U.S. Department of the Interior
Bureau of Land Management

Ambler Road

Environmental Impact Statement

DRAFT

Volume 1: Chapters 1–3, Appendices A–F

August 2019

Prepared by:
U.S. Department of the Interior
Bureau of Land Management

In Cooperation with:
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Environmental Protection Agency
Alatna Village Council
Allakaket Tribal Council (representing Allakaket Village)
Hughes Traditional Council (representing Hughes Village)
Noorvik Native Community
Northwest Arctic Borough
State of Alaska Department of Natural Resources

Participating Agencies:
Federal Highway Administration
National Park Service
U.S. Fish and Wildlife Service

Estimated Total Costs Associated with Developing and Producing this EIS: $3,002,358

Mission

Sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Cover Photo: Looking north at the Brooks Range from the Alatna Hills. Photo by Crystal Glassburn (BLM).

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Ambler Road Environmental Impact Statement

Responsible agency: United States Department of the Interior (DOI), Bureau of Land Management (BLM)

Document status: (x) Draft ( ) Final

Abstract: The BLM has prepared the Ambler Road Draft Environmental Impact Statement (EIS) in response to an application for an industrial road right-of-way (ROW) in north-central Alaska across federal public lands and other lands. The road would run from the existing Dalton Highway to the Ambler Mining District (District). The area involved lies between the Brooks Range and the Yukon River and between the Dalton Highway (to the east) and the Purcell Mountains (to the west). The Alaska Industrial Development and Export Authority (AIDEA), a public corporation of the State of Alaska, is the applicant.

BLM's proposed federal action is approval of the requested 50-year ROW. BLM's purpose is approval of a ROW grant that provides for technically and economically practical and feasible year-round industrial surface transportation access in support of mining exploration and development, and for construction, operation, and maintenance of facilities associated with that access. The need for the BLM action results from a requirement under the Federal Land Policy and Management Act for the BLM to consider such applications. AIDEA's purpose for this project is to support mineral resource exploration and development in the District. AIDEA indicates that surface transportation would help bring high-value mineral resources into production.

The BLM has evaluated 4 alternatives:

1) The No Action Alternative is a benchmark against which other alternatives are evaluated.
2) Alternative A is the applicant's proposed alignment. It begins at Milepost (MP) 161 of the Dalton Highway and runs 211 miles almost directly west, terminating at the Ambler River. It would use approximately 3,500 acres of federal public lands managed by the DOI (Gates of the Arctic National Park and Preserve [GAAR] and BLM-managed lands).
3) Alternative B shares much of its alignment with Alternative A, with the same termini. It runs 228 miles and would use approximately 3,100 acres of federal public lands managed by the DOI. While Alternatives A and B are separate alternatives, they share an alignment except in their approach and crossing of GAAR.
4) Alternative C begins at MP 59.5 of the Dalton Highway and runs generally northwest 332 miles and terminates at the Ambler River. It would use approximately 19,100 acres of federal public lands managed by the DOI.

Congress, in creating GAAR, authorized a road crossing of the Preserve (Alaska National Interest Land Conservation Act, 1980). Among the larger issues evaluated in the Draft EIS are effects of the road on water resources and wetlands; caribou, fish, and their habitats; subsistence and communities; transportation and access; and special designation lands. The Draft EIS also evaluates the indirect and cumulative effects of a mining scenario deemed reasonable to occur if the road is authorized.

Review period: The BLM is accepting comments for 45 days following publication of the U.S. Environmental Protection Agency's Notice of Availability in the *Federal Register*.

For further information, contact:

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Alaska State Office
222 West Seventh Avenue, #13
Anchorage, Alaska 99513-7504
http://www.blm.gov/ak

August 2019

Dear Reader:

Enclosed is the Ambler Road Project Draft Environmental Impact Statement (EIS). The Bureau of Land Management (BLM) prepared this Draft EIS in consultation with federal, state, and local cooperating agencies in accordance with the National Environmental Policy Act of 1969, as amended, and the Federal Land Policy and Management Act of 1976, as amended; implementing regulations; and other applicable law and policy. The Draft EIS provides the BLM's analysis of the project and disclosure of potential impacts.

The Ambler Road Project is a proposal of the Alaska Industrial Development and Export Authority (AIDEA), a State of Alaska public corporation. AIDEA proposed a new 211-mile-long industrial access road from the existing Dalton Highway to the Ambler Mining District in north-central Alaska. The Draft EIS is part of the BLM's process of responding to AIDEA's application for a right-of-way to cross federal public lands for a 50-year term. AIDEA proposed the industrial road to facilitate mining exploration and development. The decision to be made from this EIS process is whether BLM will authorize the project, in whole or in part, based on the analysis contained in this Draft EIS, as well as other state and federal permit review processes.

The BLM encourages the public to review and provide comments on the Draft EIS. The BLM is particularly seeking constructive feedback regarding the adequacy of the alternatives considered and the analysis of direct, indirect, and cumulative impacts. The BLM is interested in any new information that would help the agency produce the Final EIS, which will aid decision makers in selecting an alternative and providing stipulations related to the proposal.

Comments will be accepted for 45 calendar days following publication of the U.S. Environmental Protection Agency's Notice of Availability in the *Federal Register*. Please submit comments and any resource information within the review period.

The Draft EIS is available for review online on the project website at www.blm.gov/AmblerRoadEIS. Paper copies are also available for public review as the following locations:

BLM Alaska State Office, Public Information Center (Public Room)
222 West 7th Avenue
Anchorage, Alaska 99513

BLM Fairbanks District Office
222 University Avenue
Fairbanks, Alaska 99709

Comments may be submitted electronically, by mail or in person. To facilitate analysis of comments and information submitted, the BLM encourages you to submit comments in an electronic format.

Electronically: www.blm.gov/alaska/AmblerEIS

Email: BLM_AK_AKSO_Amblerroad_Comments@blm.gov

Mail or Hand-deliver: Ambler Road EIS Comments, BLM Public Room, 222 West 7th Avenue, Anchorage, Alaska 99513

Your review and comments are critical to the success of BLM decision making. We request that you make your comments as specific as possible. Comments are most helpful if they include suggested changes, data sources, or analysis methods and refer to a section or page number. Comments containing only opinion or preference will be considered as part of the decision-making process but will not receive a formal response from the BLM.

Before including your address, phone number, email address, or other personal identifying information in your comment, be advised that your entire comment — including your identifying information — may be made publicly available at any time. While you may ask us in your comments to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Public meetings and hearings will be held at various locations in the project area and in Fairbanks and Anchorage, with opportunities to submit comments and seek additional information. The locations, dates and times of these meetings will be announced at least fifteen (15) calendar days prior to the first meeting via a press release and on the project website.

Thank you for your interest in the Ambler Road Draft EIS. We appreciate the information and suggestions you contribute to this EIS process.

Sincerely,

Ted A. Murphy
Associate State Director, Alaska

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Acronyms and Abbreviations

°F	degrees Fahrenheit
AAC	Alaska Administrative Code
AADT	Annual Average Daily Traffic
ABR	ABR Inc. – Environmental Research & Services
ACCS	Alaska Center for Conservation Science
ACEC	Areas of Critical Environmental Concern
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADHSS	Alaska Department of Health and Social Services
ADNR	Alaska Department of Natural Resources
ADOLWD	Alaska Department of Labor and Workforce Development
AFS	Alaska Fire Service
AHRS	Alaska Heritage Resources Survey
AICC	Alaska Interagency Coordination Center
AIDEA	Alaska Industrial Development and Export Authority
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARD	acid rock drainage
ARDF	Alaska Resource Data File
AS	Alaska Statute
AWC	Anadromous Waters Catalog
BLM	U.S. Bureau of Land Management
BMP	best management practice
BP	Before Present
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CO	carbon monoxide

COPD	chronic obstructive pulmonary disease
DENA	Denali National Park and Preserve
DGGS	Alaska Division of Geological and Geophysical Surveys
District	Ambler Mining District
DMTS	Delong Mountain Transportation System
DOI	U.S. Department of the Interior
DOT&PF	Alaska Department of Transportation and Public Facilities
EEA	Environmental and Economic Analysis
EFH	essential fish habitat
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FMP	Fishery Management Plan
FNSB	Fairbanks North Star Borough
G2G	government-to-government
GAAR	Gates of the Arctic National Park and Preserve
GHG	greenhouse gas
GIS	Geographic Information System
GMU	Game Management Unit
GPS	Global Positioning System
HAP	hazardous air pollutant
HB	House Bill
HDR	HDR Alaska, Inc.
HHH	Hodzana Hills Herd
HUC	hydrologic unit code
MAAT	Mean Annual Air Temperature
MP	Milepost
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NAB	Northwest Arctic Borough

NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NNIS	Non-native Invasive Species
NOA	naturally occurring asbestos
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
OHV	off-highway vehicle
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
PCE	Power Cost Equalization
PEM	Palustrine Emergent
PFO	Palustrine Forest
PFYC	Potential Fossil Yield Classification
PGE	platinum group element
PM_{10}	particulate matter <10 microns
$PM_{2.5}$	particulate matter <2.5 microns
PML	Palustrine Moss/Lichen
PSS	Palustrine Scrub-shrub
REA	Rapid Ecological Assessment
REE	rare earth element
RMH	Ray Mountains Herd
RMP	Resource Management Plan
RNA	Research Natural Area
ROD	Record of Decision
ROW	right-of-way
RS2477	Revised Statute 2477
SF299	Standard Form 299

SRMA	Special Recreation Management Area
State	State of Alaska
SWPPP	Storm Water Pollution Prevention Plan
TAPS	Trans-Alaska Pipeline System
TCE	Terrestrial Coarse-filter Conservation Element
TCP	Traditional Cultural Property
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VHF	very high frequency
vpd	vehicles per day
VRI	Visual Resource Inventory
VRM	Visual Resources Management
WAH	Western Arctic Caribou Herd
WAH WG	Western Arctic Caribou Herd Working Group
WSR	National Wild and Scenic River System
YKCA	Yukon-Koyukuk Census Area

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Executive Summary

What is the BLM proposing to do in this Environmental Impact Statement?

In 1980, Congress passed the Alaska National Interest Lands Conservation Act (ANILCA), recognizing the mineral potential in the Ambler Mining District (District) and the need for transportation access. The U.S. Bureau of Land Management (BLM) in Alaska has prepared this Environmental Impact Statement (EIS) as required by the National Environmental Policy Act (NEPA) to analyze the Alaska Industrial Development and Export Authority's (AIDEA) application for a right-of-way (ROW) authorization across federal public land. The ROW approval would allow for an industrial access road from the Dalton Highway to the District in north-central Alaska. The application proposes construction of a road, including multiple material sites, temporary construction camps and long-term maintenance camps, airstrips, a fiber optic communications line, radio communications sites, and guard stations. The requested term of the ROW authorization is 50 years, after which the road would be closed and reclaimed (i.e., camps, communications, bridges, and culverts removed). The proposed BLM federal action is approval of the ROW application.

In ANILCA, Congress approved only access across the National Preserve portion of Gates of the Arctic National Park and Preserve (GAAR), exempting from NEPA the decision of where that route should go. Congress did not make a similar exemption for BLM-managed lands or for other federal permits that would be required. The purpose of this EIS, therefore, is to disclose to the public and federal decision makers impacts of the proposal in accordance with NEPA, before the BLM decides whether to issue a ROW authorization. The current document is a Draft EIS issued for public and agency review and comment. The BLM will publish a Final EIS that addresses substantive comments received on the Draft EIS.

Comments can be submitted for 45 days following publication of a Notice of Availability in the *Federal Register*. Comments may be submitted in the following ways:

- Comment online at the project website: www.blm.gov/AmblerRoadEIS
- E-mail comments to: blm_ak_akso_amblerroad_comments@blm.gov
- Mail comments to: Ambler Road EIS Comments, BLM, 222 University Avenue, Fairbanks, Alaska 99709
- Comment on the record at a public hearing. Hearings will be held in many communities in the region and in Fairbanks, Anchorage, and Washington, DC. A schedule will be posted at the website listed above.

The EIS also serves as the basis for decisions that other federal agencies must make, such as issuance of a permit for fill in wetlands and waters of the United States by the U.S. Army Corps of Engineers (USACE), and issuance of bridge permits by the U.S. Coast Guard (USCG) for bridges over navigable waterways. The USACE, USCG, and Environmental Protection Agency are federal cooperating agencies for the EIS. The National Park Service (NPS), Federal Highway Administration, and U.S. Fish and Wildlife Service are participating agencies. The Alaska Department of Natural Resources and Northwest Arctic Borough are state and local cooperating agencies. Alatna Village Council, Allakaket Tribal Council (representing Allakaket Village), Hughes Traditional Council (representing Hughes Village), and Noorvik Native Community are cooperating agencies for their special expertise related to traditional knowledge and for input on subsistence and cultural resources.

Ultimately, the BLM, in consultation with cooperating agencies, will make a decision to select one of the alternatives evaluated, including the No Action Alternative. The decision will be documented in a Record of Decision (ROD) that identifies the final decision and the mitigation and stipulations required of AIDEA if the ROW authorization is approved.

What are the purpose and need for the project?

AIDEA is pursuing construction of an industrial access road consistent with its mission to increase job opportunities and otherwise encourage Alaska's economic growth, including development of natural resources. Specifically, AIDEA's purpose for this project is to support mineral resource exploration and development in the District. The road would provide surface transportation access to the District and allow for expanded exploration, mine development, and mine operations at mineral prospects throughout the District.

The purpose of the BLM action is to issue a ROW grant that provides for:

1. technically and economically practical and feasible year-round industrial surface transportation access in support of mining exploration and development; and,
2. construction, operation, and maintenance of facilities associated with that access.

What are the alternatives the Bureau of Land Management is considering?

The EIS provides detailed analysis of the following action alternatives and a No Action Alternative:

Alternative A: Alternative A is AIDEA's proposed route, beginning at Milepost (MP) 161 of the Dalton Highway and extending west along the southern flanks of the Brooks Range to the Ambler River within the District. It crosses GAAR, as allowed in a clause in ANILCA. It would be 211 miles long, with 25 miles crossing BLM-managed land. The trip distance, Fairbanks to the western road terminus, would be 456 miles.

Alternative B: Alternative B is AIDEA's proposed alternative route to the Dalton Highway based on input from the NPS to minimize the amount of NPS land crossed and to avoid large water bodies. It is a variation on Alternative A, with the same termini. It dips southward near GAAR to cross the National Preserve farther south than Alternative A. It would be 228 miles long, with 25 miles crossing BLM-managed land. The trip distance, Fairbanks to the western road terminus, would be 473 miles.

Alternative C: Alternative C grew out of scoping comments that suggested a route in the Tanana, Hughes, Hogatza, and Kobuk area. The route begins at MP 59.5 of the Dalton Highway, passes through the Ray Mountains, and proceeds generally to the northwest to pass just north of Hughes and just west of Kobuk. It terminates at the Ambler River within the District. It would be 332 miles long, with 274 miles crossing BLM-managed land. The trip distance, Fairbanks to the western road terminus, would be 476 miles.

No Action Alternative. The No Action Alternative evaluates what would occur if the BLM does not grant a road ROW to AIDEA and no road is built. Federal agencies are required to evaluate taking no action as an alternative in an EIS. The No Action Alternative provides a baseline for comparison to the other alternatives, and it is a potential outcome of the EIS.

What is the relationship of the road project to potential mine projects?

AIDEA's proposed project is an industrial road project to a mining district. There is no formal proposal for any specific mine. Therefore, no federal agency is currently considering any authorization for mining activity in the District. The only authorization to be decided at this time is for the road and its supporting infrastructure described in EIS Chapter 2, Alternatives. Actual mine developments would require federal permits and would be evaluated in separate environmental review processes at the time they are formally proposed.

Although there is no formal mine proposal evaluated in the Ambler Road EIS, this EIS addresses reasonably foreseeable mine development as indirect and cumulative impacts. The anticipated development is based on limited available information about the District and on development of other similar mineral deposits. The reasonably foreseeable mining scenario is evaluated in the EIS as part of indirect and cumulative impacts (i.e., impacts induced by construction of the road and added to impacts of the proposed road). See Appendix H, Indirect and Cumulative Impacts Associated with the Ambler Road, for additional information.

The mining scenario assumes the 4 leading prospects in the District—Arctic, Bornite, Sun, and Smucker—all develop as open pit mines with some underground mining. Other future mining activity in the District is possible but is too speculative to include within the mining scenario for detailed analysis. The mining scenario includes amounts of ore processed; minerals extracted; jobs created; and road, rail, and ship traffic generated. Effects of this activity and other reasonably foreseeable actions are evaluated in Appendix H, and are summarized under each resource in Section 3, Affected Environment and Environmental Consequences, of this EIS.

How is this document organized?

The full EIS is available at BLM's ePlanning website (www.blm.gov/AmblerRoadEIS). The EIS (Volume 1) contains:

- **Chapter 1:** Introduction, Purpose and Need, Collaboration and Coordination
- **Chapter 2:** Alternatives
- **Chapter 3:** Affected Environment and Environmental Consequences
    - **3.1 Introduction**
    - **3.2 Physical Environment:** Geology and Soils, Sand and Gravel Resources, Hazardous Waste, Paleontological Resources, Water Resources, Air Quality and Climate, Acoustical Environment (Noise)
    - **3.3 Biological Resources:** Vegetation and Wetlands, Fish and Amphibians, Birds, Mammals
    - **3.4 Social Systems:** Land Ownership, Use, Management, and Special Designations; Transportation and Access; Recreation and Tourism; Visual Resources; Socioeconomics and Communities; Environmental Justice; Subsistence Use and Resources, Cultural Resources
    - **3.5 Relationship between Local Short-term Uses and Long-term Productivity**
    - **3.6 Irreversible and Irretrievable Commitments of Resources**

The EIS appendices (Volumes 1 through 3) contain further detail:

- Appendix A: Figures
- Appendix B: Chapter 1 Introduction Tables and Supplemental Information
- Appendix C: Chapter 2 Alternatives Tables and Supplemental Information
- Appendix D: Chapter 3 Physical Environment Tables and Supplemental Information
- Appendix E: Chapter 3 Biological Resources Tables and Supplemental Information
- Appendix F: Chapter 3 Social Systems Tables and Supplemental Information
- Appendix G: Alternatives Development Memorandum
- Appendix H: Indirect and Cumulative Impacts Associated with the Ambler Road
- Appendix I: Collaboration and Consultation
- Appendix J: Section 106 Programmatic Agreement
- Appendix K: Cultural Resources Data Gap Report
- Appendix L: Subsistence Technical Report

- Appendix M: ANILCA Section 810 Preliminary Evaluation
- Appendix N: Project Design Features, Best Management Practices, and Potential Mitigation
- Appendix O: References
- Appendix P: Glossary

Volume 4 contains maps referenced in the EIS.

What are the major issues evaluated?

The BLM undertook a scoping process in 2017–2018. The process was designed so that the BLM could hear from potentially affected communities, tribal entities, and agencies, as well as all levels of government, non-governmental organizations, and the public at large about AIDEA's proposal. The outcome of the process was identification of issues that the EIS would address (i.e., the "scope" of the EIS). The scoping process and its full results appear in a Scoping Summary Report, published separately and available on the BLM's project website (www.blm.gov/AmblerRoadEIS).

Key issues from scoping addressed in the EIS are:

- **Access.** Would public access be allowed on the road, and how would such access affect the region? The EIS states the road would be an industrial access road not open to the public under any alternative. It would have opportunities for commercial delivery to communities near the road under a permit process. See detail in Appendix H, Section 2.2, Indirect Road Access Scenarios.
- **Mining impact.** Will the EIS address impacts of the mines and not just the road? The EIS addresses consequences of a reasonably foreseeable mining scenario as part of indirect and cumulative impacts. See Appendix H and summaries under each resource in Chapter 3, Affected Environment and Environmental Consequences, of the EIS.
- **Geology.** Would the road cross geologic hazards, especially permafrost, acid-generating rock, and naturally occurring asbestos (NOA), and, if so, what are the effects? The EIS addresses these topics in Sections 3.2.2, Sand and Gravel Resources, and 3.2.3, Hazardous Waste.
- **Economics.** What are the economic effects, and how do they benefit the regional and state economy? Economics are addressed in Section 3.4.5, Socioeconomics and Communities, of the EIS.
- **Socioeconomics**. Will road access affect the culture, lifestyle, jobs, and economies of area communities and Alaska Native corporations? The EIS addresses these issues in Sections 3.4.5, Socioeconomics and Communities, and 3.4.7, Subsistence Uses and Resources.
- **Recreation and tourism.** How would a road affect recreation and tourism? Section 3.4.3 of the EIS addresses Recreation and Tourism. The NPS is preparing a separate Environmental and Economic Analysis (EEA) that addresses GAAR.
- **Cultural resources.** How would the road affect cultural and historic resources? The BLM is taking a programmatic approach to addressing cultural and historic resources under Section 106 of the National Historic Preservation Act and has developed a draft Section 106 Programmatic Agreement (see Appendix J) in consultation with agencies and tribal entities. Cultural resources are addressed in Section 3.4.8 and Appendices J and K of the EIS.
- **Subsistence.** How would the project affect caribou, fish, and other subsistence resources? Subsistence uses and resources are addressed in Section 3.4.7 and Appendices L and M of the EIS. The EIS also addresses mammals in Section 3.3.4, fish in Section 3.3.2, and socioeconomics (including public health) in Section 3.4.5.
- **Wilderness values.** How would the road affect existing wilderness qualities, and wild and scenic river corridors and other areas? The EIS addresses wilderness values on lands outside GAAR in Sections 3.4.3, Recreation and Tourism; 3.4.4, Visual Resources; 3.2.6, Acoustical Environment; and 3.4.1, Land Ownership, Use, Management, and Special Designations. The NPS is preparing a separate EEA that addresses GAAR.

Special Considerations Regarding Gates of the Arctic National Preserve. Potential impacts to GAAR were topics raised during scoping. The road across GAAR is authorized in law. ANILCA Section 201(4)(b) stipulated that the Secretary of the Interior "shall permit" "access for surface transportation purposes across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve…." for access to the District. ANILCA directed that the portion of the road crossing NPS lands be analyzed in an EEA in lieu of an EIS under NEPA. NPS has worked jointly with the U.S. Department of Transportation to develop an EEA, which is intended to identify the most desirable route across NPS lands and inform the development of terms and conditions to be included in the NPS ROW permit. The EEA does not address Alternative C as it would not cross GAAR.

What are the primary impacts identified in the Environmental Impact Statement?

