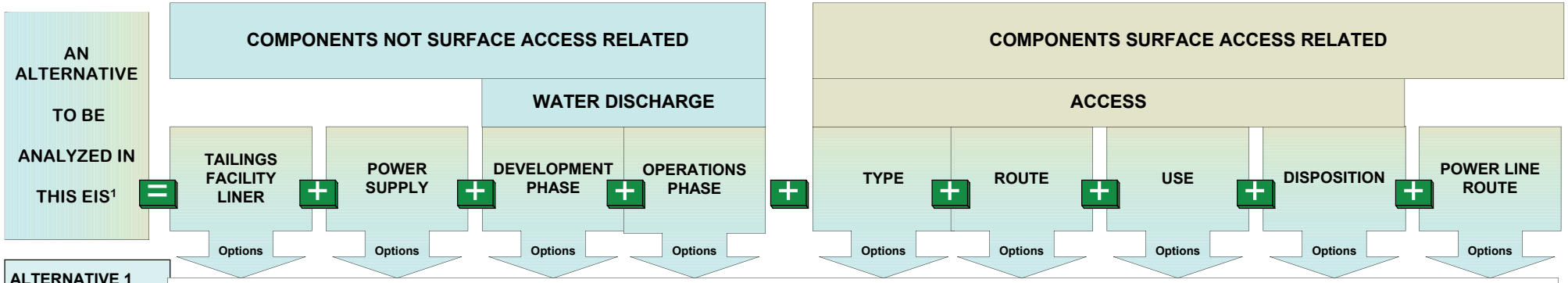
Operations Phase
- Domestic wastewater
  - Package treatment plant and direct discharge to Goodpaster River

Fuel Storage Location
- Temporary below 1525 Portal and airstrip; permanent at portal mouth and mill

Air Access
- 3,000-foot airstrip in Goodpaster Valley
- Use of road during mine operations
  - Pogo project only
  - Pogo and other industrial / commercial users only
  - Everyone
- Disposition of airstrip at end of Pogo project
  - Remove and reclaim following mine reclamation
  - Open for Industrial / commercial resource users only
  - Open for everyone

[1] Underline – Applicant's proposed option or sub-option

ALTERNATIVES ANALYZED IN THIS EIS



ALTERNATIVE 1 **NO ACTION**	Under the **No Action Alternative,** the project would not be developed and none of the options below would be implemented.									
ALTERNATIVE 2 Applicant's Proposed Project	Unlined	Power Line	Injection Wells	▪ Injection Wells, and ▪ SAS ◆ At airstrip ◆ Above Pogo Ridge	All-Season Road	▪ Shaw Creek Hillside, Richardson Egress ◆ Shaw Creek Road ◆ Tenderfoot	▪ Pogo Project Only, or ▪ Pogo and: ◆ Industrial/ Commercial ◆ Everyone	▪ Remove/Reclaim, or ▪ Road Left Open to: ◆ Industrial/ Commercial ◆ Everyone	Shaw Creek Hillside
ALTERNATIVE 3 South Ridge Route Direct Discharge	Lined	"	Direct Discharge to Goodpaster River	Direct Discharge to Goodpaster River	"	South Ridge	"	"	South Ridge
ALTERNATIVE 4 Winter Only Access Off-River Treatment Works	"	On-Site Generation	Off-River Treatment Works	Off-River Treatment Works	Winter Access Only ▪ Traditional Road ▪ Perennial Trail	Shaw Creek Flats	N/A[2]	N/A	N/A

Major Options Eliminated From Further Consideration[3]

- Constructed Wetlands
- Railroad
- Air Only (5,000-ft Airstrip)
- Richardson Egress:
  - Pipeline
  - Keystone
- Dean Cummings Crossing
- Goodpaster Valley
- Convert to Recreational Trail

[1] Excludes those components/options common to all alternatives (Table 2.5-1).
[2] Not applicable to this alternative.
[3] See Appendix A.1.

Figure S-2

Table S-2 Component Options and Sub-Options that are Specific to Certain Action Alternatives, but Not Related to Surface Access

Component / Option / Sub-Option	Alternative		
	2	3	4
Tailings Facility Liner			
▶ Surface dry stack and RTP in Liese Creek			
✦ Lined dry stack		X	X
✦ Lined RTP		X	X
✦ Unlined dry stack[1]	X		
✦ Unlined RTP	X		
Power Supply			
▶ Power line	X	X	
▶ On-site generation			X
Water Discharge			
Development Phase			
▶ Industrial wastewater			
✦ Underground injection wells	X		
✦ Direct discharge to Goodpaster River		X	
✦ Off-river treatment works			X
Operations Phase			
▶ Industrial wastewater			
✦ Soil absorption system (SAS)			
⏩ Goodpaster River Valley adjacent to airstrip	X		
⏩ Saddle above and southeast of Pogo Ridge	X		
✦ Underground injection wells	X		
✦ Direct discharge to Goodpaster River		X	
✦ Off-river treatment works			X

[1] Underline – Applicant's proposed option or sub-option

Table S-3 Component Options and Sub-Options that are Related to Surface Access

Component / Option / Sub-Option	Alternative		
	2	3	4
Surface Access			
▶ Route			
✦ Shaw Creek Hillside all-season road[1]	X		
⏩ Shaw Creek Road/Rosa egress from Richardson highway	X		
⏩ New Tenderfoot egress from Richardson Highway	X		
✦ South Ridge all-season road		X	
✦ Shaw Creek Flats winter-only access			X
⏩ Traditional winter road construction standards			X
⏩ Perennial winter trail construction standards			X
▶ Road use during mine operations			
✦ Pogo project only	X	X	
✦ Pogo and other industrial/commercial users only	X	X	
✦ Everyone	X	X	
⏩ Security gate near end of Shaw Creek Road	X		
⏩ Security gate at Gilles Creek	X		
▶ Road disposition at end of mine operations			
✦ Remove and reclaim	X	X	
✦ Leave road open (versus closed) to:			
⏩ Industrial/commercial users	X	X	
⏩ Everyone	X	X	
Power Line Route			
▶ Shaw Creek Hillside	X		
▶ South Ridge		X	

[1] Underline – Applicant's proposed option or sub-option

Alternative 1

NEPA requires that a No Action Alternative be considered. The No Action Alternative would result from denial of at least one of the federal or state permits necessary for project development, or it could result if the Applicant chose not to develop the project. This alternative may be used as a baseline for comparison with the action alternatives to determine impacts. Table S-4 presents the No Action Alternative assumptions.

Table S-4 No Action Alternative Assumptions

1. Socioeconomics

- No prison constructed at Fort Greely
- Construction of a National Missile Defense System (NMDS) at Fort Greely beginning in 2002, with completion by approximately 2004 (~3 years).
- NMDS construction employment would average 400 jobs. Most of the construction labor force would be nonresidents and would be housed on site. The total NMDS-related population during operation (including employees, their dependents, and indirect population increase) would be approximately 350 residents.
- Natural gas pipeline construction between 2005 and 2008. Impacts on the Delta area would occur for 2 years during this period, with peak impact lasting for approximately 9 months. The large majority of workers would be nonresidents of Delta area. There would be almost no increase in population from actual gas pipeline operation.
- Once the NMDS is constructed, the Delta area population should stabilize at approximately 2,100 residents, below the pre-base closure peak of 2,388 residents in 1993.

2. Non-Resource Development

Residential land sales

- Some additional private residential land would be needed for a portion of NMDS workers. There would be no sales of state land in the project area. Natural gas pipeline construction would not increase residential land needs.
- State land sales would adhere to the State of Alaska's Tanana Basin Area Plan (TBAP).

Agricultural land sales

- New agriculture land sales in the Delta area unlikely in the near future unless there are substantial changes in operation expenses and the market and demand for farm-related products.

Commercial and Industrial Activities

- Existing, and possibly new, commercial and industrial activities (such as lodges, stores, and rock quarries) would occur in the existing developed Delta area at a pace consistent with ongoing needs or other actions in the area.

Power

- Golden Valley Electric Association's Fairbanks to Delta power line would be upgraded for NMDS. This upgrade would not require more or higher poles, nor more clearing of the right-of-way (ROW).

3. Resource Development

Timber

- The current Tanana Valley State Forest (TVSF) 5-year schedule for timber sales (Fiscal Year 2003 to 2007) would be implemented, given existing winter trail access routes and market demand. The current 5-year schedule proposes harvesting four timber sales on the northwest side of lower Shaw Creek. See Section 3.17.1 for greater detail.
- The State of Alaska Division of Forestry (DOF) would construct its planned all-season road to access timber along the Shaw Creek Hillside to harvest three of those sales totaling approximately 433 acres. This road likely would be constructed incrementally over the next several years, depending on sale of the proposed harvest units and additional capital funding. The road would be open to the public, and its route would be very similar to the route for the Shaw Creek Hillside all-season road proposed by the Applicant and would extend to Gilles Creek. Estimated total round trips on this road by logging trucks, for each of the three entire sales, are 142 (Fowler Creek), 285 (Keystone Bluff # 1), and 485 (Keystone Bluff # 2). These truck trips would average to between approximately 2 and 3 truck round trips per day.

Table S-4 No Action Alternative Assumptions

- The DOF eventually would construct its planned all-season road around Quartz Lake to access timber in the vicinity of Quartz Lake and Indian Creek near the South Ridge route all-season road option route. It would be open to the public. Like the proposed Shaw Creek Hillside forestry road, it likely would be constructed incrementally and would be dependent on additional capital funding or timber sale activity. The current 5-year schedule for timber sales proposes four timber sales in the Quartz Lake and Indian Creek area, totaling approximately 610 acres. Of that total, two sales totaling approximately 470 acres would be accessed from the proposed new DOF road, while one sale of approximately 80 acres northeast of Quartz Lake would be accessed from the existing winter road on Shaw Creek Flats. Estimated total sale harvest round trips on the DOF road by logging trucks, for each of the two entire sales using the road, are 266 (Quartz Lake # 1) and 950 (Indian Creek # 1). These truck trips would average between approximately 2 and 3 truck round trips per day.

Mining

- Mineral exploration likely would slow or perhaps decline from current levels either because a lack of Pogo Mine permits would cool mining companies' interest in the area, or because the Applicant decided not to proceed on economic grounds (e.g., low price of gold).

Recreation

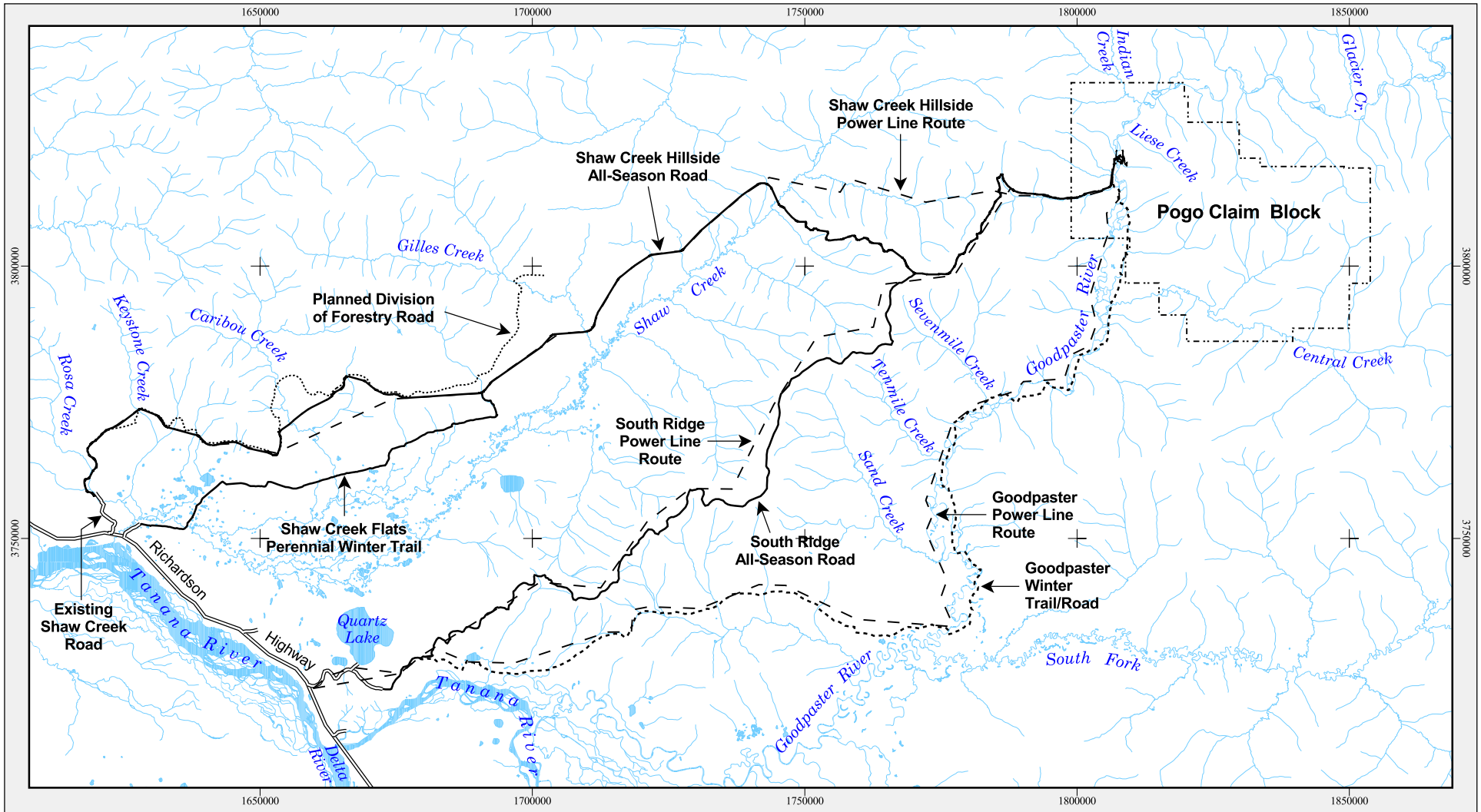
- Slow increase in use of the Goodpaster River Valley.

Alternative 2 (Applicant's Proposed Project)

In Alternative 2, the Applicant's proposed project, surface access to the mine would be by a 49.5-mile all-season road beginning at the end of the existing Shaw Creek Road, traversing the Shaw Creek Hillside, and then over the Shaw Creek/Goodpaster River Divide to the mine (Figure S-3). The road would only be used by Pogo project-related traffic, and it would be removed and reclaimed in its entirety at the end of mining operations. During intense periods of mine construction, traffic would average approximately 50 vehicles per day. Mine-related vehicle use would average between 10 and 20 round trips per day during operations, with up to 180 round trips by workers' vehicles on the initial 4.5 miles of the road during brief periods every 4 days for shift changes.

At the mine site (Figure S-4), ore from the underground mine would be ground and subject to a gravity/flotation/cyanide vat leach mill process. All tailings exposed to cyanide would pass through a cyanide destruction process and be deposited as a paste backfill underground in the mine. Non-cyanide exposed tailings would be deposited in an unlined surface dry stack in upper Liese Creek Valley located above an unlined RTP. Mineralized development rock would be encapsulated in the dry stack, and nonmineralized development rock would be used for constructing roads and other facilities.

The mill and camp would be located in lower Liese Creek Valley, and the construction camp would be located at the existing exploration camp site near the existing 1525 exploration portal. Laydown areas would be located near the existing 1525 Portal, at the airstrip, and at the mill. Gravel would be mined from existing and new pits on the Goodpaster Valley floor and in upper Liese Creek Valley.