In general, Alternatives A and B share an alignment across the project area except within and in the near vicinity of GAAR. Alternative B is 17 miles longer than Alternative A. Alternative C follows an almost entirely separate alignment, crossing different terrain, and running approximately 50 percent longer (332 miles) than the other alternatives. While the driving distance to Fairbanks would be similar, the longer road construction length means correspondingly greater acreage of impacts to vegetation, wildlife habitat, and wetlands; greater impacts to streams and wildlife movements; and greater uses of various tracts of (almost exclusively) public or Alaska Native corporation lands. Alternative C also would have greater effects on the Ray Mountain caribou herd and moose, as well as greater involvement with discontinuous permafrost. Alternatives A and B could have greater effects related to sheefish habitat, the Western Arctic caribou herd, and use of materials containing NOA. Alternative A would cross the National Preserve for 26 miles. Alternative B would cross the National Preserve for 18 miles. Alternative C would not cross the National Preserve.

Appendix C (Chapter 2 Alternatives Tables and Supplemental Information), Table 2-2, summarizes the key impacts of the project. The introduction to the table is in Section 2.5, Summary of Impacts, of the EIS.

Air and water quality and water flows would be altered along the corridor compared to current, mostly natural conditions. Thousands of culverts would channel flowing water under the road and would affect natural flow patterns, erosion patterns, natural channel migration, ponding, and flooding patterns. Best management practices would be stipulated to minimize impacts. Construction could hasten thawing of permafrost in localized areas and could damage natural topography and alter water flows and vegetation patterns. This is somewhat more likely under Alternative C than under Alternative A or B because Alternative C crosses discontinuous permafrost where the temperature of the permafrost is already closer to the thaw point. All alignments cross areas of NOA and rock that can generate acidic runoff when disturbed, although the Alternative C alignment crosses less area of high NOA potential. Either can be harmful to the environment and human health. Gravel materials containing NOA may be used in the construction of the road embankment where alternative materials are not readily available. AIDEA has committed to following State of Alaska requirements for use of gravels containing NOA in construction projects. No alternative would be expected to generate emissions of air pollutants, including dust, at levels that would approach or exceed national ambient air quality standards. However, all action alternatives would result in emissions due to combustion for movement of vehicles, heating maintenance camps and buildings, and generating power at maintenance camps and for communications facilities.

All action alternatives would result in impacts to vegetation; wetlands; and fish, bird, and mammal habitat. Besides direct fill in wetland and vegetation habitat due to road construction, the areas near the road would be affected by road dust, noise, movement, and light or shading (at culverts and bridges), and potentially spills of pollutants from truck traffic. A road would fragment wildlife habitat. Caribou migration patterns and movements of other wildlife could be affected by the presence of a road and road noise. AIDEA has committed to implementing measures that would require drivers stop and wait when caribou are on or near the road, and to report caribou movements.

Social impacts, including to subsistence and communities, would be of the same type for all action alternatives. However, different communities would be affected depending on the alternative. Kobuk, Shungnak, and Ambler would be affected by all alternatives, with direct road connection to Kobuk anticipated to develop with changes related to less expensive delivery of fuel, groceries, and construction materials likely. Alternatives A and B would be more likely to affect Bettles and Evansville, while Alternative C would affect Hughes (with a future road or year-round trail connection anticipated to develop from Hughes to the proposed Ambler Road). Alatna and Allakaket lie between the Alternative A/B and Alternative C alignments and likely would be affected by any action alternative, but to lesser degrees than closer communities. There are 27 communities with subsistence use areas that overlap the alternatives. Subsistence use would be altered by the presence of a road. Communities could benefit from road construction and maintenance jobs, and ultimately from new mining jobs. Because of its longer length and higher cost, Alternative C would generate more construction and operations and maintenance jobs. The cash income would help individuals and community economies, but also could result in migration to urban areas. The road and mines could cause individual and community impacts related to collection of traditional foods.

Recreation and tourism are closely related to wilderness values in the area. Opportunities for solitude along the corridor would be affected whether backpacking, rafting, fishing or hunting by floatplane or motorboat, or going to traditional fish camps from nearby communities. In addition, many recreational trips begin in GAAR and involve floating out of the Brooks Range to downstream communities or places where aircraft can get in to fly people out. Visitors would pass under Alternative A and B bridges midway through their multi-day trips, often trips that started on a designated wild and scenic river (designations end where the rivers flow out of GAAR). Visual and noise impacts would affect the experience. Two existing fly-in lodges that market their remote locations would be near the Alternative A and B alignments, and the visitor experience could be altered. However, the lodges and communities may have potential for commercial delivery of materials and supplies by road, likely for transfer by snowmobile or boat to their end destination.

What measures are being taken to reduce impacts and resolve issues?

AIDEA has committed to avoidance, minimization, and mitigation in their application. The BLM assumed those commitments would be carried through in their analysis of effects in the EIS. The BLM intends continued collaboration and coordination with cooperating agencies and will take into consideration comments on the Draft EIS from communities, tribal entities, non-governmental organizations, agencies, and the general public to fully understand and resolve issues to the extent possible. The BLM will consider all comments made in writing or at public hearings on the Draft EIS to avoid, minimize, or mitigate environmental impacts. Required mitigation and stipulations will be documented in the ROD. Appendix N, Project Design Features, Best Management Practices, and Potential Mitigation, contains potential mitigation measures. Due to only a portion of each alternative being located on BLM-managed land, BLM's authority to require and enforce specific measures is limited.

This EIS does not discuss avoidance, minimization, or mitigation for impacts related to the development and operations of potential future mines because details of that development are not sufficiently available at this time. However, each mine would be required to undergo its own environmental and permit analysis and state and federal agencies would consider mitigation based on the proposed mine plans prior to authorizing those developments.

What are the major conclusions and findings of the analysis?

Preferred Alternative

Alternative C. At this stage of analysis, the BLM does not believe Alternative C to be environmentally preferable. It is nearly 60 percent longer than the other action alternatives and would have far greater impacts on the natural environment—habitat, wetlands, and waters. It also would be considerably more costly to construct. Appendix C, Table 2, provides an overview of the analysis and summary of the data leading to this preliminary finding. BLM's final determination, however, will be made in the ROD and will take into account public and agency input on this Draft EIS.

Alternatives A and B. BLM's preferred alternative is the Alternative A and B alignments. While Alternatives A and B are separate alternatives, they share an alignment except in their approach and crossing of GAAR. The BLM does not have authority to select the route through GAAR. The decision making process for crossing GAAR is set out in ANILCA, and the decision to allow a road across the National Preserve was made by Congress in ANILCA Section 201(4)(b). ANILCA establishes that the decision regarding the best route across the National Preserve is left to the Secretary of the Interior based on the EEA, and that decision is exempt from NEPA.

If the Secretary of the Interior selects Alternative B as the route through GAAR, then Alternative A would no longer be reasonable under NEPA. To be reasonable, the route from the District to the Dalton Highway must be continuous. Therefore, under this scenario, Alternative A would no longer satisfy the purpose and need established in the EIS. The converse is also true. If the Secretary of Interior were to select Alternative A as the best route across GAAR, Alternative B would no longer be continuous and would cease to satisfy the purpose and need.

ANILCA Section 810

The BLM has found in its initial subsistence evaluation that Alternatives A, B, C, and the cumulative case considered in this Draft EIS may significantly restrict subsistence uses in multiple communities. According to the ANILCA Section 810 analysis (Appendix M), all action alternatives may significantly restrict subsistence uses for the communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Kiana, Kobuk, Selawik, and Shungnak. In addition, Alternatives A and B may significantly restrict subsistence uses for the communities of Bettles, Buckland, Coldfoot, Evansville, Kotzebue, Noatak, Noorvik, and Wiseman. For Alternative C, in addition to those communities listed above for all alternatives, subsistence uses may be significantly restricted for the communities of Hughes, Huslia, Stevens Village, and Tanana. Generally, the restrictions may occur because of a potential decrease in abundance and availability of caribou, fish, and vegetation. For some communities, the road may restrict community access to subsistence resources. All communities may not experience impacts equally to all resources. However, the proposed road project may impact at least 1 resource for each community named above. None of the alternatives would result in a significant restriction to subsistence uses for the other communities examined: Beaver, Galena, Livengood, Manley Hot Springs, Minto, Nenana, and Rampart. The cumulative case examined in Appendix H may further restrict subsistence uses for some communities. See Appendix M, ANILCA Section 810 Preliminary Evaluation, for additional details.

Because there may be a significant restriction on subsistence use, the BLM has undertaken the notice and hearing procedures required by ANILCA Section 810 (a)(1) and (2) in conjunction with release of this Draft EIS to solicit public comment from the potentially affected communities. The BLM will ensure that testimony on impacts to subsistence, acquired from the hearings held in affected communities, is included in the analysis of alternatives in the Final EIS. Additionally, the Section 810 Evaluation (Appendix M) may be revised to include testimony and/or mitigation measures created in response to the testimony. The ROD will briefly summarize the evaluation, findings, notice given, hearings held, and final determinations for the selected alternative, including determinations resulting from analysis of cumulative effects of the selected alternative.

1. Introduction

1.1. Introduction

The U.S. Bureau of Land Management (BLM) Central Yukon Field Office has prepared this Environmental Impact Statement (EIS) for federal authorizations in response to a right-of-way (ROW) application from the Alaska Industrial Development and Export Authority (AIDEA). AIDEA proposes to construct, operate, maintain, and remove a 211-mile, all-season, industrial access road to the Ambler Mining District (District)[1] in the Brooks Range of Alaska (see Volume 4, Maps, Map 1-1). Under AIDEA's proposal, approximately 25 miles of the proposed road would cross BLM-managed lands. According to AIDEA, the road would provide access for mineral exploration, mine development, and mining operations in the District. AIDEA is a State of Alaska (State) public corporation whose mission is to increase job opportunities and economic activity in the state. AIDEA has undertaken similar efforts, such as the industrial road that provides access to Red Dog Mine from the northwest coast of Alaska.

On November 24, 2015, and supplemented on June 20, 2016, AIDEA filed a ROW application (known as Standard Form 299 [SF299]) for surface transportation access to currently inaccessible mineral deposits in the District (DOWL 2016a). AIDEA filed the application in accordance with the provisions in the Alaska National Interest Lands Conservation Act (1980) (ANILCA) for providing access to the District (see ANILCA Sections 201(4)(b) and 1101(a)). On April 29, 2019, AIDEA submitted to BLM an amendment to the SF299, which addresses communications facilities associated with the proposed access road (DOWL 2019a).

The BLM has authority to grant a ROW across BLM-managed lands and is the lead agency for this EIS. To comply with the National Environmental Policy Act (1969) (NEPA), the BLM has assessed the environmental consequences with support from other federal, state, borough, and tribal entities. The BLM has prepared this EIS in compliance with NEPA, the Council on Environmental Quality regulations for implementing NEPA (40 Code of Federal Regulation [CFR] 1500–1508), BLM NEPA Handbook H-1790-1 (BLM 2008a), and other applicable laws and regulations.

1.2. Project Background and Overview

1.2.1 Ambler Mining District Location and Land Status

The District is located within the Northwest Arctic Borough (NAB), in the southern foothills of the Brooks Range of north-central Alaska. There is currently no road or other surface access to this region from the existing transportation network. Volume 4, Map 1-1 shows the location of the District as identified by AIDEA in its SF299 ROW application (DOWL 2016a) and an area of concentrated mining claims sometimes referred to as the "Ambler mineral belt."

The District has long been recognized as containing a variety of mineral deposits, which have been explored or evaluated for more than a century (DOWL 2016a; Grybeck 1977). The primary identified mineral resources include copper, lead, zinc, silver, and gold (DOWL 2016a). Studies have also identified cobalt and molybdenum as having "real or potential economic value in the mineral deposit" based on currently active prospects (USGS 2018a). There are more than 1,300 active mining claims in the District vicinity (ADNR 2018). A 2015 economic analysis identified 4 major mineral deposits, with Trilogy

[1] The term "Mining District" applies traditionally to geographic areas described by miners, and such districts are often governed under bylaws drawn up by miners. The Ambler Mining District, however, is an informal descriptive term applied to the approximate area mapped in this EIS and has no formal or legal standing. In contrast, the many individual mining claims and mining agreements that exist within the mapped area do have legal rights and responsibilities under state and federal law (Pearson 2016; mindat.org 2019).

Metals Inc.'s Arctic and Bornite deposits the most active (Cardno 2015). More information on mining claims and potential is found in Section 3.2.1, Geology and Minerals; Section 3.4.1, Land Ownership, Use, Management, and Special Designations; and Appendix H, Indirect and Cumulative Impacts Associated with the Ambler Road.

1.2.2 Project Development Background and History

In 1980, Congress passed ANILCA recognizing the mineral potential in the District and the need for transportation access. The State, through AIDEA, is proposing the access road in accordance with the access provisions of ANILCA and based on studies conducted by the Alaska Department of Transportation and Public Facilities (DOT&PF) and AIDEA. With funding from the Alaska Legislature, DOT&PF began to identify and evaluate alternative overland routes in 2009 and produced a series of reports in 2011 and 2012. DOT&PF transferred the project to AIDEA in 2013. In its application materials, AIDEA identified a proposed route and an alternative route (see Volume 4, Map 1-1). The portion of the road that would cross BLM-managed lands is identical under AIDEA's proposed and alternative routes.

A portion of AIDEA's proposed route goes through Gates of the Arctic National Park and Preserve (GAAR), managed by the National Park Service (NPS). In ANILCA Section 201(4)(b), Congress anticipated surface transportation access across GAAR from the District to the Alaska Pipeline Haul Road (Dalton Highway). Per ANILCA, this congressionally approved access through GAAR is not subject to NEPA. Instead, ANILCA directs the Secretaries of the U.S. Department of the Interior (DOI) and U.S. Department of Transportation (USDOT) to jointly prepare an Environmental and Economic Analysis (EEA) to determine the route through GAAR and develop terms and conditions for issuance of the NPS ROW permit. However, ANILCA included no such specific provision for access across BLM-managed lands. Also, compliance requirements under other acts (e.g., Clean Water Act) were not exempted. The DOI (through NPS) and USDOT (through the Federal Highway Administration [FHWA]) are preparing the EEA.

1.2.3 Summary of Applicant's Proposed Action

AIDEA has proposed an all-season industrial[2] access road. The proposal includes bridges, material sites, maintenance stations, airstrips, and related infrastructure and utilities (see Chapter 2, Alternatives, of this EIS). AIDEA proposed building this road in phases, starting with a seasonal, single-lane, gravel pioneer road (Phase 1). This road would be upgraded in Phase 2 to an all-season, single-lane gravel road and expanded to a 2-lane gravel road in Phase 3. In their application (DOWL 2016a), AIDEA projected the road to have a life of approximately 50 years, based on an estimate of when mineral exploration and development in the District is anticipated to be completed. AIDEA's proposal calls for removal of the road and reclamation and restoration of the ROW upon cessation of mining activities in the District. AIDEA intends for the access road to facilitate further mining exploration and development. However, AIDEA has not directly proposed mining-related development in the District. Others would pursue the mining activities, which would require separate permitting decisions and, presumably, NEPA review.

[2] AIDEA filed an application for a ROW to construct a private industrial access road from the Dalton Highway, crossing federal public lands managed by the BLM and NPS to the District. This road would be closed to the public. The BLM is not considering issuance of a ROW for a public road, and a public road is not among the alternatives this EIS is analyzing. AIDEA's SF299 ROW application expressly requests ROW for an "industrial-only road," for which access "would be controlled and primarily limited to mining-related industrial uses, although some commercial uses may be allowed under a permit process" (DOWL 2016a).

1.3. Applicant's Purpose and Need for the Project

AIDEA is pursuing construction of an industrial access road consistent with its mission to increase job opportunities and otherwise encourage the State's economic growth, including development of natural resources (AIDEA 2019). Specifically, AIDEA's purpose for this project is to support mineral resource exploration and development in the District. The road would provide surface transportation access to the District and allow for expanded exploration, mine development, and mine operations at mineral prospects throughout the District. AIDEA indicates that surface transportation access would help bring the high-value mineral resource areas into production (DOWL 2016a).

AIDEA lists multiple public benefits related to the project purpose, including direct employment for road construction and operation, indirect employment related to mining, revenues paid to local and state governments and Alaska Native corporations, and commercial access opportunities for nearby communities associated with proximity to a road (DOWL 2016a).

1.4. Purpose and Need for Federal Action

The need for federal action results from the requirement under the Federal Land Policy and Management Act for the BLM to consider AIDEA's SF299 ROW application for industrial surface transportation access across BLM-managed lands. The proposed BLM federal action is approval of the ROW application submitted by AIDEA.

The purpose of the BLM action is to issue a ROW grant that provides for:

- Technically and economically practical and feasible year-round industrial surface transportation access in support of mining exploration and development; and,
- Construction, operation, and maintenance of facilities associated with that access.

The BLM must decide whether a ROW will be granted and, if so, the terms and conditions that will be imposed.

The U.S. Army Corps of Engineers (USACE) is a cooperating agency for this project and also has its own purpose and needs to consider. Under Section 404(b)(1) Guidelines, the USACE has a *basic purpose* to determine whether the proposed project is water-dependent. Then, the USACE has an *overall purpose* that, based on AIDEA's purpose and need, serves as the basis for identifying practicable alternatives to the Applicant's proposed project. In its review as a cooperating agency, the USACE indicated that its *overall purpose* is "to provide year-round surface transportation access for mining exploration and development in the Ambler Mining District."

1.5. Collaboration and Coordination

1.5.1 Key Agency Participation

Lead Federal Agency

The BLM is the lead federal agency for this EIS. In addition to NEPA, the BLM is leading the analysis under ANILCA Section 810 and National Historic Preservation Act (NHPA) Section 106. ANILCA Section 810 requires evaluation of the project's effects on subsistence resources and access to those resources where the project will use federal public land. NHPA Section 106 requires consideration of the project's effects on historic properties and applies to the entire route, regardless of land status.

Cooperating Agencies

Other federal agencies are cooperating agencies because they have their own federal authorization decisions that require compliance with NEPA and/or they have special expertise. These agencies will use this EIS as a basis for their decisions:

- **U.S. Army Corps of Engineers.** The USACE has jurisdiction over activities that would include the discharge of dredge or fill material into waters of the United States, including wetlands (as regulated under the Clean Water Act Section 404), and work or structures constructed in, on, over, or under navigable waters (as regulated under the Rivers and Harbors Act Section 10).
- **U.S. Coast Guard (USCG).** The USCG has authority for permitting the construction of bridges over navigable waters.

In addition, the **U.S. Environmental Protection Agency (EPA)** is coordinating as a cooperating agency to maximize use of available resources and special expertise, and minimize duplication in those areas of overlapping responsibilities.

Non-federal cooperating agencies with jurisdiction by law and/or because they have special expertise include:

- **Alaska Department of Natural Resources (ADNR).** The ADNR Office of Project Management and Permitting is serving as the lead State agency to coordinate input from other State agencies, including the Alaska Department of Environmental Conservation (ADEC); Alaska Department of Fish and Game (ADF&G); Alaska Department of Health and Social Services; and Alaska Office of History and Archaeology, State Historic Preservation Officer. The ADNR would make land management decisions for ROW access across State-managed lands.
- **Northwest Arctic Borough.** The NAB is providing input on subsistence and cultural resources, and helping coordinate with tribal members and affected communities. The NAB will also enforce local permitting requirements and advise the BLM on NAB's authorities.
- **Federally Recognized Tribes.** Alatna Village Council, Allakaket Tribal Council (representing Allakaket Village), Hughes Traditional Council (representing Hughes Village), and Noorvik Native Community are cooperating agencies for their special expertise related to traditional knowledge and input on subsistence and cultural resources.

Participating Agencies

Key participating agencies include the U.S. Fish and Wildlife Service, NPS, and FHWA. The NPS and FHWA are participating in the development of this EIS to coordinate it with the EEA.

1.5.2 Cooperating Agency Engagement

The BLM and cooperating agencies met regularly throughout the development of this Draft EIS. Early on, the BLM coordinated with agencies to share data and determine methods for impact analysis, and to discuss purpose and need, screening criteria, and alternatives development. Cooperating agencies also met monthly to assist in developing the Draft EIS and provide guidance on work products.

1.5.3 Government-to-Government Consultation with Tribes

The BLM conducted a review of potentially affected federally recognized tribes along the proposed road corridors, also identifying those tribes that could be indirectly affected. Based on this review, on April 20, 2017, the BLM sent letters to 52 federally recognized tribes, presenting the opportunity for government-to-government (G2G) consultation on the project. The BLM is undertaking ongoing communications and outreach throughout the NEPA process, particularly with those tribes that are cooperating agencies. Appendix I, Collaboration and Consultation, summarizes G2G consultation during the NEPA process.

1.5.4 Alaska Native Claims Settlement Act Corporations

The Alaska Native Claims Settlement Act (1971) formed Alaska Native regional and village corporations in Alaska. On April 20, 2017, the BLM sent letters to 4 regional corporations and 18 village corporations, initiating consultation for the project. Because Alaska Native corporations are not government entities, they cannot participate in the NEPA process as cooperating or participating agencies, nor are they considered federally recognized tribes. However, Native corporations are afforded status as tribes under NHPA Section 106, and as a matter of policy, the BLM initiates consultation with Alaska Native corporations for actions that have a substantial direct effect on them. These Alaska Native corporations own large areas within the project area and represent shareholders who are members of tribes. The BLM actively engaged Alaska Native corporations during the development of the Draft EIS (Appendix I).

1.5.5 National Historic Preservation Act Section 106 Consultation

The BLM has invited 109 tribes, Alaska Native corporations, agencies, and other interested parties to participate in Section 106 consultation, and has conducted G2G with several tribes to discuss the Section 106 process. To date, 28 state and federal agencies, cities, and tribal entities have participated in Section 106 consultation with BLM (Appendix I). The BLM is also developing a Programmatic Agreement (PA), which will allow for a phased approach to complying with Section 106, pursuant to the implementing regulations found at 36 CFR 800. The BLM is developing the PA through consultation with agencies, tribes, and other interested parties. The BLM also invited the public to share any comments, concerns, or information during EIS public scoping meetings, and the draft PA will be available for public comment and review, concurrent with the Draft EIS (see Appendix J, Section 106 Programmatic Agreement).

1.5.6 Other Coordination

The BLM and AIDEA met regularly throughout the development of this Draft EIS to discuss AIDEA's ROW grant application and to request additional information or clarification about AIDEA's proposed project. The BLM also presented to a number of other groups, including the Western Arctic Caribou Herd Working Group, Maniilaq Association, and local governments (see Appendix I).

1.5.7 Summary of Applicable Laws, Regulations, and Permits

Appendix B (Chapter 1 Introduction Tables and Supplemental Information), Table 1, summarizes key anticipated authorizing laws, regulations, and permits for the project.

1.6. EIS Development Process and Coordination

On February 28, 2017, the *Federal Register* published BLM's Notice of Intent to prepare an EIS for the Ambler Road Project, initiating a 90-day scoping comment period. The BLM later extended the comment period through January 31, 2018. The BLM reviewed and processed the comments received and published a scoping summary report on the project website in May 2018 (BLM 2018a). Based on scoping comments, the BLM updated the project purpose and need, developed screening criteria, and evaluated a full range of alternatives through a coordinated process with cooperating agency input to arrive at the reasonable alternatives evaluated in full in this EIS.

BLM's Ambler Road EIS ePlanning webpage launched January 21, 2016. In October 2017, the BLM added a standalone Ambler Road EIS webpage (www.blm.gov/AmblerRoadEIS) to better enable visitors and search engines to find EIS information and direct people to the ePlanning webpage. These webpages provide background information, project documentation, and project team contact information.

1.6.1 Scoping and Key Issues

Scoping is a formal process to help the BLM determine the scope of the analysis needed in the EIS. During scoping, the BLM solicited input on potential issues, impacts, and alternatives to be addressed in the EIS. The BLM held 13 public scoping meetings and an agency scoping meeting in November and December 2017 (Appendix I). The BLM held scoping meetings in Allakaket, Anaktuvuk Pass, Alatna, Fairbanks, Wiseman, Anchorage, Ambler, Kotzebue, Shungnak, Kobuk, Hughes, Huslia, and Evansville/Bettles. The BLM conducted other outreach during scoping, including presentations at various organizations' meetings. The final Scoping Summary Report (BLM 2018a) on BLM's project website (www.blm.gov/AmblerRoadEIS) provides further details.

The BLM received oral testimony at most of the public scoping meetings. Additionally, the BLM received a total of 7,225 written scoping communications. These included 6,343 form emails, 862 unique emails (93 of which included attachments), and 20 letters and faxes. The Scoping Summary Report organized these comments into broad issue categories, which included Project/Process, Physical Environment, Biological Environment, Social Environment, and Other Topics such as air quality/dust and impacts related to specific components of the project (e.g., construction camps, gravel pits; BLM 2018a).

The BLM received public comments that expressed concerns about the effects of a new road in a remote rural area. Impacts of highest concern were those related to subsistence resources, particularly caribou and fish, and to the subsistence and rural lifestyle in the area. Related concerns were about impacts to wildlands, designated federal wilderness, wild and scenic rivers, and the broader ecosystem, as well as social impacts within nearby communities. While AIDEA has proposed the road for industrial use by permit, the potential for public access on the road was frequently mentioned, both as a potential benefit to local residents and businesses and as a potential adverse effect by spurring competition for subsistence resources by recreational hunters and fishers and introducing drugs and alcohol to dry communities. Many also expressed concerns about the impacts resulting from mining exploration and development in the District that the industrial access road is intended to promote. Supportive comment letters were also received, expressing support for jobs and the potential for reduced costs of living in the area, and outlining economic benefits from mining development.

2. Alternatives

2.1. Introduction

To identify the alternatives evaluated in detail in this Environmental Impact Statement (EIS), the U.S. Bureau of Land Management (BLM) considered a full range of alternatives. These included Alaska Industrial Development and Export Authority's (AIDEA) proposed alternative and routes investigated by the Alaska Department of Transportation and Public Facilities (DOT&PF) prior to the *Federal Register* Notice of Intent. The BLM also considered comments received during formal scoping, including multiple comments related to alternatives and factors that fed into the alternative screening process (BLM 2018a). The BLM worked with cooperating agencies to identify the range of alternatives and then evaluate them to determine which were reasonable in light of the stated purpose and need. This chapter summarizes the results of that evaluation (Section 2.2, Alternatives Development Process) and briefly describes why the BLM determined certain alternatives to be not reasonable (Section 2.3, Alternatives Considered but Eliminated from Detailed Analysis) and did not carry them forward for a full evaluation. Section 2.4, Alternatives Retained for Detailed Analysis, details the No Action Alternative, AIDEA's proposed action (Alternative A), and reasonable alternatives to AIDEA's proposal (Alternatives B and C).

The BLM documented the alternatives decision-making process in Appendix G, Alternatives Development Memorandum, which relied on relevant documents prepared by AIDEA, DOT&PF, and others to develop and screen alternatives (incorporated here by reference; see Appendix G bibliography). BLM's ePlanning website (www.blm.gov/AmblerRoadEIS) includes relevant supporting documents. Consult these documents for additional details regarding the alternatives and their evaluation.

2.2. Alternatives Development Process

Based on the purpose and need for the project, the BLM identified potential alternatives from a number of sources, including alternatives proposed by AIDEA, routes studied by DOT&PF, and routes and concepts suggested by the public during and after formal scoping. The BLM evaluated alternatives through an iterative process based on scoping comments received, input from cooperating agencies, and a review of available data compiled for this EIS. To determine whether an alternative was reasonable, the BLM employed a 2-phase screening process: (1) an initial screening of transportation modes, including road, standard rail, blimp/dirigible, pipeline, elevated rail, narrow-gauge rail, ice road, and barge, and (2) a screening of routes associated with the reasonable modes. The BLM considered an alternative's effectiveness at satisfying the purpose and need, technical and economic feasibility, the practicality of the alternative, and whether the alternative substantially duplicated others evaluated. Sections 2.3, Alternatives Considered but Eliminated from Detailed Analysis, and 2.4, Alternatives Retained for Detailed Analysis, describe these alternatives further.

2.3. Alternatives Considered but Eliminated from Detailed Analysis

This section describes BLM's rationale for determining which modes and alternatives are not reasonable.

2.3.1 Modes Eliminated

The BLM examined suggested transportation modes. The BLM determined the following modes to be not reasonable, so did not develop specific facility locations.

- **Air (Airplanes/Helicopters).** This mode would not provide surface access and would not adequately support hauling mining equipment and heavy loads.

- **Air (Blimp/Dirigible).** The BLM screened out this mode for the reasons given for air (airplanes/helicopters) and because it involves additional speculation and risk related to relying on technology untested for mining support in an Arctic environment.
- **Rail (Elevated Rail).** This mode is speculative and relies on technology untested in Arctic environments. It would have very high construction costs, essentially building a rail bridge that would be longer than 200 miles.
- **Road (Seasonal Ice Road).** This mode would not provide year-round surface access, and the BLM determined it to be unreliable in the face of a changing climate. The BLM determined operations and maintenance to be not reasonable or practical, requiring construction of more than 200 miles of new ice road each winter.
- **Water (Barge/Boat).** This mode would not provide year-round surface access. Also, the examined rivers would be too shallow for reliable seasonal access and/or would require dredging. The impacts of dredging would also make this mode not practical for environmental reasons.
- **Pipeline.** The BLM screened out this mode because pipelines alone would not satisfy the project purpose and need of providing surface access for large mining equipment and heavy loads.

Public Access Road versus Industrial Access Road. Scoping comments indicated many questions about public use of the road. The BLM considered this as part of defining the final alternatives to carry forward for analysis in this EIS. However, AIDEA did not request a publicly accessible road in their permit application. The BLM determined that a public road would be outside the stated purpose and need. In addition, the road would not be safe for general public use given the isolated conditions, narrow road/bridge design, and large industrial truck traffic. Therefore, under Alternative A, B, or C, the road would be for industrial access only, with commercial deliveries along the road possible, but not general public access. AIDEA has clarified that staffed gatehouses would be in place at each end of the road. Appendix H (Indirect and Cumulative Impacts Associated with the Ambler Road), Sections 2.2.1 (General Public Access) and 2.2.2 (Commercial Access Scenario), provide further detail about industrial and commercial uses. The Alaska Department of Natural Resources, in its role as a cooperating agency for the project, has stated that it must separately evaluate questions related to use of the road and restrictions on use and cannot commit at this time regarding restrictions where the road would cross State of Alaska (State) lands.

2.3.2 Alternatives Eliminated

The BLM evaluated alternative routes associated with industrial road and overland rail modes—the only modes determined to be reasonable. Roads and rail provide a surface transportation method that is technically feasible and can satisfy the project’s purpose and need. These modes rely on proven technology for supporting mining, including in the Arctic environment of the project area. The design criteria for these modes are well understood. The BLM considered narrow-gauge rail but with the caveat that narrow-gauge rail rolling stock could not freely interchange with the standard-gauge rail on the existing Alaska Railroad.

The BLM considered the following road and rail routes, but determined them to be not reasonable. Volume 4, Maps, Map 2-1, depicts these eliminated alternatives, and Appendix G provides additional details.

- **Original Brooks East Corridor (Road).** The BLM determined that this alternative substantially duplicates Alternative A and is not reasonable due to greater potential community impacts.
- **Rail to Dalton Highway (Along AIDEA’s Proposed Route).** The BLM determined that this alternative is not practical due to substantial material handling inefficiencies at both ends. The BLM determined an isolated rail system, not connected to a port or railroad, to be not practical.

- **Kanuti Flats Corridor (Road).** Of the environmental factors measured during screening, this alternative had higher caribou habitat impacts, crossed more anadromous fish streams, and affected more riparian acreage compared with other alternatives. It would have similar community concerns as the Original Brooks East Corridor. The BLM found it substantially similar to Alternatives A and B.
- **Parks Highway Railroad Corridor (Railroad Connecting to the Alaska Railroad).** Because of its length, this alternative would have among the highest costs and environmental impacts. This alternative would also have technical and practicality issues.
- **Elliott Highway Corridor (Road).** This is the longest road route examined and would require a large bridge over the Yukon River. It is also the most expensive road route examined. This route would be substantially duplicative of Alternative C.
- **DMTS Port Corridor (Road or Rail).** Capacity limitations at the Delong Mountain Transportation System (DMTS) Port mean that this alternative would require building a new port. Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. The BLM also considered high costs and potential environmental impacts.
- **Road to Kiana/Barge (Kobuk River).** The BLM eliminated this alternative because the Kobuk River is too shallow; therefore, barging ore and supplies on this route would not be feasible.
- **Cape Blossom Corridor (Road or Rail).** Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. The BLM also considered high costs and potential environmental impacts.
- **Selawik Flats Corridor (Road or Rail).** Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. Environmental effects and practicality were also considerations. The BLM also considered alignment variations on the Selawik Flats route suggested during scoping and found them not reasonable for similar reasons.
- **Cape Darby Corridor (Road or Rail).** Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. The BLM also considered high costs, and environmental and practicality considerations. The BLM considered alignment variations on the Cape Darby route suggested during scoping and found them not reasonable for similar reasons.

2.4. Alternatives Retained for Detailed Analysis

2.4.1 Screening Results: Alternatives Retained

Based on screening analysis, the BLM determined that the following alternatives are reasonable and retained them for additional analysis in the EIS. Volume 4, Map 2-2, depicts these retained alternatives.

Alternative A: AIDEA Proposed Route (GAAR North) to the Dalton Highway. This alternative is the Applicant's proposed route. The alternative is generally within an acceptable range for all screening criteria. Screening data indicated this alternative would be constructible and less expensive than other alternatives. This alternative would have a logical terminus (rational end point) connecting into the road and rail network to provide year-round access to existing port facilities located to the south.

Alternative B: AIDEA Proposed Alternative Route (GAAR South) to the Dalton Highway. This alternative shares much of its length with Alternative A, and screening data indicated it is substantially similar to that route. Despite the similarities, the BLM retained it because it provides a distinct route across Gates of the Arctic National Park and Preserve (GAAR) and is consistent with the alternatives the National Park Service (NPS) is evaluating in its Environmental and Economic Analysis. Furthermore, although this alternative is identical to Alternative A in those areas where it crosses BLM-managed lands, it merits treatment as a separate alternative in this EIS because the U.S. Army Corps of Engineers

(USACE) is a cooperating agency and the route is not identical across areas falling under USACE's jurisdiction.

Alternative C: Diagonal Route to the Dalton Highway. The BLM developed this alternative based on scoping comments. The 332-mile route would entail more new construction than the other reasonable alternatives but has a similar driving length from the Ambler Mining District (District) to Fairbanks. This alternative would have a logical terminus (rational end point) connecting into the road and rail network to provide year-round access to existing port facilities. Public comments during scoping showed some public support for this alignment and the potential to benefit communities along its route. The BLM carried this alternative forward for detailed analysis after considering all screening criteria, including meeting the project's purpose and need and environmental factors.

2.4.2 No Action Alternative

Under the No Action Alternative, the BLM would not grant a right-of-way (ROW) easement, and no road would be constructed or operated to the District. A No Action Alternative is required to be included in a National Environmental Policy Act analysis, providing a baseline against which action alternative impacts can be compared.

2.4.3 Features Common to All Action Alternatives

This section discusses the design and operational features attributable to the action alternatives. Sections 2.4.4, Alternative A: AIDEA Proposed Route (GAAR North) to the Dalton Highway, through 2.4.6, Alternative C: Diagonal Route to the Dalton Highway, discuss specific routing and important distinctions associated with each action alternative. Volume 4, Map 2-2, illustrates locations of some of the features discussed below.

Proposed Road. The road under all action alternatives ultimately would be a 2-lane, 32-foot-wide, all-season gravel road. Supporting infrastructure would include bridges, culverts, road maintenance stations every 50 to 75 miles, vehicle turnouts, material sites, water source access roads, and airstrips. Appendix A, Figures, Figure 2-1 shows a typical cross section of the proposed road.

Access. Under any of the action alternatives, road access would be controlled and primarily limited to industrial traffic transporting large, heavy equipment; ore; and goods and supplies in support of mine exploration, development, and operations. AIDEA has also requested that commercial access (for deliveries of goods to local communities and residents) and access for emergency response be allowed under a permitted-access process AIDEA would establish. The road would not be open to the general public. Appendix H describes anticipated traffic and use of the road.

Vehicles. The primary vehicles to use the road during operation would be trucks hauling mineral exploration and development equipment and ore concentrate, as well as supplies (including fuel). AIDEA is proposing a semi-trailer truck (WB-62 design) with 22,000-pound per standard axle loading and a street-legal maximum width of 8 feet, 6 inches as the design vehicle (i.e., the vehicle to which roadway design specifications are targeted). Other vehicles and equipment anticipated to use the road include pickup trucks, road graders and plows, and fuel delivery trucks. All trucks hauling ore concentrates would be covered and sealed to prevent the release of ore concentrate, and trucks hauling 2 trailers of ore concentrate (66 short wet tons) is the assumed typical configuration. Appendix A, Figure 2-2 depicts a typical truck and container system.

Road Traffic Volumes. Volume assumed to be transported over the first 10 years of operation is based on the Preliminary Economic Assessment for Nova Copper's Arctic Deposit (Wilkins et al. 2013). In their application, AIDEA indicates that total traffic, including fuel and other supplies, would be up to 80 trucks per day (40 round trips) during production (DOWL 2016a). Based on Appendix H, and extrapolated to include other mines, the maximum project annual average daily traffic could be 168 trips per day, year round, when other mines are in production. Double-trailer ore loads on the Ambler Road would be split and become single-trailer loads for transport on the Dalton Highway and other public roads. Appendix H describes anticipated traffic and use of the road.

Right-of-Way. AIDEA has requested a ROW with a 50-year term. The requested ROW would be 250 feet wide in most areas, although at bridge crossings and steep terrain, the width may need to be up to 400 feet to accommodate cut and fill slopes. ROW would also be needed for road maintenance stations and access roads to these facilities. Most material sites likely would be addressed as material purchase contracts with the land manager, although several would also be used for communications equipment and storage. AIDEA would have legal and financial responsibility for managing transportation elements in the ROW; however, it is assumed AIDEA would procure road design, construction, maintenance, and operation services through other parties. See Volume 4, Maps 2-3 and 2-4, for the location of proposed maintenance stations and material sites.

Construction Phasing. AIDEA has proposed building the project in 3 phases. Road construction likely would begin in support of mining exploration and would not be dependent on mine permits or approvals. Phase 1 would construct a single-lane, gravel-surfaced pioneer road, typically 16 feet wide (including 2-foot-wide shoulders) on a shallow roadbed. The Phase 1 pioneer road would be constructed over 2 years. A winter construction access trail would be established during the first year, and the pioneer road would be completed in the second year. Construction of the pioneer road would likely require year-round activity. This phase would result in a road that would be used August to April, with restricted access during spring and early summer to minimize roadway damage. Phase 1 would transition directly to Phase 2.

All proposed bridges would be constructed as 1-lane bridges (23 feet wide) in Phase 1 and would remain as 1-lane bridges through all construction and operational phases. The majority of bridge construction activities would take place in winter when rivers were frozen, facilitating temporary river crossings during construction. Culverts placed in Phase 1 would be the length needed for Phase 2.

Phase 2 would reconstruct the pioneer road to be a 1-lane, gravel-surfaced roadway, typically 20 feet wide, over a full-depth embankment (roadbed). Construction of Phase 2 is anticipated to take 2 years to complete. This phase would result in year-round access but would likely be operated in only a single direction at a time, with guided convoys of trucks traveling in 1 direction during certain hours and then in the other direction at other times.

Phase 3 would be constructed once traffic volumes justified upgrading the road, anticipated to be approximately 10 years after construction of Phase 2. Phase 3 would expand the road to 32 feet wide (2 full lanes) by widening the then-existing Phase 2 footprint[1] and extending the culverts. The Phase 3 road would be an all-season gravel road with a design speed (i.e., the speed that roadway geometry would accommodate) of 50 miles per hour. It is anticipated that sections would be posted for lower speeds and actual operating speeds would likely be lower (particularly in Phases 1 and 2). Expansion of the Phase 2 road to Phase 3 is anticipated to take 2 years to complete.

[1] Footprints used to calculate impacts in Chapter 3 (Affected Environment and Environmental Consequences) include areas of cuts and fills for the project elements plus a 10-foot buffer around those limits for construction access, clearing, and other temporary effects. A 10-foot buffer is a common buffer applied to road projects in Alaska. It represents an area of sufficient width for construction equipment to operate. The buffer is not typically used along the entire alignment; therefore, it represents a conservative estimate of the potential impacts. The impacts to the construction area are generally considered temporary.

Construction Camps. AIDEA has proposed construction camps to facilitate construction. AIDEA has estimated each camp to be 5 acres, with room for a helipad, equipment and material storage, and employee facilities (e.g., housing, food service). Construction would occur in both directions from these camp areas (which would be spaced approximately every 40 to 45 miles), with equipment staged along the road corridor. See Volume 4, Maps 2-3 and 2-4, for the location of proposed construction camps.

Construction Staging Areas. AIDEA has proposed that material sites would be used to provide temporary staging areas for construction activities, although some separate staging areas would be needed. Staging areas typically would be less than 1 acre and located within the footprint when required outside of material sites. Additional temporary staging and construction areas would likely be required for bridges, but would be within the proposed footprint.

Operations. It is anticipated that AIDEA would procure services of other parties to maintain and operate the road using fees levied on mining companies. Operations would include controlling access, maintaining security around the clock (including staffed gates at each end of the road and regular patrols), and responding to emergencies. It is anticipated that access would be controlled, with no access by the general public, including area residents. Access protocols for the road would be similar to those for the North Slope oil fields at Deadhorse, where the Dalton Highway (public highway) terminates, but miles of industrial road continue for industrial users who are permitted. AIDEA has proposed that staffed gates would be located at each end of the Ambler Road and at other locations if needed (AIDEA, personal communication 2019). At the east-end guardhouse, there would be space for an office, bathroom, small kitchen, and emergency bunking accommodations. Personnel would be housed at the nearby maintenance station. It is anticipated that AIDEA would establish an authorization and training process, and anyone accessing the road (drivers or passengers) would be required to take specialized safety training, have a very high frequency (VHF) radio, and carry personal protective equipment. Only authorized, commercially licensed drivers would be allowed to drive the road. AIDEA has proposed to adopt the wildlife interaction protocols used on its Red Dog Mine road (DMTS) during operation of the proposed Ambler Road, which would include vehicles waiting when caribou are nearby.

All drivers would be required to have 2-way radios and to report their positions regularly, likely hourly. No commercial fueling stations would be established. Permanent road maintenance stations would have fuel for maintenance equipment. The road operator would be required to have personnel trained in first aid and emergency spill response at each maintenance station. All maintenance and security vehicles and staffed facilities would be required to have spill response equipment.

During Phases 1 and 2, when the road is a single lane, most use is anticipated to be in a single direction at a time and may include convoys of trucks moving in a single direction. In Phase 3, when the road is widened to 2 lanes, bridges still would be 1 lane wide. Radio communication would coordinate traffic. Mining companies are anticipated to need areas at each end of the road to stage convoys. At the eastern end, this is assumed to be the maintenance station/material site located in that area, but could include a new area established under mining company permits (i.e., separate from this road authorization). The western end would similarly make use of a maintenance station or material site, or would be addressed through mining company proposals and permitting.

Maintenance. It is anticipated that the road for all action alternatives would receive regular maintenance, including grading, sanding, and snow plowing. The maintenance schedule would depend on the amount of traffic. As traffic grows, more wear and tear would occur, and maintenance would need to occur more often. AIDEA estimates that 2 inches of gravel would be needed annually to maintain the roadway and that dust control chemicals (palliatives) such as calcium chloride would be applied to reduce dust emissions.

Fuel and Chemicals – Road Construction, Maintenance, and Operations. Small spills or drips at fueling locations would be handled with standard best management practices (BMPs). Spills due to a crash or other accident along the road would be contained as quickly as possible using response equipment maintained on every operations and maintenance vehicle. Fuel would be stored in double-wall tanks meant to serve as secondary containment to reduce spills. Fuel storage facilities would include spill detection equipment. Tanks would be regularly inspected. BMPs would be employed for storage and handling of chemicals for dust control, deicing, cleaning, vehicle maintenance, and other purposes.

Material Sites and Maintenance Facilities. AIDEA has proposed to develop material sites to obtain gravel and riprap for construction and maintenance. Some of the material sites would be expected to be developed into long-term roadway maintenance facilities. These long-term sites would house maintenance workers and include landing strips. Most material sites would require access roads of varying lengths to connect the borrow location to the proposed road. Additionally, side roads would be constructed to provide access to water sources for road construction and maintenance activities. Appendix A, Figure 2-3, illustrates a typical maintenance station facility. See Volume 4, Maps 2-3 and 2-4, for the location of proposed maintenance stations and material sites.