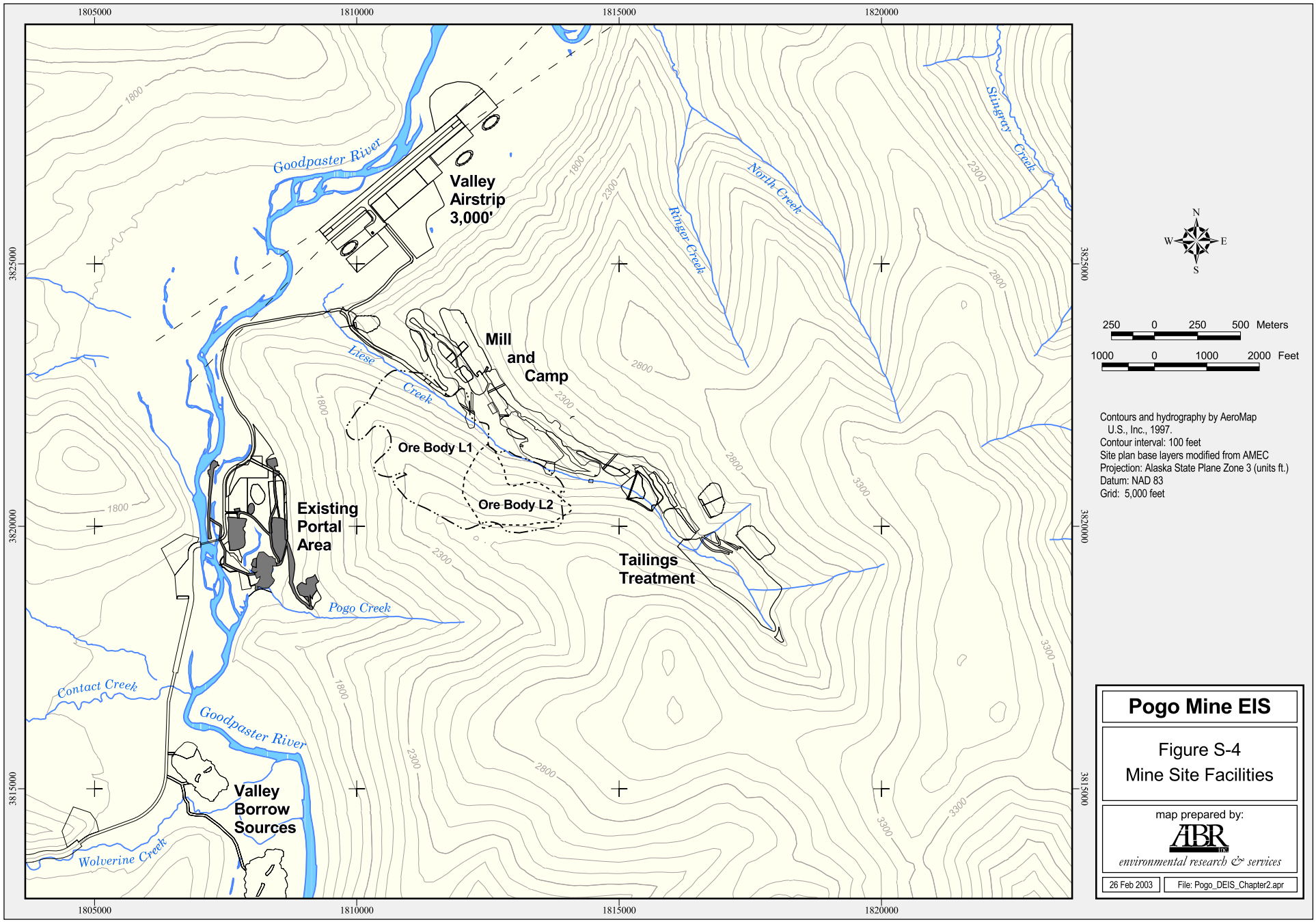
Base map: USGS 1:63,360 digital line graph mosaic
Projection: Alaska State Plane Zone 3 (units ft.)
Datum: NAD 83
Grid: 50,000 feet

Pogo Mine EIS

Figure S-3 Surface Access and Power Line Route Options, and Planned Forestry Road

map prepared by:
ABR, Inc. environmental research & services

26 February 2003 | ABR File: Pogo_DEIS_Chapter2.apr



Pogo Mine EIS

Figure S-4
Mine Site Facilities

map prepared by:
ABR, Inc.
environmental research & services

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Power would be supplied by a 50-mile power line that would follow the access road. Diesel fuel would be stored in permanent tanks at the mill and at the mouth of the 1525 Portal. Water would be supplied from mine drainage, the RTP, and wells. During the development phase, treated industrial wastewater would be injected into underground wells. During operations, treated industrial wastewater would be discharged to a soil absorption system

(SAS) adjacent to the airstrip, or injected into underground wells. Treated domestic wastewater would be discharged to underground drain fields at the camp in Liese Creek Valley and at the existing exploration camp near the 1525 Portal.

A 3,000-foot airstrip would be located on the Goodpaster Valley floor just north of the mouth of Liese Creek.

Alternative 3

Alternative 3 would be the same as Alternative 2 except:

- The surface dry stack and RTP would be lined
- During development and operations, treated industrial wastewater would be discharged directly to the Goodpaster River
- Surface access would be via the South Ridge all-season road
- The power line would follow the South Ridge all-season road route

Alternative 4

Alternative 4 would be the same as Alternative 3 except:

- Power would be supplied by on-site generation
- During development and operations, treated industrial wastewater would pass through an off-river treatment works before discharge to a channel into the Goodpaster River
- Surface access would be via a winter-only road or trail across Shaw Creek Flats to an all-season road beginning south of Gilles Creek that then would follow the Alternative 2 road route to the mine site

S.9 Mitigation, Monitoring, and Management

Environmental mitigation, monitoring, and management measures are designed to ensure that potential impacts would be minimized during construction, operation, and closure of the Pogo Gold Mine project. In general, the Applicant has incorporated extensive mitigation and monitoring measures into its plan of operations. These measures include likely requirements of the permits and approvals for the project. In addition, the State of Alaska as landowner has adopted several land management measures to minimize impacts.

S.10 Closure and Reclamation

The Applicant has submitted a reclamation and closure plan. The goal of the plan is to return disturbed land to the designated post-mining land use, defined by the Tanana Basin Area Plan (TBAP) as public recreation and wildlife habitat. The goal of reclamation is to re-establish

wildlife habitat within 5 to 15 years by stimulating growth of an early successional vegetation. The primary objective of the closure part of the plan is to ensure that water quality would not be strongly affected after mine closure. To accomplish this objective, materials that potentially could cause degradation to the lands and waters of the state would be stabilized, removed, or mitigated.

The primary objective of the reclamation part of the plan would be to stabilize disturbed mined-land surfaces against erosion. This stabilization would be accomplished by improving plant growth conditions and encouraging the succession of self-sustaining native and naturalized plant communities. Inactive areas not anticipated to be disturbed would be closed and reclaimed concurrently with mining.

S.11 Environmental Consequences

The impacts of the three action alternatives are summarized in three tables in Appendix A of this summary. Table A-1 shows the impacts from options that are common to all alternatives. That is, if the project were to proceed to development, these impacts would occur regardless of which alternative were selected.

Table A-2 summarizes the impacts of options that are specific to one of the three action alternatives, but that are not access related. Finally, Table A-3 summarizes options that are specific to one of the three action alternatives, and that are access related. The descriptions of impacts assume the recommended mitigation measures would be implemented. Note that as a convention, if a particular option would have no, or only a low, impact on a given resource, it generally is not discussed.

Cumulative Impacts

Cumulative impacts “result from the incremental impact of the proposed action and alternatives when added to other past, present, and reasonably foreseeable future actions, regardless of what government agency or private entity undertakes such actions. Cumulative impacts can result from individually minor impacts that, when viewed collectively over space or time, can produce significant impacts” (40 CFR 1508.7).

Examination showed that the overwhelming factor determining cumulative impacts was whether the all-season access road would be removed and reclaimed at Pogo Mine closure, or whether it would be maintained for other resource development purposes and/or for public use. This factor applied not only to Alternatives 2 and 3, which contain a complete all-season road by definition, but also to Alternative 4 with its winter-only access option. The factor of road access and retention was important because it would be highly likely that by the time of Pogo Mine closure, the planned Division of Forestry (DOF) road would have been constructed to the point that it would connect to the all-season road segment of the winter-only access option and be effectively operated like the complete all-season road options for Alternatives 2 and 3. Thus, the critical issue affecting cumulative impacts was not a choice of which alternative; rather, it was a management issue. That is, at Pogo Mine closure, would the road be removed and reclaimed, or would it be left in place for other resource development purposes and for public use?

Table A-4, also in Appendix A, summarizes the impacts from a resource-by-resource perspective on the basis of whether the all-season access road would be removed and

reclaimed at Pogo Mine closure, or would be maintained for other resource development purposes and public use.

S.12 Identification of the Environmentally Preferable and Preferred Alternatives

In making its Record of Decision, EPA must identify both an Environmentally Preferable Alternative and a Preferred Alternative. The Environmentally Preferable Alternative "ordinarily, means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (Council on Environmental Quality [CEQ], 1981: Forty most asked questions, no. 6a). The Environmentally Preferable Alternative can be the same as the agency Preferred Alternative or differ in some respects, depending on the analysis in the EIS.

The Preferred Alternative is the alternative EPA and the cooperating agencies believe fulfills the purpose and need of the proposed action. As provided for in NEPA and the CEQ NEPA implementing regulations, the Preferred Alternative and the Environmentally Preferable Alternative need not be the same. EPA may take into account various other considerations in choosing its Preferred Alternative, including such factors as the agency's statutory mission and responsibilities and economic, environmental, technical, and social factors.

An analysis of the impacts that are summarized in Tables A-1 through A-4 was conducted on an individual component basis to determine which options should constitute both the Environmentally Preferable Alternative and EPA's and the cooperating agencies' Preferred Alternative. That analysis is contained in the following three subsections.

S.12.1 Options Common to All Alternatives

By definition, the options common to all alternatives would be developed, regardless of which of the three action alternatives were selected. Of the ten project components with options common to all alternatives, eight had no sub-options that differed between the three action alternatives (Table S-1). Two components, however, did have options that would produce different impacts; gravel source, and use and disposition of the airstrip.

Gravel Source

Gravel Pits Versus Crushing Development Rock Gravel is on the critical path for project construction, and would be needed for two purposes immediately at the start of development; for concrete aggregate for the civil works' foundations in the mine area (water treatment plant, mill, camp, and shop facilities), and as a road topping for mine area roads. Crushing development rock for gravel at this early stage would not be an option because you cannot treat mine water without a new water treatment plant, and you cannot have underground development without a shop to maintain the equipment. Thus, from a timing perspective, crushing development rock to make gravel would not be feasible or practicable.

Experience in the existing advanced exploration adit at Pogo has demonstrated that underground development rock breaks down under traffic loads and becomes mud. It does not posses the necessary hardness specifications, and thus crushing development rock to make gravel would not be feasible or practicable from the technical perspective.

Mining gravel from existing and new pits would disturb approximately 66 more acres, approximately 13.1 acres of which would be excavated for the off-river treatment works. A portion of this disturbance would be to wetlands, and would have moderate impacts. But those impacts would be offset by pond creation in the gravel pits, resulting in negligible overall wetlands impact. Mining gravel would have a moderate local wildlife habitat impact although this, too, would be mitigated somewhat by pond formation. Still, surface mining of gravel would account for approximately 7 percent of the total surface disturbance for the Applicant's Proposed Project.

Summary analysis indicated that from the timing and technical perspectives, crushing development rock to make gravel would not be feasible or practicable. For the gravel mining option, overall impacts to wetlands and wildlife would be low to moderate on a local basis, with some positive benefits from newly created ponds in the gravel pits. And, construction of the off-river treatment works would require excavating approximately 13.1 acres of gravel in any event. Therefore, the option to mine gravel was selected as the Preferred Alternative and, because crushing development rock to make gravel would not be feasible or practicable, mining gravel also was the Environmentally Preferable Alternative by default.

Air Access

- **Airstrip use and disposition** Summary analysis indicated that allowing airstrip use by other industrial/commercial users, or everyone, during operations would have more impacts than restricting use only to the Pogo project. In a similar manner, removing and reclaiming the airstrip would have fewer impacts on most resources, and the area land use plan does not call for creating access to the mid-Goodpaster River Valley. Therefore, for both the Environmentally Preferable Alternative and the Preferred Alternative, use only by the Pogo project was selected as the airstrip use option, and removal and reclamation was selected as the airstrip disposition option.

S.12.2 Options Specific to Alternatives, But Not Related to Surface Access

Three project components had options that were specific to one of the three action alternatives, but were not related to surface access (Table S-2).

Tailings Facility Liner

- **Lined Versus Unlined Tailings Dry Stack and RTP**

  Dry-stack tailings pile Permeabilities of the fine-grained dry-stack tailings themselves were not considered to be greatly different than permeabilities of an installed liner system. Also, most seepage that would occur from the dry stack would be captured by the RTP. Still, from strictly a water quality perspective, a lined tailings facility likely would provide some measure of increased impermeability and transmission of drainage to the RTP. From a tailings pile stability perspective, however, a liner would be more problematic.

  The original dry-stack tailings pile stability analysis assumed a worst case scenario that included saturation of the general tailings placement zone. It did not include saturation of the shell zone. Placement of an impermeable liner beneath the general placement zone likely would cause saturation of the tailings pile and result in occurrence of the worst case

scenario, which was not the design intent. Thus, saturation caused by the impervious liner likely would increase stability risk.

Because there would be little benefit to water quality from installation of a liner under the dry-stack tailings pile, while there would be increased risk to stability from the liner, the unlined dry stack sub-option was selected as both the Environmentally Preferable Alternative and the Preferred Alternative.

In the Applicant's Proposed Project, there would be no erosion control/drainage blanket installed before tailings would be placed in the dry-stack tailings facility. This blanket was predicted to have no effect on the dry stack's stability, but it would permit clearing and stockpiling of organic and soil growth media to insure a sufficient volume for reclamation. Because of this benefit, inclusion of a erosion control/drainage blanket was selected for both the Environmentally Preferable Alternative and Preferred Alternative.

RTP The primary purpose of the RTP would be to capture runoff and seepage from the dry-stack tailings facility consistently, reliably, thoroughly, and predictably, during both mine operations and post closure activities.

Seepage from the dry stack would migrate downgradient below the surface, nearer the colluvium/weathered bedrock interface. An effective seepage interception and collection system would be needed to provide appropriate management of this subsurface flow. Given the nature of the flow system that would develop, the most effective interception system would be one perpendicular to the direction of subsurface flow, i.e., a cutoff wall.

The proposed RTP dam face liner system and grout curtain would establish an effective interception cutoff wall to collect this seepage. The upstream toe of the dam face liner system would be embedded in a trench in weathered bedrock filled with grout, with a drilled curtain of pressure-grouted holes extending below the toe through the weathered bedrock layer and into fresh bedrock.

A full liner under the RTP basin would not provide substantially better long term seepage collection and would introduce increased operational and performance risks for a number of reasons, including:

- A full basin liner would fail to collect the seepage at issue because the upstream toe of the liner would not have the robust cutoff wall required to collect the subsurface seepage. If such a cutoff wall at the upgradient end of the liner were required, it would follow that another liner upstream of that cutoff wall also would be needed, etc. It is thus a cutoff wall perpendicular to the flow that would be needed to capture seepage, not a liner.
- Due to the narrowness of Liese Creek Valley, and its steep slopes, hydrostatic uplifting forces from upwelling ground water beneath the liner could result in long-term liner instability, especially during periods when the RTP reservoir would be drawn down to provide storm surge volume.
- The nature of Liese Creek Valley geometry is such that a large portion of any full basin liner would be on very steep slopes. The south slopes of the reservoir exceed the maximum slopes recommended for effective liner installation (2.2 to 2.5 H to 1 V).