Airstrips. Long-term road maintenance stations would each have an airstrip approximately 150 feet wide and 3,000 feet long. These are spaced approximately every 70 miles. During construction phases, at least weekly flights (1 to 2 per week) are likely to each construction camp to change out construction crews. Likewise, during road operations, it is likely there would be 1 to 2 flights weekly to each maintenance station to change road maintenance and security crews. During construction of Phases 2 and 3, when the road would be operating and also under construction, these 2 to 4 flights per week could occur to account for both operation/maintenance and construction crew changes. Most flights likely would be by 9- to 12-passenger aircraft (e.g., Cessna 208 Caravan). During construction, additional flights are likely to occur by helicopter to construction camps and specific sites such as bridges. During road operations, in particular, some crew changes might occur by van rather than by aircraft. These airstrips would be closed and reclaimed at the end the road's useful life, along with all project components. See Volume 4, Maps 2-3 and 2-4, for the location of proposed airstrips.

Communications. Communications along the road would include a VHF 2-way radio system for security of traffic on the road, a fiber optics line tied to the VHF radio system to enhance the radio system and provide Internet connection to long-term maintenance stations, and a backup satellite system. Some material sites and the maintenance stations would be sites for communications equipment, including radio towers approximately 100 to 150 feet tall and satellite dishes approximately 10 feet tall. A small heated building at each site would house communications electronics. A generator and 4,000-gallon diesel fuel tank would be located at communications facilities at material sites. At long-term road maintenance stations, the communications system would be tied to the generator and fuel source for the entire site. Communications sites would be located every 30 to 40 miles, and each would be sited within the footprint of a material site or maintenance station. The radio towers would be installed during Phase 1, and the fiber optics line during Phase 2. Appendix A, Figure 2-4 illustrates proposed communications facilities.

Project Lifespan/Closure/Reclamation. The lifespan of the proposed road would be dependent upon the success of exploration and extraction efforts within the District. AIDEA proposes to reclaim the road and anticipates that would occur at the end of the 50-year ROW authorization, or when mineral exploration and development activities in the District conclude. Appendix H contains a hypothetical timeline of road, mine, and reclamation activities. AIDEA proposes to submit a detailed closure and reclamation plan for road project facilities as the time for closure approaches. This would be separate from any mining closure and reclamation plans. AIDEA would be responsible for road reclamation. In general, AIDEA proposes to remove all equipment and buildings, remove all culverts and bridges and reestablish natural channels, re-grade the embankments and pads where necessary to avoid erosion, and seed bare areas. The road and airstrips would be closed. The land would revert to the full control and management of the underlying landowner. It is likely that mining companies would request that some segments of the road within the District stay open and revert to mining company control to allow their continued access from airstrips to the mines for water treatment and monitoring activities, potentially in perpetuity.

2.4.4 Alternative A: AIDEA Proposed Route (GAAR North) to the Dalton Highway

Alternative A is a 211-mile alignment (25 miles traverse BLM-managed land), accessing the District from the east, with its eastern terminus at Milepost (MP) 161 of the Dalton Highway. It runs almost directly west to the District across primarily State-managed, BLM-managed, and GAAR lands. The corridor traverses the south side of the Brooks Range, following a series of stream and river valleys oriented roughly east-west, separating the Schwatka Mountains from a series of smaller mountain ranges and foothills, including the Ninemile Hills, Jack White Range, Alatna Hills, Helpmejack Hills, Akoliakruich Hills, Angayucham Mountains, and Cosmos Hills. This route crosses GAAR farther north than Alternative B (see Volume 4, Map 2-3).

2.4.5 Alternative B: AIDEA Alternative Route (GAAR South) to the Dalton Highway

Alternative B is a 228-mile alignment (25 miles traverse BLM-managed land), with its eastern terminus at MP 161 of the Dalton Highway. It follows the same alignment as Alternative A except it loops to the south to pass through GAAR at a location that crosses less National Preserve land and is farther from the Park and Wilderness boundary (see Volume 4, Map 2-3).

2.4.6 Alternative C: Diagonal Route to the Dalton Highway

Alternative C is a 332-mile alignment (274 miles traverse BLM-managed land), with its eastern terminus at MP 59.5 of the Dalton Highway. It approaches the District from the southeast, primarily across BLM-managed lands. From the Dalton Highway, the route crosses the Ray River and traverses the Ray Mountains, then roughly heads northwest toward Hughes before passing through the Indian Mountains, and then follows the Koyukuk River south. Just north of Hughes, the route continues northwest, crossing the Hogatza River, traversing the Pah Valley, passing the Selawik National Wildlife Refuge, and proceeding north past Kobuk to join the Alternative A/B alignment near the common terminus at the south bank of the Ambler River (see Volume 4, Map 2-4).

2.4.7 Summary of Major Project Components for Each Action Alternative

The action alternatives have similar infrastructure features and would operate similarly. However, each alternative has a different length and traverses different terrain, and therefore each has different numbers of components and features. Appendix C (Chapter 2 Alternatives Tables and Supplemental Information), Table 1 summarizes major project components for each action alternative.

2.5. Summary of Impacts

The analysis presented in Chapter 3, Affected Environment and Environmental Consequences, documents the affected environment and the anticipated impacts of Alternatives A, B, and C, and compares those impacts to the No Action Alternative. Appendix C, Table 2 summarizes the impacts for each alternative.

In general, Alternative A and B share an alignment across the project area except at GAAR. Alternative B is 17 miles longer than Alternative A. Alternative C follows an almost entirely separate alignment, crossing different terrain, and running approximately 50 percent longer (332 miles) than the other alternatives. While the driving distance to Fairbanks would be similar, the longer road construction length means correspondingly greater acreage impacts to vegetation, wetlands, and wildlife habitat; greater impacts to streams and wildlife movements; and greater uses of various tracts of (almost exclusively) public or Native corporation lands. Alternative C also would have greater effects on the Ray Mountain caribou herd and moose as well as greater involvement with discontinuous permafrost. Alternatives A and B could have greater effects related to sheefish habitat, the Western Arctic caribou herd, and use of naturally occurring asbestos (NOA). Alternative A would cross the National Preserve for 26 miles (NPS-managed lands). Alternative B would cross the National Preserve for 18 miles (NPS-managed lands). Alternative C would not cross the National Preserve.

Air and water quality and water flows would be altered along the corridor compared to current, mostly natural conditions. Culverts would provide for primary flows beneath the roadway embankment but would have impacts to the natural hydrology. Dispersed overland flow would be concentrated into distinct flow channels leading to the culverts. Changes in water depth and velocity could result in changes in erosion or sedimentation, ponding, or channel migration. BMPs and other measures would be stipulated to minimize impacts (see Appendix N, Project Design Features, Best Management Practices, and Potential Mitigation). Construction could hasten thawing of permafrost in localized areas and could damage natural topography and alter water flows and vegetation patterns. This is somewhat more likely under Alternative C than under Alternatives A or B, because Alternative C crosses discontinuous permafrost where the temperature of the permafrost is already closer to the thaw point. All action alternatives cross areas of NOA and rock that can generate acidic runoff when disturbed, although Alternative C crosses less area of high NOA potential. Either can be harmful to the environment and human health. Gravel materials containing NOA may be used in the construction of the road embankment where alternative materials are not readily available. AIDEA has committed to following State requirements for use of gravels containing NOA in construction projects (Appendix N). No alternative would be expected to generate emissions of air pollutants, including dust, at levels that would approach or exceed national ambient air quality standards. However, all alternatives would result in emissions due to combustion for moving vehicles, heating maintenance camps and buildings, and generating power at maintenance camps and for communications facilities.

All action alternatives would result in impacts to vegetation; wetlands; and fish, bird, and mammal habitat. Besides direct fill in wetland and vegetation habitat due to road construction, the areas near the road would be affected by road dust, noise, movement, and light or shading (at culverts and bridges), and potentially spills of pollutants from truck traffic. A road would fragment wildlife habitat. The presence of a road and road noise could affect caribou migration patterns and movements of other animals. AIDEA has committed to implementing measures that would require drivers stop and wait when caribou are on or near the road, and to report caribou movements (Appendix N).

Social impacts, including those to subsistence and communities, would be of the same type for all action alternatives. However, different communities would be affected depending on the alternative. All action alternatives would affect Kobuk, Shungnak, and Ambler, with direct road connection to Kobuk anticipated to develop and changes related to less expensive delivery of fuel, groceries, and construction materials likely. Alternatives A and B would be more likely to affect Bettles and Evansville, while Alternative C would be more likely to affect Hughes (with a future road or year-round trail connection anticipated to develop from Hughes to the proposed Ambler Road). Alatna and Allakaket lie between the Alternative A/B and Alternative C alignment and likely would be affected by any action alternative, but to lesser degrees than closer communities. There are 27 communities with subsistence use areas that overlap the alternatives. Subsistence use would be altered by the presence of a road. Communities could benefit from road construction and maintenance jobs, and ultimately from new mining jobs. Because of its longer length and higher cost, Alternative C would generate more construction, operations, and maintenance jobs. The cash income would help individuals and community economies but also could result in migration to urban areas. The road and mines could cause individual and community impacts related to collection of traditional foods.

Recreation and tourism are closely related to wilderness values in the area. Opportunities for solitude would be affected whether backpacking, rafting, fishing or hunting by floatplane or motorboat, or going to traditional fish camps from nearby communities. In addition, many recreational trips begin in GAAR and involve floating out of the Brooks Range to downstream communities or places where aircraft can get in to fly people out. Visitors would pass under Alternative A and B bridges midway through their multi-day trips, often trips that started on a designated wild and scenic river (designations end where the rivers flow out of GAAR). Visual and noise impacts would affect the experience. Two existing fly-in lodges that market their remote locations would be near the Alternative A and B alignments, and the visitor experience could be affected. However, the lodges and communities may have potential for commercial delivery of materials and supplies by road, likely for transfer by snowmobile or boat to their end destination.

3. Affected Environment and Environmental Consequences

3.1. Introduction

Chapter 3 describes the affected environment (baseline conditions), environmental consequences of the alternatives described in Chapter 2 (Alternatives), and potential mitigation.

Project Area. The project area is generally defined as the area from the Brooks Range (same latitude as the northern edge of the Ambler Mining District [District]) south to the Yukon River and from the Dalton Highway corridor west to Kobuk Valley National Park (Volume 4, Maps, Map 1-1). The affected area, however, may differ for each resource—from narrow areas limited to the proposed road corridors to more expansive areas defined by the movement of caribou, fish, or subsistence hunters. The sections in this chapter address these individual resource study areas and the maps in Volume 4 depict the extent.

Impacts Defined. Council on Environmental Quality (CEQ) regulations require that Environmental Impact Statements (EISs) address direct, indirect (secondary), and cumulative impacts. This chapter summarizes these impacts. Direct effects are those that occur at the time and place of the proposed project. Indirect effects are those that may occur farther from the project or later in time but are reasonably foreseeable to result from the proposed project. Cumulative effects are those from the project combined with past, present, and reasonably foreseeable future actions, regardless of who undertakes those actions. See Appendix H, Indirect and Cumulative Impacts Associated with the Ambler Road, for additional details on mining and other reasonably foreseeable development impacts.

The Alaska Industrial Development and Export Authority (AIDEA) has proposed a road for access to the District, with the assumption that providing access will lead to mining exploration and development. This EIS is not in response to a mining proposal, and therefore the U.S. Bureau of Land Management (BLM) has analyzed the road based on the currently known characteristics of the region and provides analysis of the potential impacts from future mining. Consequently, in this EIS, direct impacts are those that occur at the time and place of road construction and operation (attributable to the road's footprint and anticipated use of the road). The BLM considers mining exploration and mine development to be reasonably foreseeable if the road were to be built. Therefore, this analysis treats impacts resulting from mining exploration and development expected to occur off the road and later in time as indirect and cumulative effects.

The proposed action is a 211-mile road that would cross land owned or managed by multiple parties, including the BLM. Under any alternative, the BLM manages only a portion of the corridor, and BLM's purpose statement (see Section 1.4, Purpose and Need for Federal Action) is associated with the portions that would occur on BLM-managed lands, with the remainder of the road considered a connected action. The U.S. Army Corps of Engineers (USACE) jurisdiction extends to waters of the United States along the full length of any alternative. The USACE purpose statement (see Section 1.4, Purpose and Need for Federal Action) is associated with these waters wherever they occur along any alternative as land status is immaterial to the scope of USACE's jurisdiction. For this reason, certain impacts are indirect effects of BLM's proposed federal action (granting a right-of-way [ROW] across BLM-managed lands) but are direct effects of USACE's proposed federal action (issuing a permit for fill in waters of the United States). For purposes of the effects analysis, however, the distinction between an indirect and direct effect is ultimately immaterial because the National Environmental Policy Act (NEPA) requires analysis of both types of effects. Therefore, the effects analysis in this chapter generally does not distinguish between the type of action or effect, but addresses all effects for all actions.

Reasonably Foreseeable Actions. AIDEA has provided detail regarding the proposed road, but similar detail does not exist for mining proposals. To evaluate the indirect and cumulative effects of reasonably foreseeable development, the BLM convened a team of agency and private sector NEPA and mining professionals, and consulted with AIDEA and companies that anticipate mining in the District, to develop a reasonably foreseeable development scenario (see Appendix H). This scenario presents a forecast of mining development and activity anticipated to result in road use during the 50-year term of the ROW authorization and other reasonably foreseeable future actions, and discloses the anticipated indirect and cumulative effects of that development and activity.

The BLM also considered the impacts of road construction and use of the road for mining access in regards to climate change. Biological and physical resources are anticipated to be affected by climate change under all alternatives, and specific impacts are discussed in the following sections for each resource as appropriate. Additional discussion is included in Appendix H.

Project Phasing. AIDEA has proposed building the road in 3 phases starting with a pioneer road in Phase 1, then constructing a 1-lane gravel road in Phase 2, then expanding to a 2-lane gravel road in Phase 3. The impact analysis focuses on the most impactful phase (i.e., the phase with the greatest potential for significant impacts). For most resource topics, Phase 3 would have the largest footprint and most traffic, and would be anticipated to operate for the largest number of years over the 50-year lease term. This analysis identifies impacts that could be significant in Phases 1 and 2 that are different from those anticipated in Phase 3.

Magnitude and Duration of Impacts. In evaluating impacts of road construction and use of the road for mining access, the BLM considered the duration of activities associated with each as well as the magnitude of the impact. Appendix H describes the development schedule with respect to the road construction (to occur in 3 phases, each having a construction duration of 1 to 2 years) and operations (use of the road for mining access over a 50-year period). The analyses presented in this chapter address impacts for the activities based on the duration of the impact, often referring to temporary impacts associated with construction and permanent impacts related to the long-term presence of a road in the project area. These analyses quantify the magnitude of the impact to the extent possible, or express it qualitatively relative to the No Action Alternative.

Data Limitations. According to Title 40 of the Code of Federal Regulations (CFR), Section 1502.22, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information, the agency will make clear that such information is lacking. A number of topics are called out within this chapter where information is incomplete or unavailable. The BLM evaluated the data to determine if any missing information would be relevant to reasonably foreseeable significant adverse impacts; whether it would be essential to a reasoned choice among alternatives; and if it was, whether the overall costs of obtaining it would not be exorbitant. Where information was relevant and essential and the costs were not exorbitant, that information was collected (e.g., wetland delineation, updated engineering for Alternative C, economic analysis, etc.). As required by 40 CFR 1502.22, this EIS makes clear to the reader where information is lacking, explains the relevance of the information, and summarizes the existing credible scientific evidence that does exist and is relevant to evaluating reasonably foreseeable significant adverse impacts on the human environment. The BLM has evaluated the impacts in the EIS based upon research methods and theoretical approaches that are accepted in the scientific community. Based on a review of the data that is available, summarized, and cited in this document and accompanying appendices, sufficient data exists to allow the BLM to make a reasoned choice among the alternatives and ensure potentially significant impacts are disclosed.

Measures to Reduce Impacts. This EIS also discusses potential measures to reduce impacts, and it presents detailed measures in Appendix N (Project Design Features, Best Management Practices, and Potential Mitigation) that may be used to minimize or mitigate impacts. Appendix N presents a list of potential measures the BLM and regulatory agencies with jurisdiction could require as part of their authorizations for the Ambler Road Project. It contains measures that have arisen from law, regulation, and plan policy; AIDEA or other agencies have proposed; or have arisen as the BLM has worked through the analysis in the EIS. The following analyses assume measures committed to by AIDEA will be implemented. The other measures included in Appendix N are presented for consideration. This list is intended to be applicable to the range of activities AIDEA has proposed; however, not every requirement listed would be applicable to every activity/permit. The BLM may authorize portions of the project under separate permits, such as an authorization for the road ROW and separate authorizations for material extraction and sales.

Only a portion of each alternative would be on BLM-managed land, and therefore BLM's authority to require and enforce specific mitigation measures is limited. No decision will be made until the Record of Decision (ROD). Each agency may select measures such as these for inclusion in decisions related to their own jurisdictions. Measures may be added, dropped, or refined before the Final EIS and ROD based on public and agency comment and further project analysis. Because no specific mining proposal is under consideration, no specific mitigation is proposed for the indirect mining scenario. Such mitigation would be applied for each of those mines as they go through the environmental approval process. Standard mitigations for contemporary mines are generally known and have been assumed to be applied to mines evaluated in Appendix H. For a recent example of typical mitigation required for a mine in Alaska, see the Donlin Gold Mine EIS (USACE 2018).

3.2. Physical Environment

3.2.1 Geology and Soils

Affected Environment

Overview

Geology. The project area spans multiple physiographic provinces (i.e., geographic regions with characteristic geomorphology; Warhaftig 1965). Alternatives A and B follow the southern foothills of the Brooks Range and run through the Arctic Mountains province (DOWL 2011a), which consists of glacier-carved mountains and hills of folded and faulted sedimentary rocks and their metamorphic equivalents. Alluvium and glacial drift fill the valleys and lowlands between ranges. Continuous permafrost underlies this region. The northern end of Alternative C runs through the Arctic Mountains province, as well as the Northern Plateau and Western Alaska provinces. The Northern Plateau province is comprised of rolling hills covered with eolian deposits and V-shaped valleys filled with alluvial deposits. The Western Alaska province is characterized by features varying from rolling hills to lowlands dotted with thaw lakes and cut by meandering streams. Discontinuous permafrost occurs along Alternative C. The main geologic terranes (i.e., fault-bounded regions with distinctive structure and geological history) include the Ruby, Angayucham, and the Koyukuk terranes (Colpern and Nelson 2011).

Soils. Soil types in the project area vary widely, but have common characteristics: they all developed under a cold temperature regime in which biological and chemical transformations are slow and soil horizons or layers are subject to physical dislocations as a result of freeze-thaw processes (BLM 2016a). Project-specific terrain unit mapping present along the western half of Alternatives A and B identified silty-ice-rich deposits and noted the presence of organic deposits, pingos, thaw lakes, and "swampy areas" (DOWL 2011a). Mapped areas near Hughes in Alternative C include terrace gravel, alluvium, possible outwash, lacustrine deposits, muskegs, glacial lake deposits, loess, ice-rich silts, and glacial till. BLM's *Central Yukon Resource Management Plan, Analysis of Management Situation*, summarizes soil resources and their current conditions in the Central Yukon area (see Section 2.1.2, Soil Resources, in BLM 2016a) and is incorporated here by reference.

Geology and Soils Hazards

Geological hazards are natural conditions that could alter the landscape or damage structures and injure humans. Potential geologic hazards present in the project area include fault rupture and related seismic hazards (e.g., ground motion, liquefaction, lateral spreading); sudden slope movement (e.g., landslides, rockslides, rockfall, snow avalanches); slower slope movement (e.g., creep in permafrost, frozen debris lobes, rock glaciers, frost action/solifluction); distress due to permafrost degradation or warming (e.g., thaw settlement, retrogressive thaw slumps, thermokarsts); settlement due to loading of compressible soils (e.g., peat, clay); and impacts from water or ice (e.g., flooding, aufeis). Exposure of subsurface sulfidic minerals to air and water could result in the creation and leaching of acidic drainage into water bodies, which could cause adverse impacts on aquatic organisms and habitat. Geologic and soil hazards identified in the area include seismicity, permafrost, naturally occurring asbestos (NOA), and acid rock drainage (ARD).

Seismic. Alaska is among the most seismically active regions in the world. The Kobuk fault follows the southern edge of the Brooks Range, south of Alternatives A and B. The Kaltag fault runs east-west, south of Alternative C (Warhaftig 1965). The seismic hazard maps for Alaska show that Western Interior Alaska has less probability of high ground motion than the Southcentral Alaska coastal area and Aleutian chain (Wesson et al. 1999).

Permafrost. Permafrost is subsurface soil that has remained at temperatures below 32 degrees Fahrenheit (°F) for at least 2 consecutive years. Where present, permafrost slows drainage, which, combined with low soil temperatures, has resulted in soil with wet, shallow, poorly differentiated profiles and substantial, minimally decomposed organic matter. Alternatives A and B traverse areas of continuous permafrost (greater than 90 percent). Alternative C crosses a continuous permafrost area at its north and south ends, and discontinuous permafrost areas through the lowlands (Jorgenson et al. 2008). The Mean Annual Air Temperature (MAAT) indicates that the permafrost soils can be considered warm (greater than 30°F) as compared to cold permafrost soils on the Arctic Slope. These soils are highly susceptible to erosion or other soil movements caused by disturbances to ground-covering vegetation and subsequent thawing of the permafrost. Depending on soil type and ice content, permafrost may be considered thaw-stable, where foundation materials are unchanged in unfrozen condition, or thaw-sensitive (unstable), where the foundation experiences loss of strength and thaw settlement upon thawing. Aerial imagery and limited geotechnical investigations indicate the presence of ice-rich, thaw-sensitive permafrost along parts of each route (see Volume 4, Map 3-1).

Asbestos. Surveys have found NOA in mineral deposits in rock and soils in the project area. Asbestos is a fibrous, heat-resistant silicate mineral whose toxicity and health dangers are well documented (ATSDR 2019). Alaska Statutes (AS; 44.42.430(2)) define NOA as "…asbestos-containing material that has not been processed in an asbestos mill and that, when tested using a bulk method prescribed by the Department of Transportation and Public Facilities by regulation, is determined to have a content equal to or greater than 0.25 percent naturally occurring asbestos by mass." Asbestos minerals typically are stable within undisturbed soils, but disturbances to the soils through construction and excavation may cause fibers to become mobile. A preliminary evaluation of bedrock potential for NOA in the project area shows all action alternatives traverse areas of medium potential for NOA and cross large swaths of surficial deposits that are unevaluated for NOA potential (Solie and Athey 2015; see Volume 4, Map 3-2). The Alaska Department of Transportation and Public Facilities (DOT&PF) conducted explorations for suitable material sites in 2004 and 2013 for the Ambler Airport improvements project. Most test sites within surficial deposit areas had measurable concentrations of NOA present. Studies have also identified NOA in the Ambler Mineral Belt near the confluence of the Kobuk and Shungnak rivers (DOWL 2011a). DOT&PF (2009a) issued a study on available information regarding NOA in Alaska and established interim guidance for the usage of materials with NOA. See that report for additional information regarding NOA.