Because a full basin liner thus would not completely capture the desired seepage and provide the long-term reliability necessary to manage dry-stack seepage, and because the geometry of the site exceeds recommended slopes for effective installation of a liner, the

unlined option was selected for both the Environmentally Preferable Alternative and the Preferred Alternative.

Power Supply

- **Power Line Versus On-Site Generation** Summary analysis indicated that for the majority of resources the risk from fuel spills during transportation was considered to be substantially more important than the impacts from the clearing required for a power line right-of-way (ROW), especially because clearing generally would not destroy the vegetative mat and once the power line were reclaimed, the visual impacts would be removed and plant succession would eventually return the ROW to approximately its present condition. Thus, the power line was determined to be the option for both the Environmentally Preferable Alternative and the Preferred Alternative.

Water Discharge

Water discharge had two subcomponents: the project development phase and its operations phase.

Development Phase This subcomponent had three options for treated wastewater: underground well injection, discharge to the Goodpaster River, and an off-river treatment works.

- **Underground Injection Well**. The existing water treatment plant at Pogo has discharged treated mine drainage via an injection well at approximately 100 gpm since 1999. Every monthly sample during the four-year period since has met all the permit limits of the existing injection well permit. As the mine workings increase over the first two years of development, however, the amount of water to be discharged could increase to approximately 400 gpm. And, the farther one gets in both space and time from the existing conditions the more potential there would be for mine drainage water quality to diverge from that observed during the past four years. There would be potential for discharged water to surface in nearby sloughs, and the projected treated water may not meet discharge criteria for four parameters at least some of the time. If mercury did not exceed, or infrequently exceeded, its criterion, this would be considered a moderate impact from a permitting and compliance perspective.
- **Discharge to the Goodpaster River**. Treated wastewater would be discharged directly to the Goodpaster River. Water quality at the edge of the mixing zone was projected to meet discharge criteria for all parameters. The impact of this discharge was expected to be low.

  A mixing zone could not be approved if there were potential for mercury to bioaccumulate to significantly adverse levels [18 AAC 70.250 (a)(1)(A)]. It was uncertain whether mercury would bioaccumulate to significantly adverse levels from this discharge; hence, it was uncertain whether a mixing zone could be granted.
- **Off-River Treatment Works** This option was expected to have efficient mixing of treated wastewater, thus meeting criteria for all parameters even at the conservative 95th percentile of the annual maximum. The impact of this discharge was expected to be low.

Summary analysis of the development-phase discharge options determined that for the underground injection wells option the discharge may not meet criteria for six parameters at least some of the time. This inability to meet discharge criteria was considered to have a moderate impact from a permitting and compliance perspective only if mercury only infrequently exceeded its criterion. For the direct discharge option, it was unknown whether a mixing zone

could be granted because of the lack of certainty about whether mercury would bioaccumulate. In contrast, the off-river treatment works option was expected to have a low impact and more permitting certainty. Thus, the off-river treatment works was determined to be the option for both the Environmentally Preferable Alternative and the Preferred Alternative.

Operations Phase This subcomponent had the same three options for treated wastewater as the development phase, plus discharge to a SAS. Impacts from the three options in common with the development phase would be the same as discussed above for the development phase.

Soil absorption system. The influent to the SAS is expected to achieve drinking water standards for the 95th percentile of the annual average for all parameters except nitrate, and is expected to exceed TDS, chloride, sulfate, TKN, and nitrate for the 95th percentile of the annual maximum. The effluent from the SAS is expected to exceed the discharge criteria for the 95th percentile of the annual average based on dissolved and total concentrations for nitrate, cyanide, cadmium, copper, lead, and mercury. The 95th percentile of the annual average would also exceed the total recoverable criteria for manganese. For the 95th percentile of the annual maximum, TDS, chloride, sulfate, nickel, and selenium would be exceeded for dissolved and total criteria in addition to those exceeded for the annual average. Manganese would also be exceeded for total criteria only. These additional parameters at the 95th percentile of the annual maximum would likely exceed the discharge criteria less frequently than for the 95th annual average. Because the influent to the SAS and the discharge from the SAS are estimated to exceed the expected discharge criteria for a number of parameters, this discharge was defined as having a high impact from a permitting and compliance perspective, and may not be permittable.

Summary analysis for the operations phase options determined the same impacts as described for the same development phase options, in addition to the high permitting and compliance impact for the SAS option. Thus, in the same manner as for the development phase, the off-river treatment works was determined to be the option for both the Environmentally Preferable Alternative and the Preferred Alternative.

S.12.3 Options Specific to Alternatives, and Related to Surface Access

Two project components had options related to surface access specific to one of the three action alternatives: surface access and power line route (Table S-3).

Surface Access

The surface access component had three subcomponents: route, use, and disposition.

Route There were three route options: Shaw Creek Hillside all-season road, South Ridge all-season road, and the Shaw Creek Flats winter-only access.

- **Winter-only access** In the first route analysis, the concept of winter-only access was compared to the all-season road concept. Implementation of each concept would have advantages over the other for several issues. From the technical and economic feasibility perspectives, however, the winter-only access concept would not work. Technically, the issue was whether the annual winter-only access option would be feasible during the life of the mine. The Applicant estimated that a winter supply window allowing adequate time

would be absent once in 13 years. Independent confirmation of recent long-term climate warming in central Alaska suggested the Applicant's estimate was optimistic.

From an economic feasibility perspective, constructing, operating, and reclaiming a remote mine dependent on only 8 to 10 weeks of annual surface access for major resupply, with reliance of air support into a 3,000-foot airstrip susceptible to weather interruptions for the remainder of the year, raised many issues. These issues included a short window for mobilization of construction equipment and supplies for the development phase, including construction of the all-season road segment; capital costs estimated to be approximately 53 percent higher than for an all-season road; storage of an entire year's worth of diesel, propane, cement, reagents, and other materials at the mine; and total annualized operating costs estimated to be approximately 118 percent higher than for an all-season road, with freight estimated to cost approximately 60 percent more per ton and with substantial personnel air transportation costs.

Thus, because winter-only access might not be possible for 1 or more years during expected mine life, and because it would add substantial capital and operating costs that would increase the project's economic burden, it would introduce an unreasonable level of complexity and business risk. Therefore, this option did not address the purpose and need for the proposed action, and could not be considered further for the Preferred Alternative.

- **All-season road** In the second route analysis, the options for the Shaw Creek Hillside all-season route and South Ridge all-season route were compared. For purposes of the analysis, impacts from the associated power line routes also were considered because, taken as a whole, building both the road and power line in conjunction would substantially reduce total impacts from both components. Analysis showed each set of options (for the road and power line) to have advantages over the other.

  The South Ridge route had advantages in that it would cause approximately 79 fewer acres of total surface disturbance for both the all-season road and power line ROWs, and approximately 45 fewer acres of cuts and fills in wetlands. It also would cross only one stream requiring a bridge (the Goodpaster River), versus seven for the Shaw Creek Hillside route.

  The Shaw Creek Hillside route had advantages in that it would disturb roughly half the acreage of high-value habitats for moose, caribou, and brown bear than would the South Ridge route, and bird-power line collisions likely would be lower because of its more extended length below timberline. Visual impacts also would be fewer than for the South Ridge route because it would be primarily below timberline, and the Shaw Creek Hillside route would not be visible to the recreational cabin owners on the lower Goodpaster River. Therefore, the Shaw Creek Hillside all-season road would be more consistent with the visual guidelines of the TBAP, which call for consideration of visual impacts on the Goodpaster River corridor.

  In all cases, these differences in impacts between the two routes were not considered to be high on greater than a local basis, largely because the route corridors would be narrow and linear in character, and because mitigation measures would reduce impacts.

  The overriding difference between the routes, however, was related to land use. Based on the long-term Tanana Valley State Forest (TVSF) Management Plan, the current DOF 5 year timber harvest plan includes an initial forestry road to the Keystone Bluffs area of the state forest, and eventually well up the Shaw Creek Valley to upper Gilles Creek. Therefore, within the expected life of the Pogo Mine, there is a reasonable probability that

a public road up to 23 miles long would be constructed very close to the proposed Shaw Creek Hillside all-season road alignment as far as Gilles Creek if the Applicant's proposed road were not constructed. Thus, because there were no major differences in impacts between the two route options that could not be mitigated to some extent, and because constructing the Shaw Creek Hillside route would result in only one road being built into the project area (i.e., not both the South Ridge all-season road and the DOF forestry road), the Shaw Creek Hillside route was determined to be the option for both the Environmentally Preferable Alternative and the Preferred Alternative.

For the Shaw Creek Hillside all-season road option, there was an issue of what route would be used to connect the all-season road to the Richardson Highway.

- **Richardson Highway egress** There were two route sub-options for this road segment: the existing Shaw Creek Road and Tenderfoot.

  For most resources, there were no or only minor differences between the two sub-options. The Shaw Creek Road sub-option, however, had higher noise and safety impacts and would not be as favorable to new recreational users, while the Tenderfoot sub-option was determined to have higher visual and cost impacts. Of these, the noise, safety, and cost impacts were judged to be of most importance.

  For the Shaw Creek Road sub-option, both the safety and noise impacts generally were considered low. From the safety perspective, some increased impact would occur, especially if the all-season road were open to use by everyone and the shift change bus station were located near the Trans-Alaska Pipeline System (TAPS) crossing. This increased impact, however, could largely be mitigated. From the noise perspective, impacts generally would be low or moderate. If the Applicant's shift-change bus station were near the TAPS crossing, however, two residences would experience a moderate to high impact, and four would experience a high impact during short periods of time 4 days apart. These impacts also could be mitigated to some extent, including locating the bus station on the Richardson Highway.

  Shaw Creek Road is relatively narrow at present, but is well maintained and has been improved recently. The State of Alaska has reviewed expected traffic volumes and vehicle sizes, including logging truck traffic from proposed DOF timber sales and shift change traffic, and believes Shaw Creek Road can accommodate this traffic safely. Because the road could be upgraded in the future if necessary, speed limits could be adjusted and other mitigation measures implemented as appropriate, and the Applicant's policy would be to adhere to all speed limits, the safety risk from Pogo-related traffic would be low.

  For the Tenderfoot sub-option, the cost of a new approximately 3.5-mile road was estimated at approximately $2.5 million to $3.0 million. This road would terminate in the vicinity of the end of the existing Shaw Creek Road, which already is a state-maintained road.

In final analysis, it was determined that it would be unreasonable to build a new road merely to avoid an existing state-maintained road, considering that the Shaw Creek Road noise and safety impacts generally would be low, or could be mitigated to make them low.

Use For road use during Pogo project operations, there were three options:

- **Pogo Project Use Only**

- **Pogo Project and Other Industrial/Commercial Users**
- **Use by Everyone**

For almost all resources, impacts were considered to be low from the regulated use of an all-season road only by the Pogo project, and were considered only marginally higher for additional regulated use by other industrial/commercial users. Impacts from the option with use of the road by everyone were considered generally low for several resources (water and air quality, noise, wildlife, and visual), and moderate for fish. For three resources, however, impacts were considered high.

Because off-road use by ATVs and other vehicles generally is not regulated, a road open to everyone could cause major impacts to wetlands. It also would increase competition for subsistence resources. For existing recreationists, road use by everyone could have a major impact on the quality of their experiences, particularly for cabin owners along the lower Goodpaster River. Conversely, from the perspective of new recreationists, use by everyone would be beneficial because it would provide access to new areas.

In determining its preferred option, the ADNR considered its overall, broad management goals under the TBAP, as well as the more specific management objectives of the TVSF plan. Because (1) the Shaw Creek Hillside route would be both within or immediately adjacent to the state forest in lower Shaw Creek Valley; (2) an objective of the forest plan is to provide public access to forest resources; and (3) state forest roads generally are open to the public; ADNR made a proposed determination that the lower approximately 23 miles of the Shaw Creek Hillside all-season road as far as Gilles Creek would be open to public use during mine life following Pogo project construction, and published that preliminary decision in the DEIS. The proposed determination would have kept the remaining approximately 26 miles of road to the mine open only for use by the Pogo project, and possibly to other industrial/commercial users on a case-by-case basis. Such other use could occur, however, only after a public process and thorough analysis of potential impacts of the proposed uses.

Public and Tribal comments on ADNR's preliminary decision, however, were overwhelmingly opposed to opening any of the Shaw Creek Hillside all-season road past the end of the existing Shaw Creek Road to the public during the life of the Pogo Mine. ADNR, therefore, is reconsidering its preliminary decision and the EIS team has selected use of the entire mine access road during the life of the mine only by the Pogo project, and by other industrial/commercial users on a case-by-case basis, as the Preferred Alternative for purposes of this final EIS. ADNR will consider whether to adopt this option in its final decision to be made after publication of this final EIS. Use of the entire road only by the Pogo project (with no use by other industrial/commercial users) was determined to be the option for the Environmentally Preferable Alternative.

Disposition There were two all-season road disposition options:

- **Remove and Reclaim the Road**
- **Maintain the Road**

Results of this analysis were similar to those for the road use options discussed above. The primary difference was that the option for road use during mine operations had a limited time horizon while road disposition following Pogo Mine closure was considered to be permanent. Continued road use only by industrial/commercial users was considered to

have low impacts on most resources, although locally high impacts on wetlands and wildlife could happen if major resource developments were to occur.

Leaving the road open to everyone would perpetuate many of the same impacts described in the Chapter 4 alternatives analysis of the option to permit road use by everyone. In addition, it would lead to the cumulative impacts of maintaining an all-season road also described in that chapter. As discussed in Chapter 4, the degree of impacts if the road were to be maintained, particularly cumulative impacts, could be reduced in large measure by the State of Alaska land use and road management policies.

The probability of another mine or other large resource development occurring in the area prior to Pogo Mine closure is low. The TVSF Management Plan, however, contemplates public use of state forest roads. Therefore, ADNR made a preliminary determination in the DEIS that the ROW authorization for the Shaw Creek Hillside all-season road would require that at Pogo Mine closure the all-season road must be removed and reclaimed from Gilles Creek to the mine site in its entirety, and in a manner that would preclude use by ATVs. The segment from the existing Shaw Creek Road to Gilles Creek, however, would remain open for all users. ADNR could extend the life of the road to the mine site to accommodate other major resource development projects, but only after a public process that would include a thorough analysis of potential impacts of the proposed uses.

Comments on ADNR's preliminary disposition decision strongly favored opening the mine access road as far as Gilles Creek after the life of the mine. Thus, because the TVSF Management Plan contemplates public use of state forest roads, and because there was strong support for public use of the road after the mine's life, public use of the road as far as Gilles Creek was determined to be the Preferred Alternative, while removal and reclamation of the entire all-season road was determined to be the Environmentally Preferable Alternative.

Power Line Route

The power line route component had two options:

- **Shaw Creek Hillside Route**
- **South Ridge Route**

While these two options had different impacts for various resources, a constant throughout the power line route analysis was that the power line route should be the same as the surface access route because, taken as a whole, building both in conjunction would substantially reduce total impacts from both components. Because overall impacts from the surface access route would be substantially greater than those for the power line route, and because neither power line route offered any substantial benefits over the other, once the surface access route was selected the choice of the corresponding power line route was straightforward. Thus, the Shaw Creek Hillside power line route was determined to be the option for both the Environmentally Preferable Alternative and the Preferred Alternative.

In the Applicant's Proposed Project, the power line would cross the Shaw Creek / Goodpaster divide via Sutton Creek (Figure 2.3-2), to the north and away from the road corridor. As a result of public comments on the DEIS, a new sub-option was considered with the power line following the road corridor over the divide. The road corridor route would have approximately the same direct habitat impact as the Sutton Creek route, and

marginally greater wetlands impacts, but would consolidate impacts into one corridor and avoid all impacts to the Sutton Creek drainage. Thus, the road corridor sub-option was selected for both the Environmentally Preferable Alternative and the Preferred Alternative.

S.13 Presentation of the Environmentally Preferable and Preferred Alternatives

Based on the impacts analyses described above, Tables S-5, S-6, and S-7 present the Environmentally Preferable Alternative, as well as EPA's and the cooperating agencies' Preferred Alternative.

Figure S-5 presents EPA's and the cooperating agencies' Preferred Alternative in graphic form in the same manner as was shown earlier in Figure S-2, except the options that constitute the Preferred Alternative are boldly framed.

The options and sub-options selected for the Environmentally Preferable Alternative and the Preferred Alternative were the same for every project component with the exception of use and disposition of the Shaw Creek Hillside all-season road. For these two subcomponents, the Environmentally Preferable Alternative was for use only by the Pogo project, and for complete removal and reclamation of the road, respectively. In the Preferred Alternative, use and disposition of the road was the same as for the Environmentally Preferable Alternative past Gilles Creek. Between the existing Shaw Creek Road and Gilles Creek, however, public use would be allowed following the project's construction, and the road would be maintained for public use following mine closure.

Table S-5 Environmentally Preferable Alternative and Preferred Alternative for the Options Common to All Action Alternatives

Component, Options, and Sub-Options	Environ. Preferable Alternative	Preferred Alternative
Milling Process		
▶ Gravity / flotation / cyanide vat leach[1]	X	X
Tailings Disposal		
▶ Underground paste backfill	X	X
▶ Surface dry stack and RTP in Liese Creek Valley	X	X
Mill and Camp Location		
▶ Liese Creek Valley	X	X
Development Rock Disposal		
▶ Mineralized rock encapsulated in dry stack	X	X
▶ Nonmineralized rock in dry stack, RTP dam, other construction	X	X
Gravel Source		
▶ Expand existing gravel pits and develop new pits	X	X
▶ Crush nonmineralized development rock		
Construction Camp		
▶ Below existing 1525 Portal in Goodpaster Valley	X	X
Laydown Area		
▶ Permanent below existing 1525 Portal, at airstrip, and at mill	X	X
Water Supply		
Industrial		
▶ Mine drainage	X	X
▶ RTP	X	X
▶ Wells	X	X
Domestic		
▶ Wells	X	X
Water Discharge		
Operations Phase		
▶ Domestic wastewater		
✦ Package treatment plant and direct discharge to river	X	X
Fuel Storage Location		
▶ Temp: 1525 Portal and airstrip. Perm: portal mouth and mill	X	X
Air Access		
▶ 3,000-foot airstrip in Goodpaster Valley	X	X
▶ Use of airstrip during Pogo mine operations		
✦ Pogo project only	X	X
✦ Pogo and other industrial / commercial users only		
✦ Everyone		
▶ Disposition of airstrip at end of Pogo project		
✦ Remove and reclaim after mine reclamation	X	X
✦ Open for Industrial / commercial resource users only		
✦ Open for everyone		

[1] Underline – Applicant's proposed option or sub-option

Table S-6 Environmentally Preferable Alternative and Preferred Alternative for the Options Specific to Certain Action Alternatives, but Not Related to Surface Access

Component, Options, and Sub-Options	Environ. Preferable Alternative	Preferred Alternative
Tailings Facility Liner		
▶ Surface dry stack and RTP in Liese Creek[1]	X	X
✦ Lined dry stack		
✦ Lined RTP		
✦ Unlined dry stack	X	X
✦ Unlined RTP	X	X
Power Supply		
▶ Power line	X	X
▶ On-site generation		
Water Discharge		
Development Phase		
▶ Underground injection wells		
▶ Direct discharge to Goodpaster River		
▶ Off-river treatment works	X	X
Operations Phase		
▶ Industrial wastewater (RTP)		
▶ Industrial wastewater (RTP)		
✦ Soil absorption system (SAS)		
▸▸ Goodpaster River Valley adjacent to airstrip		
▸▸ Saddle above and southeast of Pogo Ridge		
✦ Underground injection wells		
✦ Direct discharge to Goodpaster River		
✦ Off-river treatment works	X	X

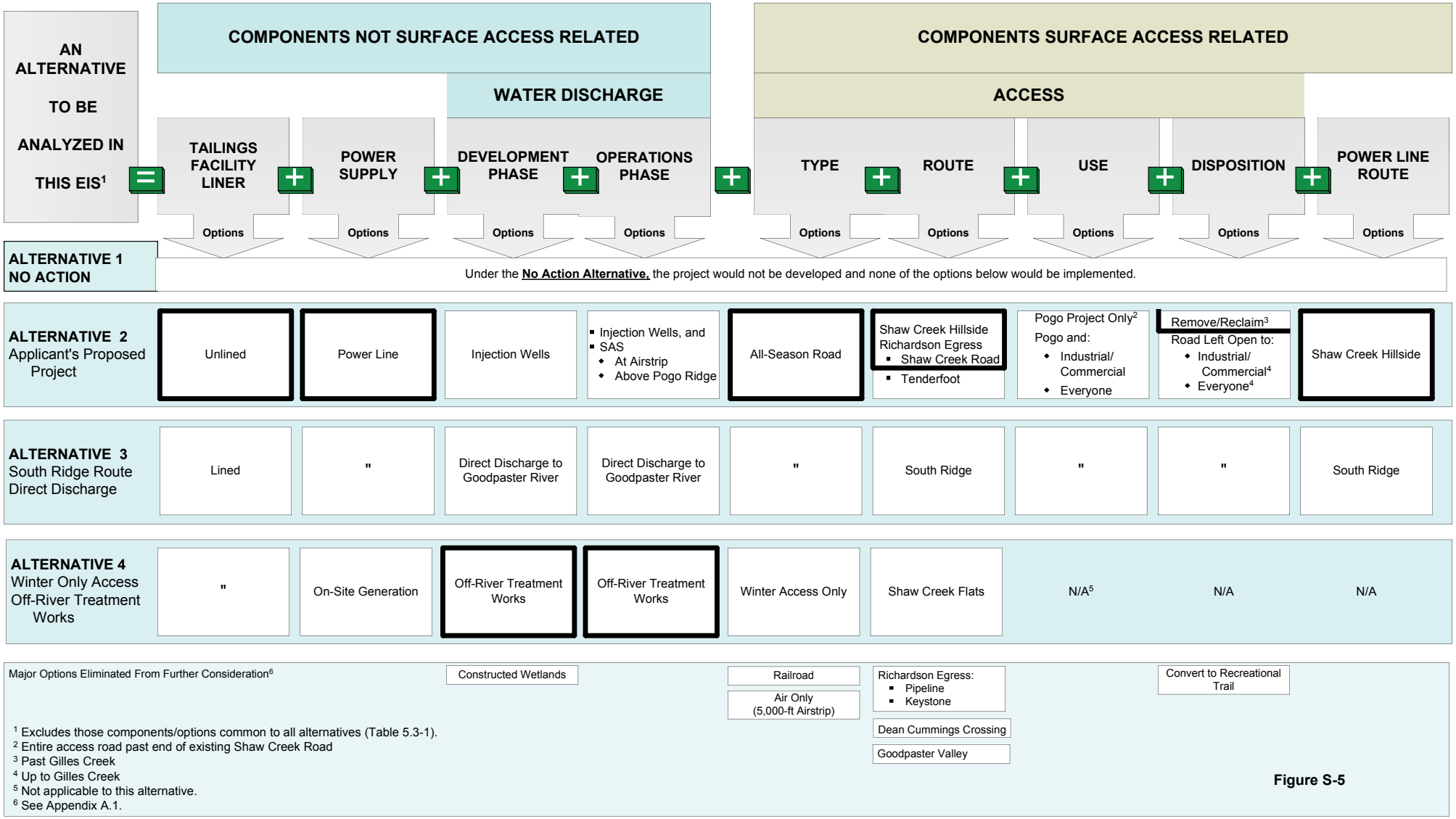
[1] Underline – Applicant's proposed option or sub-option

Table S-7 Environmentally Preferable Alternative and Preferred Alternative for the Options Specific to Certain Action Alternatives that are Related to Surface Access

Component, Options, and Sub-Options	Environ. Preferable Alternative	Preferred Alternative
Surface Access		
▶ Route		
✦ Shaw Creek Hillside all-season road[1]	X	X
⏩ Shaw Creek Road egress from Richardson Highway	X	X
⏩ New Tenderfoot egress from Richardson Highway		
✦ South Ridge all-season road		
✦ Shaw Creek Flats winter-only access		
⏩ Traditional winter road construction standards		
⏩ Perennial winter trail construction standards		
▶ Use of all-season road during Pogo mine operations		
✦ Pogo project only	X	
✦ Pogo and industrial/commercial users		X
✦ Everyone		
⏩ Security gate near end of Shaw Creek Road	X	X
⏩ Security gate at Gilles Creek		
▶ Disposition of all-season road at end of mine operations		
✦ Remove and reclaim – entirely	X	
✦ Remove and reclaim – past Gilles Creek gate		X
✦ Leave road open as far as Gilles Creek (vs. closed) to:		
⏩ Industrial/commercial users	X	
⏩ Everyone		X
Power Line Route		
▶ Shaw Creek Hillside	X	X
▶ South Ridge		

[1] Underline – Applicant's proposed option or sub-option

PREFERRED ALTERNATIVE (Shown In Bold Frames)



Major Options Eliminated From Further Consideration[6]

- Constructed Wetlands
- Railroad
- Air Only (5,000-ft Airstrip)
- Richardson Egress:
  - Pipeline
  - Keystone
- Dean Cummings Crossing
- Goodpaster Valley
- Convert to Recreational Trail

[1] Excludes those components/options common to all alternatives (Table 5.3-1).
[2] Entire access road past end of existing Shaw Creek Road
[3] Past Gilles Creek
[4] Up to Gilles Creek
[5] Not applicable to this alternative.
[6] See Appendix A.1.

Figure S-5

Executive Summary Appendix A

Table A-1 Summary of Direct and Indirect Effects of the Options Common to All Alternatives

4.1 Surface Water Hydrology
Mine area. Placement of the dry stack, RTP, mill facilities, and associated water diversion ditches would result in substantial modification of the surface water hydrology in Liese Creek. These impacts would be localized to Liese Creek with very small impacts to the Goodpaster River. Other option impacts would be low.
4.2 Groundwater Hydrology
Mine area. Dewatering of the mine would have moderate impacts on the groundwater hydrology in the vicinity of the mine and Liese Creek Valley. Installation of an erosion control/drainage blanket prior to constructing the dry stack is not expected to impact the quantity of seepage from the dry stack that would enter the ground water. The overall impacts on groundwater flow in the Goodpaster River Valley would be very low. Overall impacts on groundwater flow in the Goodpaster River Valley would be very low. Impacts from other component options would be low.
4.3 Water Quality
General mine area. Impacts on Liese Creek below the RTP would be low during operations. Installation of an erosion control/drainage blanket prior to constructing the dry stack is not expected to impact either the quantity or quality of the seepage from the dry stack. Following closure, the RTP would be drained and capped with fill overlain with rock as a mitigation measure to protect sediments from erosion. Draining and capping would reduce potential impacts to a low level. After mine closure, seepage of ground water from the mine would transport dissolved constituents to the slope and valley alluvium. Moderate increases in concentrations could occur for some parameters over the long term of 100 to thousands of years. These impacts would be localized between the mine and the river. Minimal impacts are expected on Goodpaster River water quality. During operations, moderate impacts would occur to water quality in Liese Creek between the tailings dry stack and the RTP from runoff and seepage from the dry stack and mineralized development rock. After closure of the dry stack, water quality would improve. Domestic wastewater would be treated with a single ADEC-approved package sewage treatment plant, and then discharged directly to the Goodpaster River. A mixing zone would be required in the river, but it is expected that the discharge would result in low to very low impacts. Air access. Without mitigation, use of the airstrip could result in a large spill that could have a high impact on water quality. With use of planned secondary containment and additional best management practices (BMPs), the likelihood and severity of spills would be reduced and the overall impact would be low. Use of the airstrip only by the Pogo project would have the smallest potential to affect water quality. The potential for impacts to water quality would increase with more users. At the end of the Pogo Mine life, removing and reclaiming the airstrip would have the least impact while keeping it open for all users would have the highest potential for impacts on water quality due to fuel spills.
4.4 Air Quality
Mine area. Construction would cause short-term, localized impacts on soils, vegetation, and visibility in the immediate mine area as a result of fugitive dust. Construction and mine operation equipment and generators would release combustion products locally. These impacts would be low and inconsequential.
4.5 Noise
General mine area. Because the distances to noise-sensitive receivers in the lower Goodpaster River, Shaw Creek Road, Quartz Lake, Big Delta, and Delta Junction areas would be in excess of 15 miles, initial mine area blasting noise was projected to have not impact in these areas. Once blasting moved underground, there would be no surface impacts. Mine area operational noise would not be audible at sensitive receivers in these areas even under extreme conditions. During initial construction, noise levels on the Goodpaster River between Pogo and Liese creeks were projected to range from 30 to 40 decibels (a-weighted) (dBA). Mine operational noise levels in this same area were projected to range from 25 to 35 dBA. Because this area is primarily used for recreation with outboard motors in the summer and snow machines in the winter, noise impacts would be low.

Table A-1 Summary of Direct and Indirect Effects of the Options Common to All Alternatives

4.6 Wetlands

General mine area. Alternative 3 would require filling 1 more acre of wetland than Alternative 2 at the airstrip. Alternative 4 would require clearing 6 acres less wetlands than Alternative 2 or 3 because a power line would not be built at the mine. Alternative 4 would require filling 12 to 13 more acres of wetlands than Alternative 2 or 3 because of increased storage space needed for a year's fuel and other supplies.

Mill, camp, and tailings disposal impacts would be high only in context of Liese Creek Valley. Impacts of facilities on the Goodpaster Valley floor also would be locally high, with gravel pits providing some wetland benefits if they were to become ponds.

	Alternative		
	2	3	4
Cut/fill (acres)	152	153	165
Clear only (acres)	14	14	8

4.7 Surface Disturbance

General mine area. Approximately 383 acres of disturbance would occur. There would be no substantive differences in disturbance among the alternatives, except for the gravel source option. If gravel were made from crushed mine development rock, as opposed to being mined from gravel pits, 72 fewer acres would be disturbed, leaving a total of approximately 311 acres of disturbance.

4.8 Fish and Aquatic Habitat

Air access. Impacts low to nonexistent if suggested mitigation were implemented. If the airstrip were open to all users, impacts would increase to low to moderate.

4.9 Wildlife

Mine area. Direct habitat loss, and direct impacts to birds and mammals, high only on a local mine site basis. No high indirect impacts on birds. Moose, brown bears, and marten could experience indirect impacts, but high only on a local mine site basis. Minor disruption of large mammal movements because of mine site facilities. Possibility of occasional entrapment in the RPT. If garbage not handled properly, bears likely would have to be killed.

Gravel source. Mining gravel, rather than crushing development rock, would cause surface disturbance to an additional approximately 66 acres on the Goodpaster Valley floor. Disturbance generally would be to lower value habitat. And, if the gravel pits were reclaimed as ponds, habitat benefits would accrue. Still, mining gravel would have a moderate local overall habitat impact compared to crushing development rock for gravel.

Air access. Airstrip removal at mine closure would allow relatively high value habitat to begin recovery. Airstrip removal also would eliminate continuing indirect habitat impacts from human activities.

4.10 Threatened and Endangered Species

No impacts on threatened or endangered species. High impacts to sensitive species only on a local basis.