Acid Rock. Surveys have identified volcanogenic massive sulfides deposits in the Ambler Mineral Belt. ARD is the natural result of the oxidization of these metals in the presence of water, air, and/or bacteria. The outflow of acidic water from this process could have an adverse effect on vegetation, soil organisms, water quality, and aquatic life. The oxidized metals commonly create yellow, orange, and red colors in the bedrock; aerial imagery identified areas exhibiting this characteristic staining in multiple locations along all action alternatives, indicating the potential for ARD (DOWL 2011a).

Minerals

The proposed project provides access to the District, which has been explored for mineral potential since the 1950s and contains a major mineral belt (Grybeck et al. 1996). Nova Copper U.S. Inc. (now Trilogy Metals, Inc.), Valhalla Mining LLC, and Teck Alaska Incorporated have staked more than 160,000 acres of mining claims in the District. The project may provide access to existing claims or mineral occurrences along the selected transportation corridor, including the following:

- Mining claim clusters along the routes include those near the Zane Hills and the Ray Mountains along Alternative C.
- Mining districts, claims, mines, and mineral occurrences and prospects along the project alternatives (see Section 3.4.1, Land Ownership, Use, Management, and Special Designations).
- Rare earth elements (REEs), placer gold, platinum group elements (PGEs), carbonate-hosted copper, sandstone-hosted uranium, and tin-tungsten-molybdenum deposits (see maps in Appendix H).
- Bituminous coal occurrences along Alternatives A and B in the Upper Koyukuk Basin (total estimated resource quantity unknown) and sub-bituminous coal occurrences along Alternative C in the Rampart Field (estimated resources: 50 million short tons; see BLM 2018b).

The following sources provide additional information and are incorporated by reference: (1) the 2015 Ambler Mining Region Economic Impact Analysis (see Chapter 7 in Cardno 2015) provides estimated economic impact on the region, including from potential mineral resources; and (2) the Alaska Resource Data File (ARDF) is a compilation of documented mineral prospects, occurrences, and mines (USGS n.d.). Appendix H provides a summary of mining potential and describes anticipated mining development the BLM predicts is reasonably foreseeable.

Environmental Consequences

Road Impacts

The road and its associated facilities would transect areas with existing geological hazards as well as unfavorable soil and subsurface conditions, which road construction and use may exacerbate. These include corrosive subsurface minerals; liquefiable soils; and organic-rich, ice-rich, poorly drained, or thaw-sensitive permafrost soils. Geotechnical investigations conducted during the design phase would identify these issues, and the road would be designed and constructed to avoid and minimize their risks using appropriate and standard road design practices. Soil and geological hazards may be addressed by modifying alignments, choosing appropriate cut and fill geometry, implementing slope and/or embankment stabilization measures, using wider and thicker embankments on thaw-sensitive permafrost to reduce thaw settlement, and developing road embankment and bridge designs to resist seismic hazards.

The project provides access to the District. Additionally, the road may provide access to potential mineral areas along the selected route. For most mineral occurrences in remote locations, access is a crucial part of determining feasibility for further development. Appendix H further describes impacts associated with mining.

No Action Alternative Impacts

Under the No Action Alternative, there would be no change or impact to geology and topography. Ice-rich permafrost soils in the proposed corridors are anticipated to warm and potentially thaw with or without road construction. Climate temperature trends and permafrost temperatures over the past decades show a defined increase. Increasing permafrost temperatures may lead to increased creep rates of soils on slopes and slope failures. Permafrost warming and thawing may lead to development of thaw settlement and thaw ponds. There would be no change to the existing placement of acid-bearing rocks or minerals containing NOA, and therefore no additional changes to the affected environment. Mineral exploration activities would be anticipated to develop more slowly in the District, and large-scale development and extraction projects would be less likely to occur.

Impacts Common to All Action Alternatives

There would be minor, localized changes to the geology and topography for any action alternative. Road construction in fill areas would add load from material and traffic to the current soils and subsurface structure. A potential impact includes road embankment settlement due to loading of compressible soils (e.g., peat, clay). Section 3.2.5, Water Resources, discusses changes to drainage and water resources by the placement of the road through the project area.

All action alternatives are exposed to the geological hazards described under Affected Environment, although the route lengths exposed to the different geological hazards vary. Seismicity along each of the action alternative alignments is relatively low.

Permafrost Impacts. Road construction would change drainage and vegetation patterns, remove the insulating vegetation layer, and change topography by constructing fill or cut sections along the alignment, disturbing the existing natural thermal regime. Potential impacts due to road construction include distress due to permafrost degradation or warming (e.g., thaw settlement, retrogressive thaw slumps, thermokarsts, soil creep). Changed drainage patterns will result in increased sedimentation (erosion and deposition) as permafrost soils thaw. Road performance deficiencies resulting from thermal instability may include shoulder rotation, frost heaving, excess moisture in the road section, pot-holing, ponding, surface and shoulder erosion, heaving, subsidence, and rutting. Additional gravel resources will be required for roadway maintenance and repair.

Changes to the natural thermal regime cannot be avoided; however, impacts would be minimized by using appropriate fill material and embankment designs. The gravel roadway embankment is proposed to be 3 to 8 feet thick to provide additional insulation to underlying soils. However, gravel material absorbs more solar radiation than natural vegetation and could lead to increased permafrost thaw, especially on the south face of east-west roadway alignments. Phased construction may accelerate subsurface soil temperature increases, as Phase 1 pioneer road construction would not include all design measures to insulate the roadway. Drainage changes occurring during Phase 1 (pioneer road) and Phase 2 (1-lane road) could impound water, warming subsurface soils along areas to be encompassed by the Phase 3 (2-lane) footprint. Should permafrost thaw issues occur during Phases 1 or 2, when the road width is narrower, shoulder rotations and embankment cracks could also impact the driveable surface.

Dust kicked up by vehicle traffic on a road (called fugitive dust emissions) would settle on snow, foliage, or bare ground, likely affecting an area approximately 328 feet (100 meters) from the roadway edge. The spread of road dust may result in more rapid melting of snow and additional warming of soils beyond the road footprint. AIDEA proposed potential design measures to avoid and minimize permafrost thaw and impacts from permafrost thaw (see Appendix N). Such measures are likely to be mostly, but not completely, successful where implemented and maintained. Some permafrost may melt regardless and could result in impacts as described above, including impacts to the road that may require repair. Where the road would cross lands managed by others, it is likely similar design measures would be required.

Asbestos Impacts. NOA has been documented within the project area, and asbestos-containing material is proposed to be used in the construction of the proposed road and its facilities if suitable clean materials are not available. Development of the material sites, construction of the road, and use of the road constructed using materials with NOA may result in worker exposures to asbestos, which the Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (EPA) regulate. Asbestos is a known carcinogen, and exposure to asbestos fibers through inhalation may lead to the development of pulmonary disease, including asbestosis and/or lung cancer and mesothelioma. Fugitive dust emissions would have measurable amounts of asbestos in areas of the roadway constructed with gravel containing NOA. Dusts settling on snow, foliage, or bare ground would affect an area approximately 328 feet (100 meters) from the roadway edge, spreading the asbestos contamination beyond the road footprint. Wind, precipitation, and vegetation disturbances (e.g., humans and animals moving through brush where asbestos fibers have settled) may cause asbestos fibers to become airborne or be washed into water bodies and drinking water sources.

The potential for encountering NOA exists for all of the proposed action alternatives, ranging from low to high, but due to unconsolidated surficial deposits left from glacial previous actions (see Appendix D, Table 3). The exact details of the amounts and locations of NOA are not known.[1] Work near areas of suspected NOA could pose health risks and require control measures to mitigate hazards. AIDEA proposes to avoid cutting into the existing surface soils and plans to construct the roadway on fill and minimize areas of cut slopes. Measures to control asbestos dispersion include covering NOA materials with non-NOA materials, using dust palliatives, training workers, and other measures. Avoiding the use of NOA materials and using chip sealing or mixing materials with asphalt, as suggested by the interim DOT&PF guidance and standards, or by capping with sufficient depth of clean gravel in those areas where NOA materials must be used, would lower the potential for asbestos in road dust (if it were to become a design feature in areas of NOA exposure). Phased construction would require following the guidance and standards in each stage. Appendix N, Section 3.2.7 (Air Quality and Climate), provides details about potential mitigation measures regarding NOA. If all design stipulations and mitigation measures are applied along the full length of the alignment and throughout the life of the road (i.e., during operations, maintenance, and rehabilitation), these would lower the potential for asbestos in road dust. This should not be confused with elimination of potential impacts, since NOA is existing and testing limitations can only detect 0.25 percent NOA in materials.

Acid Rock Impacts. ARD areas have been identified in the Ambler Mineral Belt, and DOWL (2011a) noted the potential for ARD along Alternatives A and B based on aerial imagery. ARD potential along Alternative C is unknown[2]. Corrosion testing during geotechnical investigations for the road and material

[1] The details of the amounts and locations of NOA is relevant to protecting against adverse health impacts. However, the information is not essential to making a reasoned choice among alternatives because there is sufficient information on the relative level of risk among alternatives (see Volume 4, Map 3-2).

[2] The ARD potential along Alternative C is relevant due to its potential for the kinds of water quality impacts described in this section. The BLM determined the lack of information along Alternative C was not essential to a reasoned choice among alternatives because according to engineering reports at the time of route development, if a bedrock material site is determined to have mineralogy that could lead to ARD, a panel of acid/base tests could be conducted to definitively determine the rock's ARD potential. If a source were to be determined to have ARD potential, methods could be implemented to prevent ARD, or an alternative site could be selected (DOWL 2019).

sites would be required to avoid cuts and use of materials with potential for ARD (see Appendix N). The impacts of the road on adjacent areas of soils and permafrost not directly affected by the road would depend largely on the amount of dusts distributed as a result of traffic on the road. In some areas, fugitive dust could include measurable amounts of acid rock or asbestos in areas of the roadway constructed with gravel that contains acid rock or NOA. If acid rock or soils with an acid/base makeup different than surrounding soils are used in the cap surface of the roadbed, the relative acidity of the surrounding soils would change as a result of dusts accumulating on those adjacent soils. The drainage of acidic water from the roadway or exposed ARD areas in material sites could impact surface and subsurface water quality and have an adverse effect on vegetation, soil organisms, and aquatic life. If design stipulations to avoid cuts and use of materials with ARD are followed, impacts should be reduced.

Alternatives A and B Impacts

Although Alternative B is longer than Alternative A, the overall topography and types of geological hazards to be encountered are similar for both alternatives. Alternatives A and B primarily follow areas of continuous permafrost (Jorgenson et al. 2008). The alternatives follow sections of lowlands and uplands with discontinuous to moderately thick permafrost to thin permafrost in those areas where the alternatives cross the Koyukuk and John rivers, as well as the project terminus near the Ambler River (see Volume 4, Map 3-1, and Appendix D, Table 2). The National Park Service (NPS) estimates soil temperatures within the NPS project area are near 30°F. Permafrost temperatures outside the NPS area along Alternatives A and B are likely similar. Maximum potential for thaw settlement along Alternatives A and B ranges from 2 to 98 feet (Jorgenson et al. 2015). Hong et al. (2014) describe a method to characterize the risk of thaw subsidence for permafrost regions in Alaska based on estimates of ground ice volume, MAAT, soil texture, mean snow depth, vegetation, and presence of organic soil. Changes in future risk were based on predicted air temperatures for 2050. Geotechnical investigations during design would be anticipated to seek to identify these locations and avoid areas particularly sensitive to high thaw settlement because the maintenance cost would be high.

Portions of the route for Alternative A and B pass through areas of bedrock with known potential for NOA, with some areas having high potential (2 and 3 percent of mapped footprints, respectively). Most areas with medium and high potential are not close to communities or high use areas (Volume 4, Map 3-2), but the road would become a high use area. People from local communities likely pass through and use some areas for hunting and travel. The unevaluated surficial deposits near Alternatives A and B (91 and 86 percent of mapped footprints, respectively) are likely to have measurable amounts of NOA (see Appendix D, Table 3).

The southern foothills of the Brooks Range have been explored, and mineral occurrences, mineral prospects, and small mines have been developed along much of these corridors. Known occurrences and prospects would likely be reevaluated regarding further development, and new mineral exploration would likely occur if Alternative A or B is selected. Approximately 26 miles of Alternative A and 18 miles of Alternative B pass through NPS-managed Gates of the Arctic National Park and Preserve (GAAR), in which mineral exploration and development is prohibited.

Alternative C Impacts

Portions of the Alternative C alignment cross terrain that has not been glaciated, and the alignment follows broad valley floors that likely contain fine-grained, organic, ice-rich, and frost-susceptible deposits on which it would be difficult to construct and maintain a road embankment. Over half of this alternative is within discontinuous permafrost zones and much of the remainder is in the continuous permafrost zone where the permafrost is characterized as moderately thick to thin (Jorgenson et al. 2008; see Appendix D, Table 2). Thaw settlement potential along Alternative C has not been studied; however, geomorphic features in aerial imagery indicate potential for substantive thaw settlement (DOWL 2019b).

Discontinuous permafrost is typically warmer than continuous permafrost, which may lead to increased or earlier warming and thawing of permafrost along this alternative compared to Alternatives A and B. Additionally, discontinuous permafrost may cause considerable differential movement.

Approximately 16 percent of the Alternative C alignment traverses areas of bedrock with "Medium" potential for NOA. This occurs in the area where Alternative C traverses the Ray Mountains. This area is distant from communities, but the road itself would be a human high-use zone. Alternative C would traverse steeper slopes than the proposed alignments for Alternatives A and B. Steep sections would be more likely to be constructed using cut sections. It may not be possible to avoid localized areas identified during geotechnical investigations as containing NOA due to topography and lack of alternative routes that could avoid such bedrock formations. Exposed rock walls may contain NOA that could mobilize through wind and precipitation. Following potential mitigation methods (see Appendix N) to control dust and minimize worker exposures would likely be more difficult and therefore more expensive in such areas, limiting its effectiveness. Avoiding such cut areas would be more effective. Surficial deposits comprising over half of the Alternative C footprint may have measurable amounts of NOA.

The ARDF lists fewer known mineral occurrences near Alternative C than near Alternatives A and B. However, several state mining claims exist in the Zane Hills and Ray Mountains. Additionally, the Alaska Division of Geological and Geophysical Surveys (DGGS) has identified high potential for critical minerals including REEs, PGEs, carbonate-hosted copper, sandstone-hosted uranium, and tin-tungsten-molybdenum near this alternative.

Mining, Access, and Other Indirect and Cumulative Impacts

The reasonably foreseeable development scenario presented in Appendix H would result in the removal of minerals, including copper and gold, from the District for transport to market. This would be anticipated to occur under all action alternatives, as long as market conditions remain favorable. This is the primary impact sought by AIDEA by implementation of this project. Actions from other non-road reasonably foreseeable development, as described in Appendix H, could contribute to the impacts.

Industrial mining and authorized commercial uses of the selected alternative are anticipated to spur the construction of additional access roads and facilities. Such additional development would result in additional localized changes to area geology, topography, and subsurface soils. Disturbances to the soil thermal regime would exacerbate and/or accelerate permafrost thaw in the area. Impacts could be mitigated if spur roads leading to the selected alignment are engineered and the locations at which they connect to the project road are carefully chosen to lessen the potential impact on subsurface soils, existing permafrost, and the project road.

Additional ground-disturbing road construction and mine development may disturb the existing placement of NOA and acid-bearing rock in the area. Use of NOA materials in construction would expose workers both during construction and during operations. Asbestos fibers are a known health risk if disturbed or released into the air. State of Alaska material use guidance and standards address the use of NOA materials on projects, but does not address mining activities such as rock crushing and blasting. The development and operations of the mines would be regulated by multiple laws and authorities, including the Clean Air Act and Safe Drinking Water Act; federal agencies with asbestos regulations, including OSHA and the Mine Safety and Health Administration (MSHA); and state agencies, including the Alaska Department of Environmental Conservation (ADEC).

Spur roads and mine development plans would expand the geographic scope of ground disturbance and dust deposition. In addition, actions that cause or exacerbate erosion may release or wash NOA into streams or other water bodies.

Some local communities are anticipated to connect to the fiber optic line that has been proposed within the roadbed. Trenching to bury fiber optic lines could have adverse localized impacts on soils and permafrost. Recent fiber-optic cable installation along the Dalton Highway has caused permafrost degradation and the development of thaw ponds. As permafrost degrades, it becomes more prone to erosion; thawing makes sediments unstable, which leads to increased erosion and sedimentation. Above-ground connections or best practice installation practices would minimize impacts of community connections.

3.2.2 Sand and Gravel Resources

Affected Environment

DOWL (2011a) studied potential borrow sources for Alternatives A and B based on previous DGGS studies (Reger et al. 2003a–g). DOWL (2011a) mapped ice-rich morainal silty gravels along these routes, but stated that less silty, Quaternary alluvial and glacial outwash gravels may be present locally. DOWL (2011a) estimated that material sources consisting of floodplain alluvium, silty alluvium, and bedrock would be available approximately every 5 to 10 miles along Alternatives A and B. A review of aerial imagery, geologic maps, and topographic maps along Alternative C indicates the majority of borrow sources would likely be in bedrock, and material source spacing would vary from approximately 5 to 30 miles. Silty alluvial sources may be present in river floodplains or local glacial outwash deposits.

Environmental Consequences

Road Impacts

The construction of the road would require large amounts of sand and gravel, embankment material, and aggregate resource, as well as sources of riprap. The current and future characteristics of subsurface soils and final road design dictate the volume and quality of material resources required for road construction. Field studies, site-specific explorations, and laboratory testing would be required to evaluate potential material sources and available material quality and quantities.

AIDEA has identified potential material sources along each alternative of sufficient volumes to construct the project and provide additional materials needed for routine maintenance and repairs of areas experiencing thawing and subsidence. Geotechnical investigations supplying data on the specific sizes, grades, and actual quantities have not been conducted. It is not currently known if there are sufficient volumes of materials that are clean of NOA. Surficial deposits that have not been evaluated are likely to have come from such bedrock ground down by previous glacial action. It should be anticipated that measurable concentrations of asbestos may be present in unconsolidated surficial deposits near bedrocks with high or medium potential for NOA (see Volume 4, Map 3-2). Potential material sites will be investigated and tested to determine if asbestos is present. DOT&PF has guidance for excavation activities and testing procedures for material sites (DOT&PF 2012a).

If NOA is determined to be present, and no alternative material sites without asbestos are available, it is presumed that AIDEA and the owners of the material sites would seek immunity provided by House Bill (HB) 258 (www.legis.state.ak.us/PDF/27/Bills/HB0258Z.PDF) to cover the use of NOA gravels for roadbeds or subgrades. HB 258 provides immunity to landowners, suppliers, contractors, and others for claims arising in connection with the use of gravel or aggregate materials classified as containing NOA (i.e., materials with equal to or greater than 0.25 percent asbestos). To obtain immunity, the use of NOA materials must comply with DOT&PF's *Interim Guidance and Standards for Naturally Occurring Asbestos (NOA) Material Use* (DOT&PF 2012a), which includes procedures for testing and minimizing dust, and specifies where the materials may be used and not used. For example, roads would need to be either paved or capped with materials free from measureable NOA.

No Action Alternative Impacts

There would be no demand on local sand and gravel material sources, or change to the existing placement of NOA or acid-bearing rocks due to this project, and therefore no impacts on these resources under the No Action Alternative.

Impacts Common to All Action Alternatives

Potential impacts from road construction and maintenance include the removal of sand, gravel, and bedrock resources for embankment fills and road surfacing from material sites. The development of material sites would affect vegetation cover, topography, drainage patterns, the thermal regime of subsurface soils, wetlands and aquatic resources, wildlife and birds, and air quality (e.g., fugitive dust). The BLM could require mitigation for impacts from material sites be included in specific material site mining plans on BLM-managed lands. Appendix N provides BLM's standard stipulations for material sites. If these mitigation commitments are applied, they would avoid, minimize, and potentially compensate for unavoidable impacts. Additionally, material site development could expose ARD or NOA materials to the environment, with associated impacts. AIDEA has proposed site-specific geotechnical explorations be performed to evaluate potential material sites (see Appendix N). Such geotechnical testing would be expected to identify the presence of ARD or NOA to avoid unnecessary cuts and unintentional exposures.

Material containing asbestos can be used within the road embankment if it is sufficiently capped or paved (DOT&PF 2012a). The applicant has proposed to avoid the use of NOA materials unless no other suitable materials are available. If NOA materials are the only feasible option for road construction, AIDEA would follow DOT&PF's interim guidance (DOT&PF 2012a) and standards for NOA material use (17 Alaska Administrative Code [AAC] 97). Following this guidance would help minimize the potential for airborne asbestos in fugitive dust.

Estimated required borrow material for road construction under the action alternatives would be approximately 15 million cubic yards (Alternative A), approximately 16.8 million cubic yards (Alternative B), and approximately 22 million cubic yards (Alternative C; DOWL 2019b). DOWL estimated that material sources would be available approximately every 10 miles along: 93 percent of Alternative A (DOWL 2019b), consisting of floodplain alluvium, silty alluvium, and bedrock (DOWL 2015); 95 percent of Alternative B (DOWL 2019b), consisting of floodplain alluvium, silty alluvium, and bedrock (DOWL 2015); and 84 percent of Alternative C (DOWL 2019b). A review of aerial imagery, geologic maps, and topographic maps along Alternative C indicates the majority of borrow sources would likely be in bedrock, and material source spacing would vary from approximately 5 to 30 miles.

<u>Mining, Access, and Other Indirect and Cumulative Impacts</u>

Indirect and cumulative impacts include the change of topography, drainage, and thermal regime due to material site and access road development. These changes may lead to permafrost warming or thawing, which may affect road performance and maintenance and water quality. Locations of material sites and access roads should be chosen and designed based on site-specific geotechnical explorations to mitigate these potential indirect impacts.