4.11 Socioeconomics

Air access. If airstrip were open to other industrial/commercial users, or to everyone, it could provide some additional industrial/commercial development and create some new economic activity, population growth, and demand for public services. Removal and reclamation would eliminate this potential.

4.12 Land Use

Air access. Closing airstrip to everyone except the Pogo project could have a major impact on potential commercial and industrial activities, such as mining. Allowing other commercial/industrial users to access the airstrip could provide new service support options, as well as fly-in recreational services. Removing and reclaiming airstrip could have a major impact on commercial air operators, recreationists, and potential new mineral development in the area.

4.13 Subsistence

Mine area. Impacts low except in the immediate mine area where subsistence users would be prohibited from hunting for public safety purposes. This area is small in context of the overall subsistence use areas. Lack of availability of the mine site for subsistence hunting would not affect the overall pattern of subsistence use because other areas are available. It would be more a reduction in opportunity to hunt in a traditional place that was used by one's relatives and ancestors.

Table A-1 Summary of Direct and Indirect Effects of the Options Common to All Alternatives

Fuel storage. If contamination were to cause fish damage, decline, displacement, or contamination, it would affect availability to subsistence fishers. Also, just concerns about contamination could lead to reduced fish consumption because of fear of contaminated resources. Depending on duration and severity, contamination could have a moderate effect on subsistence fishing uses. Although there are substantial other areas available for subsistence fishing and the overall pattern of subsistence uses would not be seriously jeopardized in such an event, the Goodpaster River is a currently used and highly regarded river by descendents and related kin of Athabaskans who used this area traditionally.

Air access. Airstrip open only to Pogo project use during mine operations, and removal and reclamation at the end of mine operations, would have low impacts. Conversely, airstrip open to everyone during and after mine operations would have moderate to high subsistence impacts.

4.14 Cultural Resources

Because adherence to cultural-resource protection procedures under CFR 800, Section 106, are the accepted process by which to mitigate impacts to cultural resources, no high impacts to cultural resources are expected.

4.15 Visual

Tailings dry stack. Airborne view impacts would be high. Because of vegetation screening, visual impacts from the Goodpaster River would be low.

Mill and camp. Goodpaster River recreationists would have obscured foreground and middle ground views, and visual impacts would be low. Airborne viewers would have obscured views due to the valley's slope and topography, but impacts could be somewhat higher to viewers desiring a totally primitive experience.

Air access. If airstrip open to everyone during and after mine operations, backcountry users desiring a nonmotorized experience would see greater aircraft activity, as well as seeing more recreational users,

4.16 Recreation

Air access. If airstrip open to everyone during and after mine operations, it would be a major benefit to prospective recreational users, particularly those desiring to hunt, fish, or float the Goodpaster River. This increased recreation access would have a low effect on existing recreational users because there is presently little recreational use. Recreational cabin owners on the lower Goodpaster River, however, could be affected moderately by floaters and fishermen who would float into the lower river past these cabins. This increased use of the river would alter their present isolation and could cause changes in fishing bag and size limits, as well as an increase in littering and vandalism.

4.17 Safety

Impacts would be low.

4.18 Technical and Economic Feasibility

Mining gravel versus crushing development rock. Gravel is on the critical path for project construction. It would be needed for two purposes immediately at the start of development; for concrete aggregate for the civil works' foundations in the mine area (water treatment plant, mill, camp, and shop facilities), and as a road topping for mine area roads. Crushing development rock for gravel at this early stage would not be an option. Most of the nonmineralized rock that would be generated from underground would not be available until later in the two-year project development period. Underground mine development must follow completion of the appropriate surface facilities described above. Advancing underground development before beginning the surface civil works isn't possible because you cannot treat mine water without a new water treatment plant, and you cannot have underground development without a shop to maintain the equipment. Thus, from a timing perspective, crushing development rock to make gravel would not be feasible or practicable.

From another perspective, experience during the Pogo Mine exploration phase has demonstrated that underground development rock does not make a good traffic surface for high volume roads. At the existing advanced exploration facilities, gravel has been used to top the surface of the high volume roads because the development rock breaks down under traffic loads and becomes mud. Thus, from a technical perspective, crushing development rock to make gravel would not be feasible or practicable. Also, a gravel road topping has helped to reduce sedimentation both on the surface and underground, where reduced sedimentation in the mine sumps has been an important factor in water treatment plant efficiency.

Another need for gravel may arise for topping portions of the mine access road. Test work at potential material sites along the proposed Shaw Creek Hillside road

Table A-1 Summary of Direct and Indirect Effects of the Options Common to All Alternatives

alignment has shown the rock in most of the proposed material sites does not conform to ATM T-13 degradation, or to Los Angeles Abrasion ASTM C131-96 specification for coarse abrasion testing of coarse rock. Thus, while the rock from these sites would still be suitable for bulk fill, topping material with sufficient hardness for the road surface would have to be hauled long distances from select material sites. Two of the material sites may contain rock suitable for crushing and use for road topping, and it would be advantageous in some areas for the Applicant to do so rather than haul gravel from the vicinity of the mine. Some of the gravel from the mine area sites, however, could be used for access road topping.

Even if nonmineralized development rock were suitable for crushing, which it is not, the direct cost to produce approximately 140,000 cu yd of aggregate for use in the mine area would be approximately three to four times greater than mining pit run gravel by expanding existing borrow pits and developing new ones as proposed by the Applicant. A reasonable cost estimate for pit run gravel at the Pogo site is approximately $4 per cu yd. Thus, crushed development rock would cost between approximately $1.1 million and $1.7 million more than mined gravel (Rowley, 2002a).

Mining gravel from existing and new pits versus crushing nonmineralized development rock for gravel would disturb approximately 66 more acres. As discussed later, the off-river treatment works was selected as the preferred option for the industrial wastewater discharge component. Because this option would require excavation of approximately 13.1 acres of gravel to create the two ponds, a portion of the overall project‘s required mine area gravel needs would be met during excavation of the ponds, and the 66-acre total would be reduced to approximately 53 acres. A portion of this disturbance would be to wetlands, and would have moderate impacts. But those impacts would be offset by pond creation in the gravel pits, resulting in negligible overall wetlands impact. Mining gravel would have a moderate local wildlife habitat impact although this, too, would be mitigated somewhat by pond formation. Still, surface mining of gravel would account for approximately 7 percent of the total surface disturbance for the Applicant’s Proposed Project.

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
4.1 Surface Water Hydrology		
Unlined tailings facilities. No effect on surface hydrology. Wastewater discharge. Injection of excess water into wells could raise water levels in adjacent sloughs by 2 feet. Overall impacts are expected to be low.	Wastewater discharge. Direct discharge of excess water to the Goodpaster River would increase flow in river. Managing discharge flows to a ratio of 45:1 (river: discharge) would limit flow increase to approximately two percent. This managed discharge would have a low impact.	Wastewater discharge. Discharge via an off-river treatment works would reduce flow in an 1800-foot stretch of the Goodpaster, but a flow of at least 20 cubic feet per second would be maintained at all times in this stretch. Even during normal annual winter low-flow conditions in the river, there would be enough water to meet wastewater mixing discharge requirements. Downstream of re-entry channel impacts would be the same as for Alternative 2.
4.2 Groundwater Hydrology		
Unlined tailings facilities. Low effect on groundwater hydrology. Wastewater discharge. Injection of excess water into wells or the SAS could raise groundwater elevations locally by up to several feet. Overall impacts are expected to be low.	There would be no groundwater impacts.	Same as Alternative 3.
4.3 Water Quality		
Unlined tailings facilities. Low effect on water quality. Wastewater discharge. Projected quality of the water to be discharged from the SAS during operations would not meet discharge criteria for a number of parameters. The inability to meet discharge criteria was considered as having a high impact from a permitting and compliance perspective, and may not be permittable.	Wastewater discharge. Direct discharge to the Goodpaster River with a mixing zone during development and operations would result in low impacts on water quality. The discharge is expected to meet all criteria for all parameters. It is uncertain, however, whether mercury would bioaccumulate to high adverse levels from this discharge; hence, it is uncertain whether a mixing zone could be granted.	On-site power generation. This option would have a moderate to high potential to affect water quality due to approximately 4.2 million gallons of fuel to be transported to the mine site annually. A major spill could cause a high impact over a large watershed area Wastewater discharge. Discharge to the Goodpaster River via an off-river treatment works during operations would result in low impacts to water quality. The discharge is expected to meet all criteria for all parameters. At 400 gpm residence time would be approximately 24 hours, which would provide ample time to respond to potential upset conditions at the water treatment plant.
4.4 Air Quality		
Power line. Low impact in the vicinity of the existing permitted power generation source near Fairbanks.	Power line. Same as Alternative 2.	On-site power generation. Low impacts on local air quality under permit conditions.

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
4.5 Noise		
There would be no or low impacts.	Same as Alternative 2.	On-site power generation. Generators would use noise reducing equipment to meet Occupational Safety and Health Administration standards, and would not cause a major addition to the noise levels projected for options common to all alternatives (Table A-1).
4.6 Wetlands		
Power line. Would require clearing and slightly disturbing ground surface of approximately 119 or 158 acres of wetlands and other water bodies, depending on route. Wastewater discharge. Minor soil absorption system impacts at either the airstrip or above Pogo Ridge, but the latter would have greater wetlands acreage impacts. Injection wells. Could have the capacity to increase the groundwater table level, flood swales and otherwise dry sloughs, and create small, scattered, wetland-like areas. There likely would be sporadic, and ephemeral, and wetland benefits would be small.	Power line. Same as Alternative 2. Wastewater discharge. No or low impacts from direct discharge to Goodpaster River.	On-site power generation. Would require transport and storage of ~ 4.2 million gallons of diesel fuel annually, substantially increasing risk spills into wetlands. Also more road traffic, resulting in increase in dust and sediment-laden road runoff into wetlands. Impact would be minor because of low risk of a substantial spill. Wastewater discharge. Off-river treatment works would have no additional wetland effects beyond those for the gravel pits because it would be constructed in the excavated pits.
4.7 Surface Disturbance		
Power line. 602 or 525 acres of clearing depending on route. Wastewater discharge. 4.4 acres for the SAS.	Power line. Same as Alternative 2. Wastewater discharge. 0.5 acres for direct discharge to Goodpaster River.	On-site power generation. ~ 22.7 acres for extra fuel storage (6.1 acres) and laydown area (16.6 acres) to accommodate winter-only access need to store a full year's fuel and supplies. Wastewater discharge. 13.1 acres, but would be constructed in already excavated gravel pits.
4.8 Fish and Aquatic Habitat		
SAS. Depending on where the ground water would reach the river, overall impacts to the river's aquatic resources in the long term would be low to moderate, and would be localized.	Direct discharge to Goodpaster. This option would have a high impact on aquatic resources in the immediate vicinity of the diffuser pipe, and a low impact outside the mixing zone during normal operations. Process upsets and facility failure could cause	On-site power generation. This option would substantially increase risk of accidents during fuel transport and storage that could have moderate to high local impacts, and high impacts to the chinook population if an accident occurred during low winter flows or spawning.

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
	impacts. Because the probable frequency of these events is low, and the dilution factor high, the impacts would be moderate and localized.	Off-river treatment works. This option would have fewer impacts than the other discharge options. Process failures, mine shutdowns, and environmental upsets could be better addressed with this option considering its storage capability. Because of the low probability of the combination of upset events that would exceed this capability, and the unknown effects of severe winter weather on the process facilities, impacts would be low to moderate, and localized. A minimum flow of 20 cubic feet per second would be maintained in the Goodpaster River at all times to provide sufficient flow for fish.
4.9 Wildlife		
Power line. Would require clearing vegetation on approximately 602 or 525 acres, depending on the route. Clearing generally would not destroy vegetative mat. Altered habitat would still provide support to wildlife, though of a different species composition. Habitat impacts, and indirect impacts to birds and mammals, would be high only on a local basis. Birds would experience direct impacts from collisions, but these are expected to be high only on a local basis. Browsing mammals would benefit from the edge effect created by clearing the ROW. This benefit would be of importance only on a local basis. SAS and underground injection. SAS surface disturbance to 4.4 acres would be moderate only on local basis.	Power line. Same as Alternative 2. Direct discharge to Goodpaster. This would have a low impact.	On-site power generation. This option would require an additional ~22.7 acres of surface disturbance for increased diesel fuel storage and laydown area versus clearing vegetation on approximately 602 or 525 acres for a power line, depending on the route. Loss of ~ 2.7 acres would be moderate and only on a local basis. This option would require ~4.2 million gallons of fuel to be transported to the mine site annually. This transportation of fuel would pose a greater impact risk to wildlife and habitat from spills than would the power line option clearing. There would be only very local high direct or indirect impacts to birds or mammals from this option. Water discharge. Off-river treatment works would have few additional effects beyond those for the gravel pits because it would be constructed in the excavated pits.
4.10 Threatened and Endangered Species		
Power line. There would be no impacts on threatened or endangered species. For sensitive species, ROW clearing could cause loss of some raptor nest sites,	Power line. Same as Alternative 2.	On-site power generation. There would be no impacts on threatened or endangered species. There would be no power line ROW

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
depending on the route. Because portions of both routes would traverse forested habitats, there would be a collision risk for Northern Goshawks.		clearing impacts. Risks from fuel spills from substantial additional fuel transport would be the same as discussed above for wildlife.
4.11 Socioeconomics		
Power line. Greater long-term potential for supporting additional industrial/commercial activity, allowing mine developers or others to enjoy a substantial construction and operation cost savings compared to constructing a new power line or providing on-site generating capacity.	Power line. Same as Alternative 2.	On-site power generation. Would not provide the greater long-term potential for supporting additional industrial/commercial activities as would a power line.
4.12 Land Use		
Power line. Would benefit potential new commercial and industrial land uses.	Power line. Same as Alternative 2.	On-site power generation. This option could have a high impact on potential commercial and industrial users because mineral development could be slower without a power line to Pogo. Such development would need to haul fuel for on-site generation, or construct a power line.
4.13 Subsistence		
Power line. ROW clearing would create an access corridor for recreational as well as subsistence users, and could increase competition for subsistence resources. Mitigation measures could limit ROW access to some extent. If road use were open to everyone, however, the power line ROW would offer little advantage because it would follow closely the road alignment.	Power line. Same as Alternative 2. Direct discharge to Goodpaster. If this option were to cause impacts on fish and aquatic habitat from process upsets, facility failures, or bioaccumulation, it could lead to the same impacts on subsistence fisheries downstream as described for fuel storage in Table **A-1** (Options Common to all Alternatives).	On-site power generation. This option would require greater on-site fuel storage, and surface movement of approximately 4.2 million gallons of fuel annually. Fuel storage and transportation would substantially increase the risk of fuel spills at stream crossings and from transfers between tankers and storage tanks, raising the same concerns for downstream impacts to fish, fish habitat, and subsistence fisheries as described in Table A-1. Off-river treatment works. Same as Alternative 3. This option would have the capacity to provide up to 24 hours of holding time in case of upset conditions at the water treatment plant.
4.14 Cultural Resources		
Because adherence to cultural-resource protection procedures under CFR 800, Section 106, are the accepted process by which to mitigate impacts to cultural resources, no major impacts to cultural resources are expected.	Same as Alternative 2.	Same as Alternative 2.

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
4.15 Visual		
Power line. High visual impacts because of the scale, distance, and viewer recognition of power poles compared to on-site power generation.	Power line. Same as Alternative 2.	On-site power generation. This option would require additional 22.7 acres for fuel storage and laydown area at the airstrip. This use of additional acreage would have a low impact on views of recreationists on the Goodpaster River. Impacts would be very substantially less than for a power line.
4.16 Recreation		
Power line. Without mitigation the cleared ROW would provide backcountry access for both motorized and nonmotorized recreational users. This increased access would be high for existing and new recreational users. If road use open to everyone, however, power line ROW clearing would offer little advantage because it closely follows road alignment.	Power line. Same as Alternative 2.	On-site power generation. This option would cause a small increase in noise and other activity in the vicinity of the mine and access route due to the generators and the additional fuel transportation. This disturbance would have a low to moderate impact on primitive and semi-primitive motorized recreational opportunity spectrum (ROS) classes.
4.17 Safety		
Impacts would be low.	Same as Alternative 2.	Same as Alternative 2.
4.18 Technical and Economic Feasibility		
Tailings dry-stack liner. Permeabilities of the fine-grained dry-stack tailings themselves were not considered to be greatly different than permeabilities of an installed liner system. Also, most seepage that would occur from the dry stack would be captured by the RTP. Still, from strictly a water quality perspective, a lined tailings facility likely would provide some measure of increased impermeability and transmission of drainage to the RTP. From a tailings pile stability perspective, however, a liner would be more problematic. The original dry-stack tailings pile stability analysis assumed a worst case scenario that included saturation of the general tailings placement zone. It did not include saturation of the shell zone. Placement of an impermeable liner beneath the general placement zone likely would cause saturation of the tailings pile and result in occurrence of the worst case scenario, which was not the design intent. Thus, saturation caused by the impervious liner likely would increase stability risk.	Same as Alternative 2.	Same as Alternative 2.

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
Overall, there would be little benefit to water quality from installation of a liner under the dry-stack tailings pile, while there would be increased risk to stability from the liner. Installation of an erosion control/drainage blanket before tailings would be placed in the dry-stack tailings facility was predicted to have no effect on the dry stack's stability, but it would permit clearing and stockpiling of organic and soil growth media to insure a sufficient volume for reclamation. RTP liner. The primary purpose of the RTP would be to capture runoff and seepage from the dry-stack tailings facility consistently, reliably, thoroughly, and predictably, during both mine operations and post closure activities. Seepage from the dry stack would migrate downgradient below the surface, nearer the colluvium/weathered bedrock interface. An effective seepage interception and collection system would be needed to provide appropriate management of this subsurface flow. Given the nature of the flow system that would develop, the most effective interception system would be one perpendicular to the direction of subsurface flow, i.e., a cut-off wall. The proposed RTP dam face liner system and grout curtain would establish an effective interception cut-off wall to collect this seepage. The upstream toe of the dam face liner system would be embedded in a trench in weathered bedrock filled with grout, with a drilled curtain of pressure-grouted holes extending below the toe through the weathered bedrock layer and into fresh bedrock. ▪ A full liner under the RTP basin would not provide substantially better long term seepage collection and would introduce increased operational and performance risks for a number of reasons, including: ▪ A full basin liner would fail to collect the seepage at issue because the upstream toe of the liner would not have the robust cut-off wall required to collect the subsurface seepage. If such a cut-off wall at		

Table A-2 Summary of Direct and Indirect Effects of Options Specific to Alternatives, but Not Surface Access Related

Alternative 2	Alternative 3	Alternative 4
the upgradient end of the liner were required, it would follow that another liner upstream of that cut-off wall also would be needed, etc. It is thus a cut-off wall perpendicular to the flow that would be needed to capture seepage, not a liner. ▪ Due to the narrowness of Liese Creek Valley, and its steep slopes, hydrostatic uplifting forces from upwelling ground water beneath the liner could result in long-term liner instability, especially during periods when the RTP reservoir would be drawn down to provide storm surge volume. The nature of Liese Creek Valley geometry is such that a large portion of any full basin liner would be on very steep slopes. The south slopes of the reservoir exceed the maximum slopes recommended for effective liner installation (2.2 to 2.5 H to 1 V). A full basin liner thus would not completely capture the desired seepage and provide the long-term reliability necessary to manage dry-stack seepage. From the economic perspective, if a liner were feasible, a very rough estimate for the cost of a full basin liner under the RPT is approximately $1.5 million.		

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
4.1 Surface Water Hydrology		
Shaw Creek Hillside all-season road. During and immediately following construction, modifications to surface water hydrology could occur due to increased runoff volumes caused by vegetation removal and soil compaction. Increased flows could be mitigated by using stormwater runoff BMPs.	South Ridge all-season road. Same as Alternative 2.	Winter-only access. Same as Alternative 2, except for the tendency of ice roads to thaw later than surrounding areas, raising potential for blockage or rerouting of runoff flows during breakup. These effects would be localized and temporary.
4.2 Groundwater Hydrology		
No groundwater flow impacts were identified.	Same as Alternative 2.	Same as Alternative 2.
4.3 Water Quality		
Shaw Creek Hillside all-season road. Primary potential impact to water quality would be from a fuel or chemical spill during transport to the mine site. The likelihood of a major release would be low, but the potential impact from a large spill into surface waters would be high. The overall water quality impact of fuel and commodity transport by this access route would be moderate. Road use and disposition. Use by the Pogo project only would have the lowest potential for accidents and subsequent releases. With increased usage, the potential for a release would increase. Continued use after mine closure would cause spill risks to persist.	South Ridge all-season road. The likelihood of a major spill would be moderate, because of the more exposed conditions, ice, higher winds, and greater potential for whiteout conditions in winter. But, potential for an individual spill to affect a water body would be lower because of fewer wetlands and the road distance from active drainages. Overall water quality impact of commodity transport by this access route would be moderate. Road use and disposition. Same as Alternative 2.	Winter-only access. Because of the intense use of the road under difficult winter driving conditions, and the route's initial alignment through more wetlands, this option would have a high potential to impact water quality. Road use and disposition. Same as Alternative 2.
4.4 Air Quality		
Shaw Creek Hillside all-season road. No or low impacts. Small fugitive dust impact on adjacent vegetation. Road use. Restricting use of the road during Pogo operation would limit fugitive dust proportionally. Road disposition. If maintained, restricting use would limit fugitive dust proportionally. If removed and reclaimed, it would eliminate low fugitive dust impacts.	South Ridge all-season road. Same as Alternative 2. Road use. Same as Alternative 2. Road disposition. Same as Alternative 2.	Winter-only access. Seasonal use of the winter-only access segment would eliminate fugitive dust impacts in lower Shaw Creek Valley, and reduce them on the all-season road segment because it would be used only in winter.
4.5 Noise		
Shaw Creek Hillside all-season road. No major impacts were	South Ridge all-season road. No	Winter-only access. There would be no major noise

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
identified. Shaw Creek Road egress. Pogo-related impacts to Shaw Creek Road area residences would be low or moderate, with one exception that would be moderate to high. If the Applicant's shift-change bus station were near the TAPS crossing, two residences would experience a moderate to high impact and four would experience a high impact. If the bus station were located on the Richardson Highway, one residences would experience a moderate impact, three a moderate to high impact, and one a high impact. Road use and disposition. Additional traffic noise from allowing everyone to use the road during and after Pogo operations would cause only a small increase in impacts above the Pogo-related level, but would approach a high impact for one residence. Of the disposal options, only removal and reclamation would reduce impacts in a meaningful way.	major noise impacts on residents in the Quartz Lake and lower Goodpaster River areas were identified. Road use and disposition. Same as Alternative 2.	impacts.
4.6 Wetlands		
Road/power line surface disturbance. All-season road and power line would cut and fill ~120 acres and clear ~158 acres of wetlands, for a total of ~278 acres. Shaw Creek Hillside all-season road. Impacts would be high within each wetland complex through which the road passed, but would be dispersed along 49-mile route and focused on flat wetlands, which are the least valuable wetland type. Effects would be minor in the context of the Shaw Creek and Goodpaster drainages. Shaw Creek/Rosa egress. No impacts. Tenderfoot egress. No impacts. Road use. Use only by Pogo or other industrial or commercial users would cause minor impacts in context of Shaw and Goodpaster drainages. Use by everyone, particularly unregulated ATVs, would cause moderate impacts. Road disposition. Continued use only by industrial or commercial users would cause minor impacts. Use by everyone would cause high impacts in certain localities, but moderate within context of Shaw and Goodpaster drainages. Security gate at Gilles Creek. Same impacts as use by	Road/power line surface disturbance. All-season road and power line would cut and fill ~75 acres and clear ~119 acres of wetlands, for a total of ~194 acres. This would be ~84 fewer acres than Alternatives 2, with ~45 of the acres with less cut and fill. South Ridge all-season road. Same as Alternative 2. Road use. Same as Alternative 2, except road use by everyone would cause only minor impacts because less off-road ATV use in wetlands is expected. Road disposition. Same as Alternative 2, except road use by everyone would cause only minor impacts because less off-road ATV use in wetlands is expected. Power line. Same as Alternative 2.	Road surface disturbance. The winter-only access segment and all-season road segment, with no power line, would cut and fill ~103 acres and clear ~50 acres of wetlands, for a total of ~153 acres. This affected acreage would be ~125 and ~41 fewer acres than Alternatives 2 and 3 (including their power lines), respectively. Road/power line surface disturbance. Although Alternative 4 by definition has on-site power generation, the winter-only access option could be paired with a power line as the Preferred Alternative. In that case, the road and power line combined would cut and fill ~135 acres and clear ~211 acres of wetlands, for a total of ~ 346 acres. This affected acreage would be ~ 68 and ~152 more acres than Alternatives 2 and 3 (including their power lines), respectively. Winter road/trail construction standards. Under the traditional winter road option, a higher percentage of wetlands would only be cleared down to the organic mat, and would remain wetlands and retain their

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
everyone, but moderate impacts would be limited to area west of Gilles Creek. Power line. Would affect extensive area by clearing, but effects would be only minor because: most wetland functions would remain undisturbed or be affected to minor degree; disturbance would be primarily to lower value wetlands; and disturbed areas would be a minimal proportion of project area wetland resource. Sutton Creek. As a result of public comments on the DEIS, a new sub-option was considered with the power line following the road corridor over the Shaw Creek / Goodpaster divide rather than up Sutton Creek. Wetlands disturbance in the Sutton Creek segment would total approximately 4 acs. Because the boundaries between wetlands and uplands are more distinct along this route, the power line likely could be sited to avoid some of these wetlands. Wetlands disturbance if the power line were routed adjacent to the road over the divide would total approximately 6 acres. Because the power line would traverse primarily mosaics of wetlands/uplands along this route, wetlands would be more difficult to avoid. While fewer wetlands would be affected by the Sutton Creek route, the absolute difference would be small, and following the road route over the divide would remove all wetlands impacts from the Sutton Creek drainage.		functions. The perennial winter trail option, however, would cut or fill 24 more acres than the traditional winter road option because its construction method would cut the ground surface. Road use. By its seasonal nature, this alternative would be less likely to promote additional development and cause wetlands impacts in the Shaw Creek, Goodpaster, and adjacent drainages. Once the DOF road eventually reached the lower end of the all-season road segment south of Gilles Creek, however, impacts from road use would be the same as Alternative 2
4.7 Surface Disturbance		
Surface access. 770 acres for Shaw Creek Hillside route with Shaw Creek/Rosa egress option. 43 more acres with Tenderfoot egress option (total 813 acres). Power line. 602 acres for Shaw Creek Hillside route.	Surface access. 768 acres for South Ridge route. Power line. 525 acres for South Ridge route.	Surface access. 594 acres for Shaw Creek Flats winter-only access route. Power line. If a power line were paired with winter-only access, 600 acres would be cleared for the Shaw Creek Hillside route.
4.8 Fish and Aquatic Habitat		
Shaw Creek Hillside all-season road. Impacts none to low. Road use. If open to everyone, overall impacts low to moderate due to traffic volume and recreational activities. Boating in low flows on Goodpaster could disrupt spawning behavior and dislodge and suffocate eggs. Exhaust emissions	South Ridge all-season road. Same as Alternative 2, except even fewer impacts because only one stream crossing (Goodpaster River) and would completely avoid the Shaw	Winter-only access. Impacts would be higher than Alternatives 2 and 3 due to risk of accidents during the short winter transportation window, especially fuel spills, at or near stream crossings under severe winter conditions, and particularly on the steep divide between

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
pollute water and could disturb riparian habitat by undercutting banks through wake action. Increase in number of boats on the Goodpaster. Road disposition. Maintaining road open to everyone would have same impacts as for road use. Security gate location. Same impacts as for road use by everyone, except impacts would only occur in lower Shaw Creek Valley. Would eliminate impacts from angling and boating on the Goodpaster.	Creek drainage. Road use. Same as Alternative 2. Road disposition. Would differ from Alternative 2 because with no stream crossings other than the Goodpaster, removal and reclamation would still allow ATV access to the Goodpaster via cleared ROW for some time following reclamation. Such access likely would result in erosion problems as shown by historical ATV use.	Shaw Creek and Goodpaster drainages. An accident near the upper Shaw Creek or Goodpaster crossings could cause high impacts to overwintering fish during low flows of winter. Road use. This option initially would eliminate road use impacts by the public; however, this condition would last only until the DOF road eventually reached the lower end of the all-season road segment south of Gilles Creek. At that time, impacts from road use would be the same as Alternative 2 unless public use were restricted.

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
4.9 Wildlife		
Shaw Creek Hillside all-season road and power line. Habitat. Because the 1,372 combined acres of disturbance: would be linear in nature; have low or no impacts on rarer or uncommon habitat classes; are well represented within project area and interior Alaska; would affect few Conservation Priority Index lands; and have small impacts on high value habitat for large mammals, habitat loss would not be high. Also, the approximately 602 acres within the power line ROW would only be cleared of vegetation, with little actual surface disturbance. Birds. Primary direct impacts from collisions, with impacts high only on a local basis. There would be no major indirect impacts. Mammals. Primary direct impacts from vehicle collisions, particularly in winter. This mortality would be low. If road open for everyone, this mortality could be moderate only on a local basis. Indirect impacts would be low for most species. Brown bears and wolverines likely would avoid the road corridor other than for crossing. This avoidance would not cause major habitat fragmentation for these species. For marten, however, the road corridor likely would serve as more of an indirect behavioural barrier to movements and could cause some habitat fragmentation. Security gate at Gilles Creek. Impacts would be similar to those described above, but limited to lower two-thirds of Shaw Creek Valley. This reduction of public use would lower collision mortality. Power line route. The sub-option of following the road corridor over the Shaw Creek / Goodpaster divide, rather than separately up Sutton Creek, would have approximately the same habitat impact, but by consolidating the two corridors, as occurs for the large majority of the remainder of this alternative's route, it would remove all wildlife impacts from Sutton Creek with minimal additional impacts adjacent to the road.	South Ridge all-season road and power line. Habitat. Approximately 1,293 combined acres of disturbance would occur. Habitat impacts would be similar to Alternative 2, and would not be major. This alternative, however, would disturb roughly twice the acreage of high value habitats for moose, caribou, and brown bear than would Alternative 2. Birds. Direct and indirect impacts on birds would be the same as Alternative 2, except that bird-power line collisions likely would be higher because for approximately 25 miles it would be above timberline along the South Ridge. Mammals. Indirect impacts generally would be the same as Alternative 2. This alternative, however, would avoid the moose rutting area in Shaw Creek Valley, and its long run above timberline along the Shaw Creek and Goodpaster divide would not pose the same habitat fragmentation concern for marten as would Alternative 2.	Winter-only access. Habitat. Approximately 594 acres of disturbance would occur. Habitat impacts would be similar to Alternative 2, and would not be high. This alternative, however, would disturb only approximately 37 acres of high-value Conservation Priority Index lands in lower Shaw Creek Valley versus approximately 85 acres for Alternative 2. This alternative also would disturb approximately 54 percent less high value habitat than would Alternative 2. Birds. Direct and indirect impacts would be the same as for Alternative 2. Mammals. Direct impacts from collisions would more likely to occur than for Alternative 2 because of substantially greater winter traffic. These impacts would be locally low to moderate, depending on the particular winter. Indirect impacts would be similar to Alternative 2, but would be very small for approximately 9 months of the year. During the annual winter use period, however, vehicle noise and activity levels would be very high. This noise and activity would cause disturbance to moose, and caribou if they were in the vicinity, at a critical time (middle and late winter) when energy reserves are low. Road use. Would eliminate road use impacts by the public; however, this condition would last only until the DOF road eventually reached the lower end of the all-season road segment south of Gilles Creek. At that time, impacts from road use would be the same as for Alternative 2 unless public use were restricted.