Indirect future actions, such as additional ground-disturbing road construction and mine development, may disturb the existing placement of NOA and acid bearing rocks in the area. State of Alaska material use guidance and standards address the use of NOA materials on projects, but does not address mining activities such as rock crushing and blasting. The development and operation of the mines would be under the auspices of multiple agencies and laws, including the Clean Air Act and Safe Drinking Water Act; federal agencies with asbestos regulations, including OSHA and MSHA; and state agencies, including

ADEC. See Appendix H for additional details on mining and other reasonably foreseeable development impacts.

3.2.3 Hazardous Waste

Affected Environment

Hazardous waste is not a resource that could be affected by the proposed project; rather, it is a potential condition in the environment that could affect natural resources and human health if exposed to air, water, or soil pathways. The physical environment section of this chapter discusses hazardous waste because it is often found buried or has spilled and seeped into the soil or groundwater. The project area has had limited human or industrial activities that could have resulted in solid or hazardous wastes being introduced into the environment. Localized spills and contaminated sites are present near existing communities and along the Dalton Highway and Trans-Alaska Pipeline System (TAPS), which form the eastern boundary of the project area. ADEC's contaminated sites database indicates there are no contaminated sites within 5 miles of Alternatives A and B; however, 17 contaminated sites are located within 5 miles of Alternative C, with the closest active site located approximately 1.5 miles away (see Appendix D, Table 4, and Volume 4, Map 3-3).

Environmental Consequences

Road Impacts

Construction and operation of the roadway would transport chemicals and produce solid waste in an area with limited human or industrial activity, which could result in solid or hazardous wastes being introduced into the environment. The road project would be anticipated to include the transportation, storage, and use of diesel and other fuel products; oils and lubricants for road construction and maintenance of equipment; and dust palliatives. Transportation on the road would include the movement of fuels (including liquefied natural gas for mine power production), chemicals, and supplies to support the development and operation of the mines, as well as the movement of wastes and ore concentrates. All of these actions involve substances that could be toxic to organisms, including humans.

Impacts from spills vary, based on the material type, size, and season. Substance behavior—if released into the environment—is influenced by environmental factors (current weather or season), the environment onto which the spill occurs, and the physical and chemical properties of the spilled material. Appendix D, Table 5, describes potential spill behavior during the 4 seasons, as described in the Alpine Satellite Development Plan EIS. A spill prevention and response plan would be developed to guide construction and operation activities. The plan would identify measures to reduce the potential for fuel spills, locations of spill response materials, and training of construction and maintenance staff on spill response.

No Action Alternative Impacts

Under the No Action Alternative, there would be no generation of solid waste, wastewater, or spills of oils or other hazardous substances in the project area attributable to the project.

Impacts Common to All Action Alternatives

All action alternatives would generate solid waste consisting of food wastes, sewage sludge, and other nonhazardous burnable and non-burnable wastes from road construction, operations, and maintenance. Solid wastes would be separated and stored in approved containers until they are incinerated or transported to an approved landfill. Burning waste would temporarily affect air quality.

Spills are not a planned activity and are unpredictable in cause, location, size, time, duration, and material type. However, they are likely to happen, given the expectation of regular use of the road over a 50-year period by vehicles, all of which are likely to require fuel and lubricants. A large percentage of vehicles on the industrial road would transport bulk shipments of fuel or chemicals. The majority of construction spills tend to be relatively small amounts of refined products, such as gasoline, diesel, and lubricating and hydraulic fluids resulting from vehicle and construction equipment fueling and maintenance. Most small spills would likely occur on the road prism (road surface and road embankment). A tanker truck accident or a fuel storage tank failure is the most likely source of large spills.

Chemicals used in mining processes would be transported along the ROW. The applicant provided a list of commonly used chemicals anticipated to be shipped via the road, including copper sulfate, hydrochloric acid, lime, methyl isobutyl carbinol, sodium cyanide, sodium diisobutyldithiophosphinate, sodium isopropyl xanthate, sulfuric acid, zinc sulfate, and adipic acid (DOWL 2016a). These chemicals are toxic and would be transported dry or in sealed containers to minimize risk of exposure to humans and aquatic environment should a vehicle collision or turnover occur. Permits and authorizations for the mines would address transportation, storage and usage, and emergency response procedures for hazardous materials used in mining activities.

Mining activities to extract minerals would also result in ore concentrates that may contain toxic dusts, including lead and zinc. The applicant has committed to requiring mineral concentrates be loaded into specialized (sealed) intermodal bulk shipping containers for transport to port. With this containerized system, metal releases from the transport of ore concentrate would not be expected to be commonplace. Diesel fuel, gasoline, lubricants, liquefied natural gas, listed chemicals, and ore concentrates could be toxic to plants, animals, and people, sometimes at low concentrations in air, water, or soil. Uncontained larger spills that left the gravel road embankment could kill or damage plants, fish, wildlife, and human road users and pollute water, soil, and air.

All action alternatives have similar total transportation lengths to and from Fairbanks. All action alternative embankments would be surrounded by approximately 60 percent wetlands and waterbodies within 328 feet (100 meters; see Section 3.3.1, Vegetation and Wetlands). Contaminant releases near wet areas and beyond the gravel embankments would have short migration pathways to aquatic habitat. Once contaminants reach unfrozen waterbodies, clean up and removal would be difficult.

Because the area is remote and little infrastructure exists, the existing capacity for response to spills is limited. While the statewide capacity for oil spill response is well established, there is minimal capacity to handle a spill of liquefied natural gas or chemicals such as sodium cyanide. Response plan development would be required to comply with regulations regarding spill prevention, containment, preparedness, and response. Appendix N, Section 3.2.3 (Hazardous Waste), outlines potential mitigation measures for hazardous waste, solid waste, and fuel handling and transport. If such commitments are applied, the potential risk of spills may be reduced, and adverse impacts from resulting spills may be minimized but are not expected to be eliminated.

Alternatives A and B Impacts

Construction of Alternative A or B would be shorter than C, resulting in less vehicle equipment and vehicle maintenance associated with the construction activities. This may result in less incidences of construction related leaks and spills. The shorter distance to the Dalton Highway with Alternatives A and B, however, results in longer driving distances on the Dalton Highway and increased risk of fuel truck spill on the highway relative to Alternative C. The controlled access of the proposed road may reduce the likelihood of spills.

Alternative C Impacts

Where Alternative C traverses the Ray Mountains, the alignment is anticipated to have more steep sections than Alternatives A and B, which could result in more difficult driving conditions and more risk of contaminant releases as a result of vehicle accidents. The Alternative C alignment also crosses more streams and follows several streams, resulting in a greater percentage of the alignment in or within 1,000 feet of estimated floodplains (see Section 3.2.5, Water Resources), which could increase risks of contaminant dispersion and difficult cleanups.

Mining, Access, and Other Indirect and Cumulative Impacts

Reasonably foreseeable development actions would increase the potential of spills in the project area. Development and operations of large-scale mining operations in the District would likely include the transportation of liquefied natural gas by tanker truck. Spills and potential risk of spills as a result of the development and operation activities of mines as identified in Appendix H are more predictable and more serious than those discussed above as part of the proposed road project. Toxic chemicals would be stored on site as part of any developed mine and used as part of their ore extraction and concentration process. Any contaminants released to the environment through any activity made possible by the road, including but not limited to large-scale mining, would be addressed in coordination with the ADEC and EPA. The action taken to remediate environmental impacts of the release would be site specific, protective of human health and the environment, and consistent with all environmental laws and regulations. The Alaska Department of Natural Resources (ADNR) Office of Project Management and Permitting typically coordinates large mine permitting. ADNR Division of Mining, Land and Water, Dam Safety and Construction Unit, would review dam design and operation for state certification, and ADEC would issue permits to authorize the disposal of tailings, waste rock and wastewater, and ensure compliance with applicable water quality standards. Regardless, tailings dam failures occur and could have major adverse effects to water quality, fish and wildlife habitat, fish and wildlife mortality, and human mortality. It is not possible to state with specificity spill impacts from mining because no specific mining proposal has been made. However, the risk of spills and impacts from spills would be anticipated to be similar to the risks addressed in BLM's Donlin Gold EIS, Section 3.24, Spill Risk. That EIS evaluated spill risk associated with diesel fuel, liquefied natural gas, mercury or cyanide used in ore processing, and mine tailings stored behind a tailings dam. These are appropriate examples of the types of spills and impacts that could occur in similar mining operations. See Appendix H for additional details on mining and other reasonably foreseeable development.

3.2.4 Paleontological Resources

Affected Environment

Paleontological resources include fossilized and non-fossilized remains of ancient life. According to the BLM (2016a), little work has been done to inventory paleontological materials on BLM-managed lands in the Central Yukon planning area. However, a wide range of plant and invertebrate fossils are known across the area. The nature of the paleontological resources in the Central Yukon planning area spans the Paleozoic Era (approximately 540 to 250 million years ago) to the Cenozoic Era (approximately 65 million years ago to present). All types of vertebrate and invertebrate animals and plant specimens are reported, with the large mammal vertebrate remains concentrating in the Pleistocene epoch (approximately 1.8 million to 10 thousand years ago). Vertebrate fossils within the planning area typically fall within the Pleistocene or Cretaceous (approximately 144 to 65 million years ago) age classes, with the earlier Cretaceous being much rarer.

The BLM is required to use the Potential Fossil Yield Classification (PFYC) system, which is a tool for assessing potential occurrences of paleontological resources in mapped geologic units. The PFYC system provides baseline information for assessing paleontological resources and provides a consistent and streamlined approach to determine if an action may affect paleontological resources on public lands. The system is created from available geologic maps and assigns a class value to each geologic unit. PFYC values range from Class 1 (very low) to Class 5 (very high), and indicate the probability for the mapped unit to contain significant paleontological resources and the degree of management concern for the resource. Geologic units without enough information to assign a PFYC value are assigned Class U (Unknown Potential). PFYC values for geologic units in Alaska were first assigned in 2010 (Armstrong 2010), and an updated geospatial PFYC model for Alaska is currently being developed. Based on preliminary results, PFYC values for the mapped geologic units in the project area range from Class 1 (very low) to Class 2 (low). No Class 3, 4, or 5 values are identified. Class U values are present, but are primarily assigned to bodies of water. There are no previously-recorded paleontological locales in the project area.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Current changes to paleontological resources, such as increased exposure due to changes in permafrost, riverbank erosion, and weathering, would continue to occur. There would be no potential direct impacts on paleontological resources as a result of the project under the No Action Alternative.

Impacts Common to All Action Alternatives

Direct impacts on paleontological resources could occur during material site development and gravel mining due to construction. Indirect impacts on paleontological resources may occur in areas cut for roadway or airstrip construction, or during material site excavation. Since the paleontological resources in the project area have not been extensively studied, infrastructure construction may support additional scientific research and identification of paleontological resources (e.g., during geotechnical testing, road cuts, or further cultural resource investigations). Similarly, improving access to areas with paleontological resources may result in unauthorized fossil removal, looting, and damage. Removal of ground cover could expose fossil-bearing units that would then expose the unit to weathering influences, which may damage the resource and its context.

Appendix D, Table 7, summarizes anticipated acreage of impacts on PFYC units. No Class 3 (moderate), 4 (high), or 5 (very high) acreages are impacted, although some areas are unevaluated. Impacts on Class W (water) would be mitigated by bridge structures.

Alternative A Impacts

The Alternative A footprint crosses geologic units identified as Class 1 (very low) and 2 (low) for paleontological resources. See Appendix D, Tables 6 and 7, for more detailed descriptions.

Alternative B Impacts

The Alternative B footprint crosses geologic units identified as Class 1 (very low) and 2 (low) for paleontological resources. The Alternative B footprint disturbs approximately 600 more acres than Alternative A due to its longer length. See Appendix D, Tables 6 and 7, for more detailed descriptions and project classifications.

Alternative C Impacts

The Alternative C footprint crosses geologic units identified as Class 1 (very low) and 2 (low) for paleontological resources. Alternative C footprint impacts the most acreage of all alternatives due to its longer length. Approximately 400 acres (5 percent) of the Alternative C footprint has unknown potential, and would be identified for medium to high management concern until field surveys or additional research is performed. See Appendix D, Tables 6 and 7, for more detailed descriptions.

Mining, Access, and Other Indirect and Cumulative Impacts

Ground-disturbing activities from past and present activities (see Appendix H) may have affected paleontological resources in the project area in areas of mineral exploration or community infrastructure construction for airports or local roads. Reasonably foreseeable future actions (see Appendix H) that could affect paleontological resources include mine and road development in the project area. Scientifically significant paleontological resources on federal lands are protected under the Paleontological Resources Preservation Act (16 United States Code [USC] 470aaa – 470aaa-11). Activities with the potential to adversely affect paleontological resources are typically required to have professional inventories filed with the BLM before specific development projects begin (BLM 2018a). These include requirements to minimize or eliminate adverse impacts on paleontological resources. Mine and road development on state-owned lands would be required to coordinate with the state land manager, as stipulated under the Alaska Historic Preservation Act (AS 41.35), which specifically covers fossils. The effects of climate change could influence the rate or degree of permafrost melting, resulting in exposure or damage to paleontological resources, contributing to potential cumulative impacts. The No Action Alternative would have no potential cumulative impacts on paleontological resources.

3.2.5 Water Resources

Affected Environment

Overview

The water resources of the region are influenced primarily by climate and topography. Moderately warm summers and cold winters prevail, with mean daily temperatures below freezing from the beginning of October through the end of April and snowfall occurring from September to May. Average annual precipitation is only 17 inches, but varies slightly throughout the area due to microclimate conditions such as elevation and topography (BLM 2016a). The project area has limited coverage from meteorological or hydrological recording stations. Some climate records are available from the National Centers for Environmental Information for Bettles and Coldfoot, Hogatza River, and Kiana and Selawik on the east, south, and west sides of the project area, respectively. Appendix D, Tables 8 through 12, show data for these stations. Appendix D, Tables 8, 9, and 11, show mean monthly precipitation values for Coldfoot, Bettles, and Selawik.

Surface Waterbodies

The topography of the project area defines the drainage basins, major rivers, and general direction of flow. The area is generally comprised of the Yukon River watershed and its tributaries, which enters near the southern boundary of the project area where it crosses the Dalton Highway and flows southwest to the Bering Sea (see Volume 4, Map 3-5). Large rivers joining the Yukon include the Ray, Big Salt, Tozitna, Melozitna, and Koyukuk rivers. The Brooks Range, to the north, is the headwaters for many of the rivers flowing south and then west. The Koyukuk basin rises in the Chandalar Shelf east of the Dalton Highway and parallels the highway south, and then west, to join the Yukon River south of the project area and empty into the Bering Sea. Large rivers joining the Koyukuk include the Wild, John, Alatna (includes the Malamute Fork of the Alatna), Indian, Hughes Creek, and Hogatza rivers. The Kobuk basin rises in the Brooks Range and flows south and then west to the Chukchi Sea. Large rivers joining the Kobuk include the Reed, Mauneluk, Kogoluktuk, and Shungnak rivers and Beaver Creek. Volume 4, Map 3-6, depicts these major rivers and lakes, and Appendix D, Table 13, lists the large rivers, headwater origins, receiving waters, drainage areas, and alternatives that cross them.

In addition to the large rivers noted above, hundreds of named and unnamed smaller rivers and streams intersect the proposed alternatives, requiring 2,921 to 4,585 additional bridge and culvert crossings as identified in Appendix D, Table 17. These smaller rivers and streams provide water conveyance, fish habitat, floodplain storage, and watercourse/wetland connectivity.

According to BLM's *Central Yukon Resource Management Plan, Analysis of Management Situation* (BLM 2016a), streams typically have low dissolved solids, dissolved oxygen near saturation, and neutral to moderately basic pH. Water temperatures during summer are typically less than 57°F. Appendix D, Table 14, provides the location, period of record, and type of data collected for the U.S. Geological Survey (USGS) gages. Appendix D, Table 15, provides similar data for the University of Alaska Fairbanks–Water and Environment Research Center stations. Volume 4, Map 3-5, shows the distribution of the river monitoring stations within the project area.

Several large lakes exist along the northern routes (Alternatives A and B) near the southern boundary of GAAR, including Walker Lake, Nutuvukti Lake, Lake Selby, and Narvak Lake (within the preserve), and Iniakuk Lake, Norutak Lake, Lake Minakokosa, Avaraart Lake, and Kollioksak Lake (outside the preserve). Large lakes along the Alternative C route include Klalbiamunket Lake (near Hughes) and Lake Tokhaklanten, but no information on their water quantity, quality, or bathymetry is available. The many small lakes within the project area are located primarily along the lower gradient sections of the rivers or wetland areas. Lakes are prevalent along the Kobuk River, Kogoluktuk River, Mauneluk River, Pah River Flats, and Kanuti National Wildlife Refuge (NWR), including the Kilolitna, Kanuti, Alatna, John, Wild, and Koyukuk rivers. No information on water quantity, quality, or bathymetry for these lakes was available[3].

Limited surface waters within 5 miles of the alternatives have been reserved for mining and drinking water. See Appendix D, Table 16, for ADNR-listed surface and subsurface water uses.

The USACE has authority over navigable waters in Alaska that are regulated under Section 10 of the Rivers and Harbors Act. As of October 19, 1995, the USACE Alaska District had identified 4 rivers meeting the definition of navigability that could be affected by the project. USACE (1995) considers the following river segments: the John River from its confluence with the Koyukuk for 105 miles upstream, the Kobuk River from the Chukchi Sea upstream for 200 miles, the Koyukuk River from its confluence with the Yukon River upstream for 544 miles, and the Yukon River for its entire length of 1,432 miles in Alaska. None of these river segments within the project area is subject to tidal influence.

The Seventeenth U.S. Coast Guard District also makes navigability determinations to determine its jurisdiction on specific waterways or portions of waterways in Alaska. These determinations are subject to change or modification pursuant to 33 CFR 2.45. Under Section II, Internal Waters Determined to be Navigable Waters of the United States, the list represents waterways for which the U.S. Coast Guard (USCG) has made a navigability determination. Omission of a waterway from this list does not mean the waterway is not navigable, just that no determination has been requested. This list includes the entire length of the Dietrich River (a tributary to the Middle Fork of the Koyukuk River), the Kobuk River from its mouth to the Village of Kobuk, and the entire length of the Yukon River in Alaska. Boats are known to use many rivers and streams in the project area. Section 3.4.2, Transportation and Access, and Section 3.4.3, Recreation and Tourism, discuss some of these uses.

[3] Because of the distance of the alignments from these waters, the BLM determined that the lack of data was not relevant to understanding reasonably foreseeable significant adverse impacts and that this data was not essential to making a reasoned choice among alternatives.

Flooding and Hydrology

Records of discharge and stage as well as precipitation in the project area are limited. Flooding can be the result of snowmelt in years with high snowfall and accumulation of snow water equivalent in the catchment in late spring, ice jams during breakup (frequent in the area), or excessive rainfall during summer. Generally, maximum discharge occurs during spring breakup, which usually happens during the latter part of May south of the Brooks Range (BLM 2016a). Gage records for Jim River near Bettles indicate that peak flows occurred during the typical spring breakup period and fall rainstorms. Studies estimated the Koyukuk River at Hughes reached a discharge of 330,000 cubic feet per second during a flood event resulting from 2 high-precipitation events approximately 1 week apart in August 1994 (Kane et al. 2015). This event resulted in floods in Allakaket, Alatna, and Hughes that Kane et al. (2015) estimated to be 100-year runoff events. Many river basins within the project area likely have similar hydrology. Flows in the larger rivers are usually at a minimum in March and maximum in June, July, or August, and winter flows are generally about 20 percent of peak summer flows (BLM 2016a). The south-flowing rivers originating in the Brooks Range likely experience flooding from snowmelt and ice jamming more than from large rainfall events. These rivers would be expected to experience overbank flows during breakup each year, especially at locations where ice jams impede conveyance. The wide river valleys with lower slopes, such as the Lower Koyukuk, Kanuti, and Lower Kobuk, drain a considerably larger area and may experience more summer flooding than snowmelt or ice jam flooding.

Subsurface Water (Groundwater)

Like most areas underlain by permafrost, groundwater is mainly contained within the thaw bulbs of rivers and lakes. Mountainous and steep river reaches tend to have braided channel systems with potential for water transport within the bed or gravel substrate. These systems are more likely to develop aufeis when local geologic features or springs result in water pushing to the surface during extreme cold periods or during increasing subsurface discharge. Increased aufeis development could occur when the ground is disturbed, especially in instances where groundwater or intra-streambed water flow is restricted. Studies have reported no significant aufeis accumulations (lasting into summer); the lack of late spring/summer imagery precludes identification of likely areas where formation is possible. Thaw bulbs could become extensive in lowland river valleys characterized by meandering channels. Groundwater sources may be considerable, especially in areas where the mean average ground temperature is near 32°F (see Volume 4, Map 3-1). It has been noted that snow and ice fields on the south side of the Brooks Range feed important springs that emerge on the north side of the Brooks Range within the Arctic NWR (Yoshikawa et al. 2007; Kane et al. 2013).

The ADNR Division of Mining, Land, and Water maintains a list of water rights and temporary use authorizations for subsurface and surface sources. Within approximately 5 miles of the project alternatives, there are 7 subsurface water use permits, certificates, and pending actions, including the City of Hughes, City of Kobuk, and several private uses. Surface water rights exist for the City of Shungnak and a private entity (see Appendix D, Table 16). The public and private drinking water supplies provided by drilled wells are at least 1.6 miles from the nearest alignment alternative and should, for the most part, be unaffected by potential roadway spills. The City of Kobuk well, however, is likely influenced by the water quality of the Kobuk River. While located 1.6 miles upstream of Alternative C, it is also downstream of Alternatives A and B and could be impacted by spills on those alternatives. The public drinking water supply for the City of Shungnak is a surface water supply from the Kobuk River and would be more affected by spills near the Kobuk River. This supply is 5.2 miles (approximately 10 river miles) downstream from Alternative C. This analysis has not identified specific areas of snow collection for water supply/sources for villages.

Water Quality

Limited water quality information is available, other than measurements made at the water monitoring stations described in Appendix D, Tables 8, 9, and 11. However, the majority of streams and lakes within the project area are undisturbed and have little to no human-caused impacts on water quantity, water quality, riparian function, or stream stability. Except for elevated sediment levels in summer due to glacial melting, water quality is generally good to excellent (BLM 2016a). For these reasons, the BLM determined the lack of data was not relevant to understanding reasonably foreseeable significant adverse impacts and this data was not essential to making a reasoned choice among alternatives. Because of natural occurrences of asbestos, many rivers or streams in Alaska already have relatively high levels of asbestos. This is especially likely in rivers or streams that occur near areas that are found to have NOA. Due to climatic conditions, surface water and soils are frozen in winter, limiting pollution inputs into streams. Where surface-disturbing activities are or have been occurring, streams experience elevated turbidity during spring snowmelt and rainfall events. The ADEC Division of Water maintains a list of impaired waters; none of the waters within the project area appear on that list.