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
4.10 Threatened and Endangered Species		
Shaw Creek Hillside all-season road. No impacts on threatened or endangered species. Sensitive species impacts would be low. Power line. Route would be in close proximity to three recently active Northern Goshawk nests, but would cross relatively little high-value goshawk habitat.	South Ridge all-season road. Same as Alternative 2. Power line. Route in close proximity to only one recently active Northern Goshawk nest, but would cross substantially more high value goshawk habitat.	Winter-only access. There would be no impacts on threatened or endangered species. Impacts on sensitive species would be low.
4.11 Socioeconomics		
Shaw Creek Hillside all-season road. More employees could reside in Delta area because work periods would be shorter and employees would be bused. Between ~100 and 135 of mine's 385 workers would live in Delta area and create another 30 to 40 jobs in local economy. Mine-related population would be between ~260 and 350 and have a substantial and positive local effect. Annual mine-related payroll in the Delta area would be between ~$7.2 million and $9.4 million. Effects on the local school system likely would be low, with a slight increase in demand for other public services. Effects on the housing market would be high, and generally positive. Road use and disposition. If open to industrial and commercial users, the road would increase access for other development, creating additional economic activity, population growth, and demand for public services. If open for everyone, the road would create more economic activity. In either case, local effects likely would be low.	South Ridge all-season road. Same as Alternative 2.	Winter-only access. Employees would work longer periods, have longer off-work periods, and be flown to and from site, allowing them to live more distant. Between ~40 and 80 workers would live in Delta area and create another 10 to 15 jobs in local economy. Mine-related population would be between ~100 and 190 and have a major and positive local effect. Annual mine-related payroll in the Delta area would be between ~$2.8 million and $5.7 million. Other effects would be the same as Alternative 2.
4.12 Land Use		
Shaw Creek Hillside all-season road. Land use impacts would be low because all uses would be compatible with adopted land use plans. Existing land uses, however, could be substantially *changed*. Richardson Hwy. Egress. Shaw Creek/Rosa option would substantially increase existing use of Shaw Creek Road, while Tenderfoot option would substantially *change* existing land use. Shaw Creek and Richardson Highway areas generally	South Ridge all-season road. Impacts would be similar to those for Alternative 2, except that the impacts to existing residential and other users near the Richardson Highway would occur in the vicinity of the highway near Quartz Lake rather than in Shaw Creek area.	Winter-only access. Impacts similar to those for Alternative 2, except as noted below. Road use. Access not as beneficial to potential commercial/industrial users. New development likely would be slower to develop than with an all-season road. If open to the public, because of its seasonal nature, it would be a benefit to existing residential and recreational users in the Shaw Creek and Goodpaster

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
would experience some increase in residential use and development with either option. Road use. Access could substantially benefit new commercial and industrial users. If open to public, it would provide access to large presently remote areas. Road disposition. Reclaiming the road could be a substantial impact to new commercial/industrial land uses that occurred because of initial road construction, but existing land uses along Shaw Creek Road would not be substantially affected. If open to the public during project operation, reclaiming would be substantial impact to new recreational users, and any service businesses that developed to support new backcountry users. Security gate location. Limiting public access to south of Gilles Creek would substantially reduce likely changes to existing land uses beyond Gilles Creek. DOF road. This road would not be built if the Shaw Creek Hillside all-season road were constructed.	DOF road. Planned road into the Indian Creek area could cause moderate *changes* in land use (e.g., timber harvesting in presently uncut areas), but harvests would be compatible with existing land use plans.	valleys, including the Goodpaster cabin owners, because users would be able to access the upper reaches of the Shaw Creek and Goodpaster drainages only in winter, which they largely can do now. Trappers, commercial sled dog tour operators, and other backcountry users also would consider winter-only access less of an impact. Potential recreational users, however, would not have increased access to more remote areas during the 9 months when the perennial winter trail would be impassable. DOF road. If the winter-only access option were constructed, the DOF forestry road would be built and eventually would connect with the southern end of the all-season road segment of this winter-only access option. Because the DOF road would be open for public use, all impacts discussed in Alternative 2 likely would occur at least to the point south of Gilles Creek where the roads would connect.
4.13 Subsistence		
Shaw Creek Hillside all-season road. Road itself would have a low effect on the availability of subsistence resources. Road use and disposition. Least access into Shaw Creek and upper Goodpaster River drainages would have fewest impacts. Use by everyone would open inaccessible areas to the general public. If sport hunters and other recreationists were able to cross the Goodpaster River, it could ease problems of reaching high country north and northeast of Healy Lake. It would create substantially increased access and competition for a long time period over a potentially large geographic area. This impact would be major within the local and regional context for present-day subsistence hunters. Recent subsistence use areas, however, are substantially larger than the immediate area of the all-season road. Traditional users may avoid the area because of the road and traffic. Thus, the road has potential to be regarded as a loss of a part of one's homeland for hunting, not necessarily the	South Ridge all-season road. Same as Alternative 2, except that subsistence use patterns along the South Ridge route are slightly different.	Winter-only access. Would not allow all-season road access to upper Shaw Creek and the mid-Goodpaster River Valley, thus substantially limiting potential subsistence impacts from increased recreational and other subsistence users. The Shaw Creek Flats portion of the route would cross wetlands and recent and traditional subsistence use areas. Any fuel or cyanide accidents on the flats resulting in resource damage, decline, displacement, or contamination would affect availability to subsistence users, and contamination concerns could lead to reduced resource consumption and years of wondering if the resources from the area as well as "downstream" were safe to eat. Although road use by the public could be restricted on the winter-only access segment on Shaw Creek Flats, as the DOF road, which would be open to the public, was extended toward Gilles Creek, subsistence impacts from public use would begin to approach those

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
primary or most used hunting area, but one that was historically and is currently used. Security gate location. Would limit impacts to lower Shaw Creek Valley. Richardson highway egress. Little difference in effects between Tenderfoot and existing Shaw Creek Road options. Power line. Little or no additional impacts to those of road.		described for Alternative 2,
4.14 Cultural Resources		
Shaw Creek Hillside all-season road. Because adherence to cultural resource protection procedures under CFR 800, Section 106, are the accepted process by which to mitigate impacts to cultural resources, no major impacts to cultural resources are expected from direct project development. Road use and disposition. Additional road users would increase the likelihood that surface artifacts would be more vulnerable to looting and other types of damage.	South Ridge all-season road. Same as Alternative 2.	Winter-only access. Same as Alternative 2, except limited seasonal access would decrease human presence considerably and surface artifacts and other cultural resources would be less vulnerable to looting and other types of damage.
4.15 Visual		
Shaw Creek Hillside all-season road and power line. Routes would be along lower elevations of the hillside and would have low impacts as viewed from Richardson Highway. They still would be evident to backcountry users and airborne viewers. Impacts would be high to some Shaw Creek Road residents because of the close viewing distance and the substantial contrast to the natural landforms of the hillside. The Goodpaster River Bridge, and the power line, would have high visual impacts to viewers on the river near the mine site. Richardson highway Egress. Tenderfoot egress option is located in a low visual absorption capability area. Development of this option would have moderate to high impacts on the visual resources because of high viewer sensitivity. There would be no impacts with the Shaw Creek Road/Rosa option. Road use. Impacts would be low from use only by Pogo-related traffic. If other users, there would be greater disturbances (light and dust) potentially viewable for longer periods. There also would be an increase in vehicle lights	South Ridge all-season road and power line. More visible higher elevations along this route would have moderate to high impacts due to the low visual absorption capability and the sensitivity of viewers. Impacts would be considered high to Goodpaster River cabin owners and Goodpaster River Winter Trail users. Road corridor would not be visible from Quartz Lake; however, the power line would be somewhat visible from the lake at a distance of ~2 miles. Road use. Because this alternative would have higher visual impacts than Alternative 2, use by others than the Pogo project would have correspondingly greater impacts than Alternative 2.	Winter-only access. The Shaw Creek Flats route would not be visible from the Richardson Highway because of the low elevation of the flats and its high visual absorption capability. Overall impacts would be low. Road Use. Use by other than the Pogo project would have low visual impacts because of the nature of a winter-only access and its limited window of operations. Road disposition. Impacts for the all-season road segment would be the same as Alternative 2. The Shaw Creek Flats winter-only access segment simply would not be used again for Pogo purposes and would be available for use by anyone, much as a majority of the route is today.

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
during periods of low natural daylight, particularly in winter. Road disposition. Removal of road and power line would have fewest impacts on visual resources. Current visual appearance would be restored as vegetation reclaimed the corridor. Other options would have an increasing impact in ascending order of industrial/commercial users and open to everyone.	Road disposition. Same as for Alternative 2, except that because the visual impacts of this alternative would be greater, they would remain longer before vegetation obscured them.	
4.16 Recreation		
Richardson Highway Egress. The Shaw Creek/Rosa option would have low impacts on existing or prospective recreation users. Tenderfoot would have a high positive effect on potential recreational users because route presently is undeveloped. Road use and disposition. Use by Pogo and other industrial or commercial users only, and removal and reclamation, would have a high impact on prospective motorized recreational users, but would have a low impact on existing recreational users. Permanent access for everyone would have a high impact on existing recreational users desiring remote recreational experiences. The Goodpaster Bridge could become a popular launching site for floaters and fishers and bring them into the lower river and past these cabins. This could change the present relative isolation of the cabins, and could cause changes in fishing bag and size limits, and an increase in littering and vandalism. Security gate location. Same impacts as use by everyone, except impacts would occur only lower Shaw Creek Valley. Impacts to Goodpaster recreational cabin owners and other existing recreational users north of Gilles Creek would not occur. Potential recreational users, however, would not receive the benefits of easy access to the mid-Goodpaster River	Road use and disposition. Same as Alternative 2, except there would be somewhat more impacts on the Goodpaster Valley recreational cabin owners because parts of the access road would be visible from the cabins.	Winter-only access. Road use. If use limited to Pogo-related traffic, or other industrial/commercial users, it would lower the quality of existing nonmotorized recreational experiences, but this would be limited to the area of the road corridor. Because this alternative would reduce new recreational motorized vehicles, it would not affect traditional recreational experiences in the primitive and semi-primitive motorized areas as much. Snow machines still would use traditional routes to access these areas, however. There would be few impacts on recreational cabin owners on the lower Goodpaster River because the Goodpaster River Bridge would not be accessible to floaters and fishers as would occur for Alternatives 2 and 3. Although road use by the public could be restricted on the winter-only access segment on Shaw Creek Flats, as the DOF road, which would be open to the public, was extended toward Gilles Creek, recreational impacts from public use would begin to approach those described for Alternative 2
4.17 Safety		
Shaw Creek Road egress. This option would cause some safety risk for the six year-round residences along the road. Overall, mine-related vehicle use would average between 10	No safety impacts were identified for this option. Safety issues similar to Shaw Creek Road (due to	Winter-only access. Would require moving large volumes of supplies during a relatively short window under very cold and dark conditions that would be more

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
and 20 round trips per day. During intense periods of mine construction, traffic would average ~50 vehicles per day. If the Applicant's shift-change bus station were located near the TAPS crossing, there would be two, approximately one-hour periods every 4 days, during each of which up to 180 vehicles would traverse the road. If the bus station were located on the Richardson Highway, the number of vehicles during each of these periods would be reduced to approximately six buses. The former location option would have a higher safety risk along Shaw Creek Road than would the latter location. Shaw Creek Road is relatively narrow at present, but is well maintained and has been improved recently. The State of Alaska has reviewed expected traffic volumes and vehicle sizes, including logging truck traffic from proposed DOF timber sales and shift change traffic, and believes Shaw Creek Road can accommodate this traffic safely. Because the road could be upgraded in the future if necessary, speed limits could be adjusted if appropriate, and the Applicant's policy would be to adhere to all speed limits, the safety risk from Pogo-related traffic would be low. DOT/PF may have to conduct a traffic impacts analysis, in conjunction with issuance of a drive way permit, which may result in specific mitigation measures being required. Tenderfoot egress. This option would have low safety impacts. Its use would eliminate the Shaw Creek Road safety issue. Road use. Opening the road to other users would cause a small increase in the safety risk to residents identified above. The increased risk would be due to more traffic (public and logging operations), and because typical users likely would not be as observant of speed limits as would drivers under specific direction from the Applicant. The safety risk, while increased, would still be low. Road disposition. If road were to remain open to other users after mine closure, this safety risk would continue. Security gate location. A security gate near the end of Shaw Creek Road would restrict public use and impacts would be low. A gate at Gilles Creek likely would result in considerably	recreational traffic, there is actually more non-mine traffic on the Quartz Lake road. The State made these comments on Chapter 5 as well and they should be included in both places)	likely to cause accidents. While the safety risk would be low, it would be tangible and higher than that associated with an all-season road. Road use. If winter-only access were open to everyone, there would be a moderate safety risk. Maintaining traffic control under these conditions just for Pogo project trucks would be a challenge. If other users were to be on the winter road/trail at the same time, the chances of an accident, particularly with a snow machine, would be substantially higher.

Table A-3 Summary of Direct and Indirect Effects of Surface Access Related Options Specific to Alternatives

Alternative 2 (Shaw Creek Hillside)	Alternative 3 (South Ridge Corridor)	Alternative 4 (Shaw Creek Flats Winter-Only Access)
more traffic than a gate near the end of Shaw Creek Road. Safety impacts, however, still would be low.		
4.18 Technical and Economic Feasibility		
Tenderfoot egress. While constructible, the route would cross difficult terrain, with poor soils and likely permafrost. Deep incised gullies indicate loess deposits that would require deep side hill cuts. Ascent and decent segments would require 5 to 7 percent grades for approximately 1.5 miles on each side of the ridge. Switchbacks would be required, with several curves having a radius less than the design criterion for 500 feet, and possibly less than the minimum of 300 feet. This option would require construction of an essentially new, ~3.5-mile road to the vicinity of end of existing Shaw Creek Road. A reasonable construction cost estimate is ~$2.5 million to $3.0 million to avoid using the existing Shaw Creek Road.	South Ridge all-season road. Soil and topography conditions along the first several miles of this route are difficult. They are characterized by steep slopes, many small drainages, and probable ice-rich soils, compared with good terrain and soil conditions on the Shaw Creek Hillside route. The steep slopes and angular talus in the vicinity of Shaw Creek Dome along the South Ridge route likely would make construction difficult. The elevated and exposed terrain, and severe winds experienced in the Delta region, would make maintenance more difficult and driving more hazardous, especially in blowing snow conditions. This route would be expected to be available for use approximately 10 fewer days than would the Shaw Creek Hillside route.	Technical feasibility. The focus of this issue is whether annual winter-only access would be feasible for mine life. Applicant estimates adequate winter supply window would be absent once in 13 years. Recent data confirming long-term climate warming in central Alaska may mean Applicant's estimate is optimistic. Economic feasibility. Constructing, operating, and reclaiming a remote mine dependent on only 8 to 10 weeks of annual surface access for major resupply, with reliance of air support into a 3,000-foot airstrip for remainder of year, raises many economic feasibility issues. ▪ Short window for mobilization of construction equipment and supplies for construction of all-season road segment ▪ Annual resupply of year's worth of fuel and supplies must occur during 8- to 10-week window. Rest of year project dependent solely on logistical air support ▪ Capital costs estimated at 53 percent higher. ▪ Annualized operating costs at 118 percent higher Winter-only access would add substantial capital and operating costs and increase the project's economic burden, and introduce an unreasonable level of complexity and business risk. This increased economic burden and unreasonable business risk were considered to have a major impact on the project's economic feasibility.