Environmental Consequences

Road Impacts

Water resources evaluated in this section include rivers, streams, lakes, and groundwater both in terms of quantity and quality. The analysis of impacts is based on available data for the water resources within the study area and the proposed Ambler Road conceptual design plans. This section also describes measures that could be implemented to avoid or reduce potential impacts on water resources.

Components and actions of the alternatives that have the potential to affect water resources during construction and operations include gravel mining; placement of gravel fill for infrastructure (e.g., road, access roads, pads, airstrips), placement of ice roads and ice pads during initial roadway construction (Phase 1 Pioneer Road), installation of culverts and bridges, extraction of water supply from local lakes or rivers (for construction of ice roads and ice pads, construction of roadway embankment, potable water use, and dust suppression), and wastewater discharge.

Potential impacts on water quantity and quality would include the following: blockage or convergence of natural drainage (overland flow); changes in stage and velocity of water flow; changes in channel/bank erosion and deposition (scour/sedimentation); increased turbidity during construction and operations; increased potential for overbank flooding; increased potential of aufeis formation; changes in groundwater flow; changes in the soil thermal regime and permafrost; hydrocarbon, mineral concentrate, or other toxic spills; acidification of surface water from exposure to ARD at road cuts; NOA released from gravel extraction or runoff from roadway gravels; fugitive releases of metals from haul trucks; and the demand for water supply.

Impacts were evaluated qualitatively and include an evaluation of potential temporary and long-term impacts on water resources for the construction and operation of the Ambler Road. Many of the impacts on water resources quantity and quality resulting from construction of any action alternative would be similar to impacts anticipated during the operations phase of that alternative. Appendix N, Section 3.2.5 (Water Resources) provides potential mitigation measures intended to avoid or minimize impacts on water resources, and other stipulations and best management practices (BMPs). These primarily include the appropriate design, construction, and maintenance of crossings (e.g., bridges, culverts, and drainage culverts). While these measures would address the primary flow passage beneath the roadway embankment, impacts to natural hydrology would remain. Dispersed overland flow would be concentrated into distinct flow channels leading to the culverts. Changes in water depth and velocity could still result in changes in erosion or sedimentation, ponding, or channel migration.

No Action Alternative Impacts

The road would not be built and there would not be impacts on the water resources associated with AIDEA's proposal under the No Action Alternative. Water resources would be affected by changing climate and permafrost conditions (see Sections 3.2.1, Geology and Soils, and Section 3.2.7, Air Quality and Climate) and other reasonably foreseeable future actions, as described in Appendix H.

Impacts Common to All Action Alternatives

The impacts are described as a result of specific components or actions taken in the construction and operation of the proposed road. Most actions span both construction and operations and also have multiple impacts on water resources. Appendix E, Chapter 3 Biological Resources Tables and Supplemental Information, Tables 13 through 15, quantifies wetland impacts, and Appendix E, Table 17, summarizes impacts to fish stream habitat.

The requirements of the ADEC Construction General Permit (CGP) describe control measures that must be used to manage storm water runoff during construction activities. These measures minimize erosion and reduce or eliminate the discharge of pollutants, such as sediment carried in storm water runoff from construction sites. Polluted storm water runoff could adversely impact fish, animals, plants, and humans and the permit ensures protection of water quality and human health. The Storm Water Pollution Prevention Plan (SWPPP) is part of the CGP and describes control measures and BMPs that will be used during construction and operation to minimize erosion; protect water bodies; control dust; and address dewatering, soil stabilization, treatment chemicals, fueling areas, spill notification, and inspections. The CGP and SWPPP would control activities associated with gravel extraction, placement of fill, and construction of bridges and culverts as well as maintenance operations.

Gravel for construction of the roadway embankment, airstrips, access roads, and pads, plus for annual maintenance operations, would be extracted from identified material sites along each alternative route (see Volume 4, Maps 2-3 and 2-4, for locations of proposed material sources for the action alternatives). Proposed material sites are located in a variety of terrains, including ridge, upland, and floodplain areas (see Appendix C [Chapter 2 Alternatives Tables and Supplemental Information], Table 2). There would be no mining within the beds of active streams. Removal of gravel from areas near streams, including floodplains, could result in changes to groundwater level and flow patterns, which is particularly important in fish spawning and rearing stream habitat. Gravel material sites in the floodplain also have the potential to be flooded during snowmelt or high-flow events, risking breaching of the material site into the stream corridor and resulting in increased sediment flow into the stream. If floodplains of meandering streams are not avoided for material sites, the stream's migration over time may also breach the gravel mine site. This could result in increased sediment introduction into the watercourse, changes in streambed characteristics, and degradation of fish habitat. Most potential material sites are underlain by permafrost and development of the site, and removal of surface vegetation may result in local permafrost thaw or thermokarsting, especially if the mine site is filled with snowmelt/floodwater or located in the floodplain of rivers or streams. Gravel mining would create some localized dust that could be carried to water bodies and downstream. Following reclamation, gravel mines in the floodplain may function like a natural lake, but would remain a risk to the natural stream habitat if breached due to channel meandering.

The construction of the gravel road and its associated infrastructure would compact underlying soil, potentially impact thaw depths, and reduce natural infiltration into areas below the gravel footprint, all of which could alter the shallow groundwater movement in the active layer. Groundwater flow beneath roadway embankments may increase the thaw of permafrost, requiring appropriate engineering design measures for flow beneath/through embankments (Darrow 2013; see Appendix N for potential measures). The gravel roadway embankment is proposed to be 3 to 8 feet thick, which provides additional insulation to underlying soils with the potential to reduce the active layer thickness. The gravel material, however, absorbs more solar radiation than the natural vegetation and could lead to increased permafrost thaw, especially on the south face of east-west roadway alignments. Placement of gravel fill could also cause changes in the patterns of natural surface drainage, leading to creation of new pathways or changes to existing drainage patterns.

Locally, reduced groundwater flow and interrupted surface drainage could result in areas of pooling on the uphill side of the embankment and drying of soils on the downslope side. Pooling would result in greater thermal absorption in summer, accelerating permafrost thaw and potential thermokarsting. Aufeis forms at locations where groundwater or stream flow is forced to the surface and freezes, such as upslope ditches and culverts when the active layer at the roadway freezes quicker than the upslope soils, pushing groundwater to the surface. Drying may reduce the vegetative cover, allowing increased solar absorption and permafrost thaw. The changes in surface and groundwater flow may result in increases or decreases in local stream flow and potential changes in timing of lake and wetland recharge. Soils on road embankments are more susceptible to erosion during snowmelt and rainfall runoff than vegetated areas, leading to increased turbidity of receiving waters.

During embankment construction, the disturbance of natural soils and dust from gravel placement would be increased, and dust would be deposited on snow and ice during the winter or on vegetation and open water during the summer. The sediments and dust could be introduced into waterbodies when melting occurs, causing an increase in turbidity. Construction impacts on water quality would be limited to entrainment of fine-grained fill material in runoff during snowmelt and rainfall events in summer, following construction. Changes in the configuration of the roadway embankment (Phase 1 to Phase 2 to Phase 3) would also increase construction type impacts of gravel placement.

Long-term effects of the gravel infrastructure over the life of the roadway include potential changes to the existing hydrologic regime, although this could be largely mitigated with properly placed culverts and bridges at defined waterway crossings and regularly placed cross-drainage culverts, as outlined in Appendix N. The gravel infrastructure would result in an increase in sedimentation and turbidity in nearby waterways because of erosion of the embankment materials. Water quality could be affected by the long-term accumulation of road dust during operations. While dust deposited directly into water sources may cause minor impacts, the dust that builds up over time on tundra or floodplain vegetation may cause a larger impact on water quality. During a rain event, accumulated dust could be washed into nearby waterbodies over a short period and increase turbidity, total suspended solids, and other pollutant concentrations depending on the makeup of the source material (see discussions of NOA in local minerals in Sections 3.2.1, Geology and Soils; 3.2.2, Sand and Gravel; and 3.4.5, Socioeconomics and Communities; see also NewFields 2019). Dissolved oxygen concentrations could be affected by increased turbidity. These increases in turbidity are similar to those that occur during high-flow events when sediments that have been deposited on bars and shorelines over time during low-flow conditions are suddenly mobilized and transported downstream.

Changes in road grade, vegetation clearing, plowed snow banks, guard rails, and bridge abutments change wind patterns, which in turn change snow accumulation and drifting patterns (NCHRP 2019: Section 3.10). Gravel fill from the roadway embankment would also change snow accumulation patterns, which, in turn, could change drainage patterns once the snow melts and increase inundation (flooding) or drying of affected areas. Snow drifting could also result in insulation of the surface soils, reducing the freezing of surface soils (active layer) and potentially increasing the depth of permafrost thaw. Increased inundation from melting snow accumulations could increase areas of pooling and thermokarst action, creating settlement, impounded areas of water, and increased permafrost thaw.

AIDEA proposes to complete bridge construction and much of the Phase 1 road during winter. As such, ice roads and pads are anticipated to be a necessary winter construction technique. Ice pads may be constructed to support gravel mine extraction activities, for staging equipment and supplies during construction, and for work platforms for bridge construction. River crossings and wetland area ice covers in some areas would likely be thickened to provide bearing capacity for heavy construction vehicles during initial pioneer road construction. Ice roads and pads could locally change snow accumulation patterns and may damage underlying vegetation. Ice roads in Alaska typically require approximately 1 million gallons of water for each mile of a 25-foot-wide ice road; however, individual road segments are not anticipated to be even 1 mile long. Approximately 250,000 gallons would be required per acre of ice pad. As discussed below, water necessary for construction of ice roads and pads would be withdrawn from lakes or large rivers near the construction activities as allowed by State of Alaska temporary water use authorizations and fish habitat permits.

During spring breakup, ice road segments across floodplains and ice pads could temporarily block sheet flow within drainages, altering the natural distribution of surface waters. Until ice roads melt, shallow groundwater and sheet flow may build up on the upslope side, potentially increasing permafrost thaw. To ensure adequate drainage at stream crossings, ice roads would be removed, slotted, or scored prior to spring breakup to avoid increased erosion of streambanks upstream and downstream of the crossing. Meltwater from ice roads and pads during spring breakup could have a temporary localized effect on specific conductance, alkalinity, and pH in the surrounding waterbodies. Spills or material releases (e.g., lubricants, oils, fluids) on ice roads or pads would be required to be removed prior to melt out as per appropriate BMPs.

The proposed project alternatives would require a number of bridges and culverts as defined in Appendix D, Table 17 (see DOWL 2016a: Appendix 5C, Maps 6 through 14, for diagrams showing typical culverts and bridges). Bridges have the potential to impact flow velocities and depths, especially during high-flow events, freeze-up and breakup ice runs, and ice jams. Bridges are defined as small (less than 50-foot span), medium (50- to 140-foot span), and large (multiple spans of up to 140 feet with sets of piers within the river channel). Bridges would be designed to pass a 100-year flood event with limited impact to the floodplain, minimal increase in water levels upstream of the bridge, and nominal changes in water velocity through the bridge opening. Abutments are proposed to be designed outside of the full channel width and would be protected from erosion by riprap or other appropriate scour protection. Large bridges would include piers within the river channel, which have a local impact on water velocity and bed scour around the piers during flood events. The piers should be located to minimize impacts on fish and boat passage while maintaining sufficient protection from scour in the event of channel shifting. Construction of piers in the river channels may impact water quality by disturbing substrate and temporarily increasing suspended solids. Construction of the bridges is proposed to be primarily during winter to minimize disruption of the riverbed during low flow conditions.

Consideration of boat passage is a USCG requirement for bridges on rivers the USCG has determined are navigable waters, and they would need to be designed to maintain a bottom chord clearance sufficient for boat passage. Boat size is likely to vary considerably depending on the water body, from canoes and rafts to loaded barges. The USCG would undertake navigability determinations for streams where no previous determination has been undertaken.

There is the potential for AIDEA to use a variety of methods to install steel or concrete bridge piers or abutment pilings into the earth. Some techniques use drilling fluids (drilling muds) to provide cooling to the drilling bit, provide stability to uncased borings, and facilitate moving cuttings to the surface. If used, there is the potential for this material, composed primarily of a combination of water, bentonite, and barite, to be discharged to the river (even in winter). If discharged, this material would increase turbidity and potentially deposit on the streambed in areas of low velocity, affecting fish habitat.

Culverts would be installed at defined drainages to maintain drainage patterns and connectivity of wetlands and other surface waterbodies and minimize floodplain impacts. Culverts are defined as major (11 to 20 feet in diameter), moderate (4 to 10 feet in diameter) and minor (3 feet in diameter) (see DOWL 2016a: Appendix 5C, Maps 6 through 14, for diagrams showing typical culverts and bridges). Major and moderate culverts would be embedded and are proposed to be designed according to fish passage criteria and natural channel design practices. AIDEA intends to provide fish passage at all perennial and well-established ephemeral stream crossings during Phase 1 construction. Flow constrictions and increased stream velocity may occur at the inlet and outlet of a culvert on a defined channel, which could lead to increased depths upstream of the culvert and potential streambed scour and bank erosion at the culvert outlet, with sediment deposition a short distance downstream of the culvert outlet. Culvert design is proposed to include insulation and bedding material beneath the culvert to facilitate groundwater flow at the crossings and to minimize aufeis formation. Riprap protection would also be provided at the inlet and outlet to prevent erosion of the embankment.

Cross-drainage culverts are proposed to be placed in gravel roadways to maintain natural surface drainage patterns. While defined drainage and connectivity culvert placement has been determined by aerial photography and the National Hydrography Database, additional cross-drainage culverts (size, placement, and need for fish passage) would need to be determined based on hydraulic design criteria and in consultation with regulatory agencies. Final design placement of culverts would need to be field-verified and reviewed with the Alaska Department of Fish and Game (ADF&G) for concurrence during permitting. The estimated spacing of cross-drainage culverts is every 1,000 feet; however, some culverts could be spaced closer than 1,000 feet to mitigate the impacts of sheet flow interruption and thermokarst action. AIDEA has proposed a design feature that cross-culverts in wetland areas without defined water channels be spaced approximately 150 feet apart (see Appendix N). Culverts would be installed during Phase 1 construction at the Phase 2 length required, with additional embankment cover to protect the culverts prior to the construction of the Phase 2 roadway embankment. Additional cross-drainage culverts could be placed after the first spring breakup as site-specific needs are further assessed with regulatory agencies, in combination with field observations of impacts on natural drainage patterns. During Phase 3 construction, the culverts would be extended as needed to accommodate the increased embankment width, which would result in local impacts on water quality by disturbing substrate and temporarily increasing suspended solids. Construction of the culverts in Phase 1 and increasing their length in Phase 3 would result in disruptions to the streambed and banks, and may impact water quality by temporarily increasing suspended solids.

Water access points would be located along the routes at rivers and lakes to provide water for construction activities, maintenance (dust control), and potable water supply for maintenance or fueling stations. While the specific locations of water access points have been proposed within GAAR, they have not all been identified outside of GAAR. Some water access points also identify the footprint for access roads leading from the Ambler Road to the water location. Water for construction and maintenance of any ice roads (stream and river crossings) and pads, and domestic use at the construction camps during construction activities would be withdrawn from lakes or large rivers near the construction activities. State of Alaska temporary water use authorizations and fish habitat permits would be required. The permit requirements limit the amount of water that can be withdrawn from these sources. Withdrawals of unfrozen water from lakes during winter would be anticipated to be subject to stipulations and BMPs similar to those for North Slope activities described by the BLM (2013a). If sensitive fish are present in these lakes, water withdrawal is limited to 15 percent of the estimated water volume below 7 feet. In lakes with only non-sensitive fish present, water withdrawal is limited to 30 percent of the estimated water volume below 5 feet. In lakes without fish, water withdrawal is limited to 35 percent of the total lake volume (BLM 2013a).

Water withdrawal at individual permitted lakes is not expected to impact the hydrology other than causing minor fluctuations in water levels during winter. The impacts would decrease as natural lake recharge occurred during spring breakup. Many lakes and wetland areas have surface and subsurface connections with adjacent lakes, whereby water withdrawals from a lake might lower the level of an adjacent lake. This effect would likely be short-lived due to the annual recharge processes from snowmelt during breakup and the high level of interconnectivity of the lakes. Temporary water quality effects from water withdrawals from ice-covered lakes during winter include decreasing dissolved oxygen concentrations, alkalinity, and pH until spring breakup and snowmelt. Water withdrawals may also occur from the larger rivers within the project area but may be limited to ice-free periods as winter flows are very low and access points may be difficult to maintain. Access roads to these water access points would be designed to avoid impacts on the floodplain (e.g., flow blockage, erosion of access pad), as water levels would have a greater variation from base flow to flood stage. See Appendix N for measures to avoid and minimize impacts.

Construction camps and maintenance stations would generate wastewater from typical domestic operations associated with food preparation and lodging of personnel. The construction camps would have a greater number of people at the camps but would be short duration (1 to 2 years for each construction phase). The maintenance stations would house fewer personnel, but may have a greater incidence of collected materials associated with vehicle maintenance and repair. Impacts of wastewater discharge would depend on the method of disposal. The road operator would be required to submit plans for waste management for review and approval by appropriate regulatory agencies, and these plans are anticipated to be similar to those at maintenance stations along the Dalton Highway. Wastewater would likely be treated in a small package plant and discharged to a drainfield. Solid waste would likely be incinerated and hazardous wastes would likely be trucked off site for proper disposal. Typical wastewater would be discharged through an engineered system that would meet ADEC requirements. Such a system typically would impact shallow groundwater in terms of increased release of warmer water and potential pollutants, including fecal coliform bacteria. Thermal impacts of these systems could also increase thaw of the permafrost, which could result in additional changes to the groundwater flow and potentially damage the system itself through thermokarsting of lagoons or failure of mounded septic systems. As the construction camps would be temporary, the efficiency of the treatment system must be considered in the design. If wastewater effluent is to be discharged to streams, appropriate ADEC permits would be required, which would also address impacts on the stream.

Spills, including fuels, chemicals, and ore concentrates are discussed in Section 3.2.3, Hazardous Waste. Their effects on water quality streams, lakes, and groundwater will be dependent on the type of spill, quantity of material spilled, time of year (frozen ground and surface waters), and the discharge in the receiving water body.

Human health hazards from drinking water containing asbestos are considered to be orders of magnitude less hazardous than the potential hazards due to airborne asbestos. The World Health Organization (2003) concluded, "although asbestos is a known human carcinogen by the inhalation route, available epidemiological studies do not support the hypothesis that an increased cancer risk is associated with the ingestion of asbestos in drinking-water." The EPA Drinking Water Standards set 7 million asbestos fibers per liter as the Maximum Contaminant Level for public drinking water. Runoff and fugitive dust washed off vegetation in areas where NOA is used in road construction would increase the concentration of asbestos in water resources.

Alternative A Impacts

Alternative A would have the shortest length and footprint area of main and access road embankments. Alternatives A and B have the same number of construction camps, maintenance stations, and airstrips.

Alternative A would have the least number of vehicle turnouts and material sites. With the least footprint area of gravel infrastructure (see Appendix C, Tables 1 and 2), Alternative A would be expected to have the least overall impacts associated with blocking surface and groundwater flow, redirecting surface drainage pathways, and increasing permafrost thaw as well as the least amount of increased turbidity associated with gravel placement during embankment construction or road dust washed into streams and rivers.

Also, as the shortest alignment, Alternative A would have the fewest number of minor culverts (2,869). It would have 15 moderate and 19 major culverts, which would be greater than Alternative B. The number of cross-drainage culverts required, in addition to these stream channel culverts, would also be expected to be the fewest of all the alignments. The total number of culverts would be the least of all the route alignments, and therefore would be expected to have the least impacts associated with flow constrictions, increased stream velocity at the culvert inlet and outlet, increased depths upstream of the culvert, potential streambed scour and bank erosion at the culvert outlet, and sediment deposition downstream of the culvert outlet.

The area of floodplain that would be impacted by the roadway embankment, drainage culverts (excluding additional cross drainage culverts), and impacts upstream and downstream of the culverts was estimated to be approximately 84.5 acres, which is the smallest of the alternatives (see Appendix D, Table 17). There would be 3 small bridges, 15 medium bridges, and 11 large bridges on Alternative A. Analysis indicates that 2,025 acres of floodplain would be affected for bridges in Alternative A (see Appendix D, Table 17).

The impacts of the roadway on water quality were estimated by determining the miles of roadway embankment in a floodplain or within 1,000 feet of a floodplain. For this estimate, the available floodplain vegetation mapping (primarily for larger rivers) was compared to the various alternative alignments. Floodplain mapping for smaller streams does not exist. For Alternative A, 4.61 miles of the roadway alignment would be located in a floodplain (primarily where it crosses rivers and streams), and a total of 16 miles are within 1,000 feet of a floodplain (includes the miles in the floodplain; see Appendix D, Table 18). These impacts to water quality of the floodplain areas should be considered in conjunction with impacts to wetlands and vegetation, which also affect water quality. Those impacts are discussed in Section 3.3.1, Vegetation and Wetlands, and Appendix E, Tables 13 through 15, and include the direct footprint impacts and dust impacts to different classifications of wetlands along the alternatives.

Alternative A has 3 more medium bridges than Alternative B. Two large bridges pass over different reaches of the Reed and Kobuk rivers for Alternatives A and B, but all other large bridges are the same for these 2 alternatives. The crossing over the Kobuk River (Wild and Scenic River designation) on Alternative A occurs within GAAR. The crossings of the Kobuk and Reed rivers on Alternative A are higher up in the basin, and therefore would experience lower discharges and would be further upstream from sheefish spawning habitat on the Kobuk River, farther downstream.

The alignment passes close (0.25 mile) to Lake Nutuvukti within GAAR and could impact water quality from roadway runoff. While the alignment may be within the sight distance of Walker Lake, it is approximately 3 miles away and not within impact distance for water quality.