Table A-4 Summary of Cumulative Impacts

All Season Road Removed and Reclaimed at Mine Closure	All Season Road Maintained at Mine Closure for Other Resource Development Purposes and Public Use
4.1 Surface Water Hydrology	
Absence of an all-season road would limit other resource development activities and human use, and would result in very low cumulative impacts on hydrologic flow regimes of surface water.	Development of timber resources, mining, and public recreational and other uses all would have potential impacts on the surface water hydrologic regime that could be cumulative with the activities of the Pogo Mine project. Extension of the life of the Pogo project, development of hypothetical Sonora Creek and Slate Creek mines, or other resource developments occurring because of continued existence of an all-season road, individually would cause surface hydrologic impacts of a nature and magnitude similar to those from the proposed Pogo Mine project. Given their likely physical separation in different watersheds, the State of Alaska's management and regulatory tools, and the individual small impacts to the surface water hydrologic system, these mines and other resource developments would have low cumulative impacts on hydrologic flow regimes of surface water.
4.2 Groundwater Hydrology	
Absence of an all-season road would limit other resource development activities and human use and would result in very low cumulative impacts on ground water.	Cumulative impacts on groundwater resources in the area could result from development associated with timber harvesting, extension of Pogo Mine life, and development of the hypothetical Sonora Creek or Slate Creek mines. Assuming sound management practices and permitting stipulations, and because such development activities would be distributed over such a large area, there would be low cumulative impacts on ground water.
4.3 Water Quality	
Absence of an all-season road would limit other resource development activities and human use, and would result in very low cumulative impacts on water quality.	Cumulative impacts on water quality could result from increased traffic associated with timber harvesting, extension of Pogo Mine life, and development of the hypothetical Sonora Creek or Slate Creek mines. During road extension construction, disturbed surfaces could erode and increase sediment in runoff that could cause increased suspended sediment in waterways. Such increased sediment and turbidity levels would be temporary and could be mitigated by the proper use of BMPs during construction and revegetation. These impacts cumulatively would be small. Additional transport of fuel, chemicals, and ore would increase risk of an accident and subsequent release that could affect water quality. The degree of increased risk would be proportional to the increase in commodity transport. If discharges from the hypothetical mines were similar to those projected from the Pogo Mine, slight increases in concentrations of a few parameters could occur, but the differences would be difficult to detect under most flow conditions. Overall, water quality cumulative impacts from maintaining the road would be low.
4.4 Air Quality	
Absence of an all-season road would limit other resource development activities and human use, and would result in essentially no cumulative impacts on air quality other than those of fugitive dust associated with road reclamation.	Although there would be minute impacts in the general area of any other developed project as a result of long-range transport of air pollutants, the distances between projects likely would be such that air quality emissions of any one project would not affect the ability of any other projects to be permitted. The permitting processes are used to ensure that cumulative impacts of new as well as existing projects do not result in exceeding the National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards. The construction and use of new access roads to the hypothetical Sonora Creek and Slate Creek mines would generate additional fugitive dust during construction and operation of the roads themselves as well as other facilities associated with these hypothetical projects. Fugitive dust also would be generated by an airstrip associated with a new Slate Creek mine. Such fugitive dust impacts would be small and limited to the local

Table A-4 Summary of Cumulative Impacts

All Season Road Removed and Reclaimed at Mine Closure	All Season Road Maintained at Mine Closure for Other Resource Development Purposes and Public Use
	area. Overall, air quality cumulative impacts from maintaining the all-season road would be very low.
4.5 Noise	
Absence of an all-season road would limit other resource development activities and human use, and would result in essentially no cumulative noise impacts other than those associated with road reclamation.	The primary area for cumulative noise impacts concern would be at the residences located along the existing Shaw Creek Road. With continued all-season road operation, it would be possible that traffic could increase substantially over time from logging, other industrial/commercial developments, and a road be open to the public. For a least one residence on Shaw Creek Road, this cumulative increase could approach a high impact In other areas, noise from road use and scattered developments is not projected to result in any high local long-term noise impacts. There may be times in certain areas, however, when cumulative noise from different sources could result in a substantial, temporary short-term noise level increase.
4.6 Wetlands	
Absence of an all-season road would limit other resource development activities and human access. Cumulative wetland impacts to the time the road was removed would include those from the Pogo project itself, the road to the mine, and off-road ATV use from the road. These impacts would be moderate with the Shaw Creek Hillside all-season road and low with the South Ridge all-season road, in the context of the Shaw and Goodpaster drainages.	Mine developments such as a hypothetical Sonora Creek mine would increase wetland impacts, but the location of the hypothetical mine close to the Pogo project's infrastructure would limit those impacts to an assumed 75 acres. A hypothetical Slate Creek mine accessed by extension of the Pogo all-season road would directly eliminate an assumed additional 200 acres of wetlands, including some of high value in the Goodpaster River Valley. Impacts would be limited through permitting processes. The maintained road would accelerate timber harvests. Although these harvests would focus on uplands, roads would require some wetland crossings, including impacts to valuable slope and riverine wetlands. Effects would be greater with a Shaw Creek Hillside all-season road than with a South Ridge all-season road because more timber harvests likely would occur in the Shaw Creek drainage, which contains more wetlands. An all-season road open to everyone would cause a moderate cumulative impact to wetlands in the Shaw Creek and Goodpaster River drainages. A few hundred acres of wetlands would be eliminated; a few hundred more would be slightly degraded by proximity to commercial and industrial structures and activity; and more would be severely degraded by recreational and subsistence activities, particularly those employing ATVs. While the impacts would affect a small proportion of the wetlands in the Shaw and Goodpaster drainages, the effects would be detectible on the scale of those drainages. Wetland impacts related to residential and commercial land development near the Richardson Highway would continue to be stimulated by ongoing resource extraction and public use activities associated with the road.
4.7 Surface Disturbance	
Not applicable.	Not applicable.
4.8 Fish and Aquatic Habitat	
Absence of an all-season road would limit other resource development activities and human use, and would result in essentially no cumulative impacts to fish and aquatic habitat.	Direct and indirect cumulative impacts would occur from extraction of timber and mineral resources, and increased recreational use from access opportunities and population growth. Although impacts could be minimal in any one occurrence, over time these impacts cumulatively would result in habitat loss and smaller, though still viable, fish populations. The brunt of this cumulative impact would fall on recreational users of the Goodpaster River through more restrictive regulations on fish harvest and possibly access. Additional mineral development would increase risks due to land disturbance and upsets from accidents and natural events. A hypothetical Slate Creek mine would involve an additional 25 miles of road on the

Table A-4 Summary of Cumulative Impacts

All Season Road Removed and Reclaimed at Mine Closure	All Season Road Maintained at Mine Closure for Other Resource Development Purposes and Public Use
	Goodpaster River Valley floor adjacent to the river. Proper design, construction, and permitting stipulations, as well as State of Alaska management practices, could mitigate such risks. Overall, cumulative impacts would be moderate, and high only locally.
4.9 Wildlife	
Absence of an all-season road would reduce considerably resource development and related direct and indirect cumulative impacts on wildlife, particularly caribou.	Cumulative direct impacts to habitat, birds, and mammals under the TBAP from scattered timber and mining resource developments could be high on a scattered local basis, but would be low in the context of the Shaw Creek and Goodpaster River valleys. If these developments were connected by an all-season road it likely would increase resource development further, which could have a moderate cumulative indirect habitat effect on some wildlife species. A likely effect of increasing mineral exploration and development activity would be harassment of wildlife by aircraft, both intentional as well as unintentional, particularly by low-flying helicopters. In combination with general, nonmineral-related aviation, and the U.S. Air Force's aerial combat training, these activities could substantially increase cumulative impacts on caribou. Of particular concern would be disturbance to the Fortymile Caribou Herd during its critical calving period. Extension of an all-season road to a hypothetical Slate Creek mine would expand year-round human activities and push the perimeter of habitat fragmentation to the edge of the herd's summer range. It is not possible to predict the degree of cumulative indirect habitat loss because road extensions and developments are only speculative; however, based on the likely mineral potential of the area, the State of Alaska's constitutional directive to develop its resources, the existing TBAP, and the history of Alaska road development in general, additional cumulative indirect impacts would be very likely.
4.10 Threatened and Endangered Species	
There would be no cumulative impacts on threatened or endangered species. Absence of an all-season road would substantially reduce cumulative impacts on sensitive species.	There would be no cumulative impacts on threatened or endangered species. Cumulative impacts on sensitive species would occur, especially if the road were extended to a hypothetical Slate Creek mine. The degree of cumulative impacts is not possible to predict because future developments are speculative.
4.11 Socioeconomics	
Absence of an all-season road would lower the probability for other resource developments in the project area, and could slow long-term economic growth based on such development.	By end of decade, with construction of the NMDS and/or a natural gas pipeline and the Pogo Mine, a cumulative total of between ~430 and 605 new permanent jobs could be added to the local economy for substantial positive economic effect. Most of the increase would be due to NMDS. Total Delta area population would rise to ~2,300 to 2,400. Pogo would directly or indirectly account for between 11 and 15 percent of population, a substantial effect. Estimated personal Delta area income would increase from ~$45 million in 2000 to ~$52 million to $54 million. The cumulative effect on local schools could be substantial, and demand for other public services also would increase, though not necessarily at a rate proportional to population increase. Although housing availability could be tight during NMDS construction, longer term cumulative effects on local housing market generally would be positive, resulting in increased valuations and additional housing

Table A-4 Summary of Cumulative Impacts

All Season Road Removed and Reclaimed at Mine Closure	All Season Road Maintained at Mine Closure for Other Resource Development Purposes and Public Use
	construction. At the same time, local rental rates could rise.
4.12 Land Use	
Absence of an all-season road would limit other resource development activities and human use, and would change then existing land uses by removing the access that had allowed for mining development.	Cumulative impacts would be low because all uses likely would be compatible with adopted land use plans. *Changes* to existing land uses, however, could be substantial. A road to a hypothetical Slate Creek mine likely would cause changes to existing land use even though such change would be compatible with adopted land use plans. Remote reaches of the upper Goodpaster River would become more economically accessible to new commercial/industrial land uses, possibly opening up other adjacent mining areas in the future. Existing trappers, recreationists, and other users of the area likely would consider such infrastructure a substantial change to existing land uses, while new commercial and industrial land users would consider such infrastructure a substantial benefit.
4.13 Subsistence	
Absence of an all-season road would considerably reduce resource development and recreational access to subsistence use areas that are currently difficult to access, and thus would have substantially fewer cumulative impacts.	Direct subsistence impacts of a hypothetical Sonora Creek mine would be similar to those for the Pogo Mine because of its closeness to the Pogo Mine infrastructure. A Slate Creek mine near the headwaters of the Goodpaster River accessed by an all-season road would provide even greater access into a currently inaccessible area, especially if open to use by everyone. Such a road would extend well inside the edge of the Fortymile Caribou Herd's recent annual range. Road extension into the herd's range is a particular concern of subsistence users. With the exception of caribou and moose, however, the area between the Pogo Mine site and a hypothetical Slate Creek mine site is outside recent subsistence use areas. Although a road to such a mine would not in itself have a high impact on current subsistence uses because it is outside of current subsistence use areas, subsistence users likely would perceive it as a further cumulative encroachment of the "wilderness" to the north and another step toward connecting to the Taylor Highway and "surrounding" the village of Healy Lake with roads and modernization. Construction of a new road represents a classic fear of cumulative impacts from a road, because, in the view of the subsistence workshop attendees, "roads beget more roads." The land use policies that would permit a road to the Pogo Mine site could do likewise for other resource developments, and through Alaska Industrial Development and Export Authority or another vehicle might even help fund more roads. Thus, maintaining an all-season road could have a major cumulative impact on subsistence resources. These impacts, however, could be mitigated if the State of Alaska undertook appropriate land and resource management policies for the area that would limit public access to, and impacts on, subsistence resources.
4.14 Cultural Resources	
Absence of an all-season road would decrease human presence considerably, and surface artifacts and other cultural resources would be less vulnerable to looting and other types of damage.	No major cumulative impacts would be expected from major developments because adherence to cultural-resource protection procedures under CFR 800, Section 106, would be required. Because additional road users would increase the likelihood that surface artifacts would be more vulnerable to looting and other types of damage if the road were maintained after Pogo Mine closure, cumulative impacts could be increased. If a road to a hypothetical Slate Creek mine were open to public use, the potential for impacts to cultural resources would further increase.

Table A-4 Summary of Cumulative Impacts

All Season Road Removed and Reclaimed at Mine Closure	All Season Road Maintained at Mine Closure for Other Resource Development Purposes and Public Use
4.15 Visual	
Removal and reclamation of the all-season road would result in a slow restoration process as vegetation reclaimed the corridor over time, and there would be no or low cumulative visual impacts.	Hypothetical mines developed because the all-season road was maintained would cumulatively contribute to visual impacts because of natural vegetation clearing for surface and air access, power, and other mine-related facilities. A road extension from Pogo to a hypothetical Sonora Creek mine would be minimally visible from the Goodpaster River, and would have low visual impacts for river users. Because of its relatively short length and location close to the substantial Pogo infrastructure, the road extension also would have low visual impact to airborne viewers. Visual impacts from mine site facilities themselves would be major only to ground viewers within the context of the Sonora Creek drainage, but would be low in a larger context to airborne viewers because of proximity of the facilities to the substantial Pogo infrastructure. A road extension up the Goodpaster Valley to a hypothetical Slate Creek mine could have a high visual impact to floaters on the river, as well as airborne viewers, in the context of the upper Goodpaster Valley. Visual impacts from mine site facilities themselves would be high to ground viewers within the context of the Slate Creek drainage. In conjunction with a road up the Goodpaster Valley, these facilities would have a high visual impact to airborne viewers within the context of the upper Goodpaster Valley.
4.16 Recreation	
Although removal and reclamation of the all-season road would result in a definite impact on new recreational users, there would be no cumulative impacts because there were no other current or foreseeable future actions identified that also would reduce access for recreation in the project area.	Pogo mining activities, as well at the potential for extending the life of the Pogo project and the hypothetical Sonora Creek and Slate Creek mines, would substantially affect ROS classes in these areas. Primitive and semi-primitive motorized ROS classes would change to semi-primitive motorized and roaded natural. If the road were maintained and open to public use, and if additional mines or other developments occurred farther up the Goodpaster Valley, recreational access would increase to these locations. Thus, road maintenance and public use could have a high cumulative recreational impact on existing recreational users as well as a high beneficial cumulative recreational benefit to prospective recreational users.
4.17 Safety	
Removal and reclamation of the all-season road would have no cumulative impacts on safety because there were no other current or foreseeable future actions identified that also would reduce safety issues in the Shaw Creek Road area.	If the Shaw Creek Road egress option were used and the road were open for use by everyone, there could be a cumulative safety impact on residences along Shaw Creek Road from public use and timber harvest-related traffic in addition to use by the Pogo project. If this status were maintained after mine closure, cumulative safety impacts likely would increase if other major developments were to occur and public use were to intensify. These impacts could be mitigated by the Alaska Department of Transportation and Public Facilities' traffic management measures on both existing Shaw Creek Road and the all-season road
4.18 Technical and Economic Feasibility	
Not applicable.	Not applicable.