Alternative B Impacts

Alternative B would be slightly longer than Alternative A (17 miles longer), and would follow the same alignment except for a short portion that travels in the near vicinity of and through GAAR. Since it is longer, it would have a greater number of access road embankment miles, vehicle turnouts, and material sites. Alternative B would have the same number of construction camps, maintenance stations, and airstrips as Alternative A. Alternative B would have a somewhat larger total infrastructure footprint (see Appendix C, Tables 1 and 2), and therefore would be expected to have greater impacts associated with blocking surface and groundwater flow, redirecting surface drainage pathways, increasing permafrost thaw, and a greater amount of increased turbidity associated with gravel placement during construction or road dust washed into streams and rivers compared to Alternative A (see Appendix D, Table 18).

Alternative B would have a greater number of minor culverts (3,155) than Alternative A but would have only 12 moderate and 12 major culverts, which is less than Alternative A. The number of cross-drainage culverts required, in addition to these stream channel culverts, would be expected to be greater than Alternative A since Alternative B is longer overall. Because the total number of culverts would be greater, Alternative B would be expected to have the greater impacts associated with flow constrictions, increased stream velocity at the culvert inlet and outlet, increased depths upstream of the culvert, potential streambed scour and bank erosion at the culvert outlet, and sediment deposition a short distance downstream of the culvert outlet.

The area of floodplain impacted by the roadway embankment, drainage culverts (excluding additional cross drainage culverts), and impacts upstream and downstream of the culverts is approximately 88.5 acres, which is greater than under Alternative A. The floodplain impact estimate of the bridges (3 small, 12 medium, and 11 large) indicates that 2,021 acres of floodplain would be affected by the bridges in Alternative B, which is slightly less than, but similar to, Alternative A.

The impacts of the roadway on water quality were estimated by determining the miles of roadway in a floodplain or within 1,000 feet of a floodplain where data exist. Floodplain mapping for smaller streams does not exist. For Alternative B, 5.43 miles of the roadway alignment would be located in a floodplain (primarily where it crosses rivers and streams), and a total of 17 miles are within 1,000 feet of a floodplain (includes the miles in the floodplain).

As stated above, the number of bridges is the same for Alternatives A and B except for the section where Alternative B loops to the south to minimize the length of roadway within GAAR. There are 3 fewer medium bridges on Alternative B than on Alternative A. The Alternative B crossing over the Kobuk River (Wild and Scenic River Designation) is longer than the crossing on Alternative A and occurs along a straight, faster moving section. The crossings of the Kobuk and Reed rivers on Alternative B are lower in the basin than those on Alternative A, and therefore would experience higher discharges and would be closer to sheefish spawning habitat on the Kobuk River farther downstream.

The alignment would, however, pass within 0.5 mile and upslope of Norutak Lake just outside of GAAR boundary and could be within impact distance for water quality from roadway runoff.

Alternative C Impacts

Alternative C would be longer than Alternatives A and B at 332 miles and would follow an alignment that would traverse along river valleys for a large part of its length. Since it would be the longest of the action alternatives, it would have the greatest number of access road embankment miles, vehicle turnouts, material sites, construction camps, maintenance stations (5), and airstrips (5) compared to Alternative A or B. As such, Alternative C would have a larger total gravel infrastructure footprint (see Appendix C, Tables 1 and 2) and would be expected to have the greatest impact associated with blocking surface and groundwater flow, redirecting surface drainage pathways, and increasing permafrost thaw as well as the greatest amount of increased turbidity associated with gravel placement during construction or road dust washed into streams and rivers of all of the alternatives (see Appendix D, Table 18).

Alternative C would have the greatest number of minor culverts (4,076), moderate culverts (131), and major culverts (141)—substantially more than either Alternative A or B. The number of cross-drainage culverts required in addition to these stream channel culverts would also be greater than Alternative A or B due to the length. The total number of culverts would be greater than Alternative A or B, and therefore would be expected to have the greatest impacts associated with flow constrictions, increased stream velocity at the culvert inlet and outlet, increased depths upstream of the culvert, potential streambed scour and bank erosion at the culvert outlet, and sediment deposition a short distance downstream of the culvert outlet of any of the action alternatives.

The area of floodplain that would be impacted by the roadway embankment, drainage culverts (excluding additional cross-drainage culverts), and impacts upstream and downstream of the culverts is approximately 181 acres, which would be greater than Alternative A or B. There are 79 small bridges, 158 medium bridges, and 14 large bridges. This number of bridges is much higher than Alternatives A and B. Floodplain analysis indicates that 4,092 acres of floodplain would be affected by the bridges in Alternative C—considerably more than Alternative A or B (see Appendix D, Table 17).

The impacts of the roadway on water quality were estimated by determining the miles of roadway in or within 1,000 feet of a floodplain. For this estimate, the available floodplain vegetation mapping (primarily larger rivers) was compared to the various alternative alignments. Floodplain mapping for smaller streams does not exist. For Alternative C, 54 miles of the roadway alignment would be located in a floodplain (primarily where it crosses rivers and streams) and a total of just over 96 miles are estimated to be within 1,000 feet of a floodplain (includes the miles in the floodplain)—much more than Alternative A or B. This is a result of the proposed Alternative C alignment traversing parallel to many of the stream drainage corridors rather than crossing them.

The crossing of the Kobuk River on Alternative C is approximately 1,400 feet wide and is lower in the basin than Alternatives A and B, and therefore would experience higher discharges and would be closer to sheefish spawning habitat on the Kobuk River.

Mining, Access, and Other Indirect and Cumulative Impacts

The greatest indirect impacts would arise from potential mine development. Mine development would include impacts from new mine access road construction in terms of changed surface and groundwater flow patterns, establishment of large infrastructure pads, and removal of vegetation and overburden soils. Hard rock mining often involves moving massive amounts of rock (open pit), which disrupts the natural surface and groundwater interaction and requires removal of water from the mine to be stored for reuse in tailings ponds. Large excavations would likely intercept the groundwater table, resulting in increased aufeis formation. Placer mining operations could result in extensive changes to channel alignment, bed and bank configuration, stream habitat, and floodplain geometry and function in addition to water quality, turbidity, and aufeis formation. Water supply and usage for the mining of rock, processing of ore, and maintenance of facilities, combined with potable water requirements, would be expected to have an impact on water quantity of rivers and lakes. Groundwater levels and permafrost within mined areas would be permanently disrupted. Impacts on water resources quality include increased dust from mining operations, potential spills and containment of ore concentrates, chemicals used in processing ore, fuels, and process water, in addition to wastewater from operations of facilities and camps, and may require treatment of toxic mine water in perpetuity (Hughes et al. 2016; Limpinsel et al. 2017; Woody et al. 2010). Indirect impacts from mine development would also be local to the mine development sites, but could be greater in terms of water quantity (water use), extent of impacts due to changes in drainage patterns, and potential water quality impacts from mine operations.

AIDEA has proposed that communities would be allowed to use the road for commercial deliveries. Therefore, other indirect impacts include the potential development of new access roads to tie into the

Ambler Road for delivery of commercial goods and fuel supplies. These roads would have the same types of impacts as the development of the Ambler Road in terms of water resources.

Impacts to permafrost and natural drainage patterns will continue to occur over the life of the project and mine operation. In areas of ice-rich permafrost, climate change would result in permafrost thaw and subsidence, potentially resulting in roadway embankment damage or changes in culvert inverts or alignments, which would cause additional changes to hydrology. Cumulatively, Alternative C has the most water resources impacts due to its length and would experience the earliest permafrost effects to the stability of the roadway.

3.2.6 Acoustical Environment (Noise)

Affected Environment

Natural sounds (e.g., wildlife, wind, water) and human-made sounds (e.g., vehicles, aircraft, boats) comprise the acoustical environment (or soundscape). Several factors influence sound, including distance from the sound's source, terrain, vegetation or ground cover, and atmospheric conditions (e.g., wind, weather). Sounds are considered noise when they have the potential to affect the natural acoustical environment, noise-sensitive receptors (i.e., wildlife and people who experience increased sensitivity or exposure to noise during activities), and values. Noise, measured in decibels, is based on perception (i.e., whether it disrupts normal activity or diminishes quality of life), and is affected by pitch, frequency, intensity, and duration. A-weighted decibels closely correlate to the frequency response of normal human hearing (see DOWL 2016a regarding noise metrics).

The study area is remote, with a soundscape primarily characterized by natural sounds (e.g., wildlife, birds, flowing water, wind, etc.). Human-made noise in the study area is intermittent, transitory, and generally concentrated at rivers. Human-made noise sources include off-highway vehicles (OHVs), snowmobiles, and motorized boats used for subsistence hunting and travel; fixed-wing aircraft and helicopter overflights; aircraft/helicopter and boat activity for recreation and research; and firearms associated with hunting.

The BLM conducted a Geographic Information System (GIS) examination of the affected environment consisting of a buffered area 2.5 miles from proposed infrastructure. This buffer was based on the impact distance identified for the Red Dog Mine noise analysis (EPA 2009). Noise-sensitive receptors in the area include the community of Kobuk, approximately 1 mile from Alternative C; GAAR where Alternatives A and B transect its southern portion; people crossing or accessing the area for subsistence purposes and recreation; and wildlife. The NPS contracted the development of a noise model to analyze noise impacts within GAAR. At BLM's request, NPS expanded the model calculations over the full length of Alternatives A, B, and C. See Appendix D, Attachment A, for the road model description and results (Betchkal 2019).

Part of the proposed project area transects the southern portion of GAAR. The NPS has policies/authorities to preserve soundscapes and reduce noise in parks (NPS 2000a, 2006a, 2006b).

Environmental Consequences

<u>Road Impacts</u>

Noise associated with construction and operation of the proposed project has the potential to impact people and wildlife in or near the study area by altering the acoustic environment/soundscape. Project sources of noise include construction activities such as blasting, pile driving, operating construction equipment and vehicles, diesel generator operations at construction camps, maintenance stations, material sites and radio communication towers, aircraft take-offs, landings and overflights, and vehicle operations along the roadway. See Sections 3.4.7, Subsistence Uses and Resources; 3.4.3, Recreation and Tourism; 3.3.2, Fish and Amphibians; 3.3.3, Birds; and 3.3.4, Mammals for additional information.

No Action Alternative Impacts

The No Action Alternative would not construct the proposed road, and therefore would not result in project-related noise effects for humans (residents, subsistence users, visitors) and wildlife (birds, mammals, fish) inhabiting or traversing the study area. Small-scale mining and exploration activities would likely continue, but noise impacts from these activities would be localized, intermittent, short term, and temporary. Most of the soundscape would be expected to generally remain unchanged from current conditions.

Impacts Common to All Action Alternatives

All action alternatives would introduce a new, 2-lane, all-season gravel road and supporting infrastructure (e.g., bridges, culverts, road maintenance stations, communication sites with towers, vehicle turnouts, material sites, access roads, airstrips) as well as associated air and ground traffic across a remote and mostly natural setting, altering its existing soundscape.

Noise from construction would dominate the acoustical environment near the activity for its duration (see Appendix D, Table 19, for noise levels for typical construction equipment and operations). Construction noise impacts would increase for each phase of the project based on the enlarging footprint and longer period/seasons of activities. The greatest impact during construction may come from impulsive noise (e.g., gravel mine and road cut blasting, bridge pile driving), which results in high-intensity, short-duration bursts. Birds and wildlife may perceive it as a threat, resulting in startle responses and avoidance.

Construction and operation would result in increased noise from aircraft (fixed wing and helicopter), which would be used to transport cargo and/or personnel. Noise impacts from aircraft activity would vary based on the type of aircraft (smaller aircraft are likely to be used), phase (landing/take-off is generally louder than level flight), location (e.g., at specific locations such as airstrips; along in-transit flight paths; dispersed locations for exploration, research, recreation), altitude (lower is louder), frequency (1 to 4 per week, depending on project phase), and timing in relation to locations and activities of receptors.

Construction and operation would introduce noise from ground transportation vehicles (e.g., gravel, semi-trailer, and fuel delivery trucks; lighter-duty vehicles; bulldozers; graders; compactors) into the study area. Truck traffic would increase over the 3 phases, and would be greatest once mine production peaks (maximum project annual average daily traffic [AADT] of 168 trips per day; see Appendix H). The NPS noise model assumes evenly distributed traffic throughout the year and day, averaging 6 heavy trucks per hour. The greatest contributors to road noise are vehicle braking and engine noise, and tires on the road surface. Traffic density and speed also affect road noise, with lower speed and density allowing for longer noise-free intervals. See Appendix D, Attachment A, for an estimate of decibel levels and maps showing the location of predicted noise increases (Betchkal 2019). Distance to where a person or animal's ability to hear traffic or construction noise would vary depending on terrain as well as temperature, wind direction, and existing natural conditions.

Overall impacts of construction and operation noise would be of medium to high intensity, local to regional extent, and construction impacts would be temporary. All project sounds would attenuate to low intensity as distance from the source increased. Construction and operation noise would potentially cause local changes in wildlife movement and distribution patterns, but would be unlikely to cause population-level impacts. See more on wildlife effects from noise in Sections 3.3.3, Birds, and 3.3.4, Mammals. Construction and operation noise would potentially reduce the sense of isolation and solitude that village residents and visitors in and near the study area currently value.

Appendix N lists potential mitigation measures and design features that would minimize noise, such as keeping vehicles and mufflers in good operating condition. Noise barriers are not considered practical over such long distances. Requirements such as good mufflers and limiting use of air brakes would reduce traffic sounds but would not completely stop the sound propagation from the road.

Alternatives A and B Impacts

Alternatives A and B would have similar impacts. Traffic noise impacts are identified at an average width of 3.7 miles across the lengths of both alternatives (centered on the roadway), after which natural conditions would limit a person or animal's ability to hear truck noise at distance (See Appendix D, Attachment A). It would not be anticipated that the nearest communities to these alternatives (Bettles/Evansville and Kobuk, at 8 and 9 miles distance, respectively) would be affected by traffic noise under typical conditions. Alternatives A and B would cross GAAR, resulting in additional impacts on visitors. When compared to other NPS units in Alaska and the Lower 48, GAAR is relatively free of noise (e.g., Walker Lake North has the lowest observed noise event rate of any site in the national park system to date; Betchkal 2015). Walker and Nutuvukti lakes, near Alternatives A and B, are primary access points for the southern portion of GAAR, so visitors would experience noise impacts from construction and operation of the alternatives. Alternative B crosses the Kobuk and Reed rivers, so visitors floating these rivers would experience noise impacts from the road. Other rivers with float use are discussed in Section 3.4.3, Recreation and Tourism.

Alternative C Impacts

Alternative C overall would have greater noise impacts compared to Alternatives A and B due to the longer road and additional material and support facilities required to construct and maintain it. Alternative C proposes more and longer bridges than Alternatives A and B, which would likely require more pile driving activities. Impulsive, high intensity noise sources are often considered more intrusive to normal human and wildlife activities. Alternative C may also require longer sections of construction using rock cuts and blasting than Alternatives A and B, due to steep sections along the Ray Mountains. Alternative C will affect more previously undisturbed land than Alternatives A and B, and the impacts would spread wider due to terrain differences, averaging 5.1 miles across (centered on roadway) before natural conditions would limit the ability to hear truck noise at a distance (see Appendix D, Attachment A). The communities of Kobuk and Hughes, located 2 and 3 miles from the roadway, respectively, would be anticipated to perceive traffic noise from Alternative C. Vehicle trips (ground and air) and vehicle miles travelled are projected to be slightly higher for Alternative C than for Alternatives A and B (due to greater maintenance requirements), which would be expected to result in a greater overall amount of vehicle-related noise. However, given the longer road length, noise-free intervals between trucks may be longer, allowing longer periods without noise, which could be beneficial to wildlife movement (Betchkal 2019).

Alternative C would avoid crossing GAAR, resulting in no impact to the character of those lands. Alternative C would follow and cross many other rivers, including the Kobuk and Koyukuk rivers, resulting in noise impacts on area residents using them as a travelway and visitors using them for recreation. In addition, Alternative C has greater potential for noise impacts on residents in Kobuk and Hughes, who may experience noise impacts associated with construction and operation on the portion of the road nearest the community.

Mining, Access, and Other Indirect and Cumulative Impacts

Cumulative effects from noise are unique because noise above ambient levels occurs only when a noise-generating action is occurring, and the distance between a noise source and the receiver influences noise intensity. Louder noises tend to dominate noise levels; therefore, the cumulative effect of other noise sources may be masked by the loudest noise source. All action alternatives would elevate noise above ambient levels in the study area. When this increase in sound level is assessed cumulatively with effects of past and present activities and reasonably foreseeable developments from activities associated with mining, road traffic, community access traffic, and Dalton Highway improvements (see Appendix H), there would be an incremental increase in noise levels, especially where noise sources are closer to communities, subsistence use and recreation areas, or other noise-sensitive locations. Intermittent noises (e.g., blasting at material sites, road cuts, and mine sites) may occur concurrently with other projects, or may increase the overall frequency of disturbances to noise sensitive areas and receptors.

3.2.7 Air Quality and Climate

Affected Environment

Air Quality

Emissions from natural sources such as wildfires and human-induced air pollutant emissions from industrial processes and mobile emissions affect air quality. The proposed project is in a remote area of the Northern Alaska Intrastate Air Quality Control Region (AQCR) where there are few major pollutant emission sources. The emissions produced are generally localized in residential populated areas and would be expected to be below applicable EPA-approved National Ambient Air Quality Standards (NAAQS; see EPA 2016). No air pollutant monitoring sites are within the analysis area. Monitoring sites nearest the area are in Fairbanks and Denali National Park and Preserve (DENA). Real-time data are available through EPA website AirNow (www.airnow.gov) and the Alaska air quality network (dec.alaska.gov/Applications/Air/airtoolsweb/Aq). Fairbanks is a highly populated area and the air quality is not representative of the project. DENA is therefore used to characterize the affected environment. Monitoring data show air quality in DENA to be good.

The AQCR is designated mainly as attainment or unclassifiable for criteria pollutants that EPA has established NAAQS for under 40 CFR 81.302. The project is roughly 200 miles north of the closest EPA designated Class I protected area of the DENA. The closest population center is the Fairbanks North Star Borough (FNSB), which EPA designated in 40 CFR 81.302 as non-attainment for particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) for the 24-hour NAAQS with its air pollution managed under a State Implementation Plan. The area is also classified as a maintenance area for carbon monoxide (CO) where, notably, industry changes have helped reduce the CO emissions from non-attainment. The combination of temperature inversions and emissions such as mobile combustion, industrial emissions, and wood-stove burning contribute heavily to pollution in Fairbanks and on main highways.

In remote areas like the project area, fugitive dust is a main source of particulate pollution (particulate matter less than 10 microns [PM_{10}] and $PM_{2.5}$) in the atmosphere. Particulate is often a result of wind erosion, natural and human-made (anthropogenic) fires, combustion by-products, and vehicle travel on unpaved roads. The particulate mix could contain minerals such as asbestos and others due to the geology of the area. During summer in the project area, particulates from forest fires are common.

GAAR participates in the Interagency Monitoring of Protected Visual Environments Network, monitoring regional haze and pollutant concentrations in precipitation (wet deposition) in Bettles. Regional haze data collected from 2008 to 2015 can be found at vista.cira.colostate.edu/improve. The wet deposition data National Trends Network Station AK06 measures sulfate, nitrate, ammonium, chloride, calcium, magnesium, potassium, sodium, and mercury. Data from 2008 to present can be found at the National Atmospheric Deposition website (nadp.slh.wisc.edu/NTN/ntnData.aspx).

Climate

The project area is in Interior Alaska, where the climate is characterized as subarctic and semiarid. The area has microclimates that experience low annual precipitation of approximately 17 inches and a range of temperatures as high as 100°F and as low as -70°F (BLM 2016a). Lowland basins and broad valleys between the Brooks and Alaska-Aleutian ranges largely influence the climate. Area winds are dominated by wind flows from the east that average 15 to 25 miles per hour. High winds in the lowland areas with open riverbeds often re-entrain particulate (ADEC 2016). These climate factors could contribute to haze and poor visibility, but also to atmospheric clearing.

BLM's *Analysis of Management Situation* has a concise summary of climate change in Interior Alaska, which is summarized in the following paragraphs (BLM 2016a). Sources of existing greenhouse gasses (GHGs) in the project area are primarily a result of wildfires and direct on- and off-road vehicle fuel combustion, as well as indirectly from electric power generation. In more populated areas, common GHG sources are from equipment operation. Increases in any of these factors have the potential to contribute to overall GHGs in the atmosphere.

The global mean surface temperature has increased since the last half of the nineteenth century, and observations and computer model predictions indicate that increases in temperature are likely to be greater at higher latitudes like the project area. Climate modeling predicts an increase in the length of the summer season, with fall freezes occurring later and spring thaws occurring earlier. Impacts of climate change visible in Alaska include coastal and river erosion, increased storm effects, retreat of sea ice, and permafrost thaw (U.S. Global Change Research Program 2018). Other anticipated effects include changes in wildfire patterns and in species abundance and diversity. Warmer temperatures and a longer growing season are expected to increase evapotranspiration enough to outweigh a regional increase in precipitation. Seasonal changes in climate could have profound impacts on the condition and health of wildlife habitat. Such changes could lead to increased fire risk and contribute to the likelihood of wetlands, streams, and lakes drying out (Rupp and Springsteen 2009).

Environmental Consequences

Road Impacts

Impacts on air quality are anticipated from the proposed project as a result of fugitive dust, mobile source emissions, and fixed equipment such as generators and heating systems. The fugitive dust emission sources include particulates associated with construction activities and dust entrainment from processes such as wind erosion to disturbed surface areas and vehicle traffic. Mobile sources of emissions include tailpipe or stack emissions from vehicles such as cars, trucks, and equipment. Air emissions would occur during construction and occur after the road was completed and is traveled by vehicles and equipment.

Air pollutants of concern include the criteria pollutants regulated under the NAAQS and Hazardous Air Pollutants (HAPs), as well as airborne asbestos that could be contained in fugitive dust when materials containing NOA are used for road construction. Emissions from road traffic would include both criteria pollutants and HAPS, and are regulated by federal and manufacturing requirements. In addition, the presence of minerals with NOA is of concern, and potential impacts are discussed in more detail in Sections 3.2.1, Geology and Soils; 3.2.2, Sand and Gravel; and 3.4.5, Socioeconomics and Communities (see also NewFields 2019).

Impacts on air quality as a result of construction activity would only occur during active construction. During construction, the proposed project has the potential to increase criteria pollutants and HAPs in the short term subject to non-road engines and portable generator regulations such as 40 CFR 9, 69, 80, 86, 89, et al. (See Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel, EPA Final

Rule 2004). The main impacts of the activities from construction, however, would be from deposition of fugitive dust. Fugitive emissions made up of heavy particulates are often localized and would settle out near the proposed road. Any operating permits obtained for the construction would help to ensure compliance with regulations, and fugitive dust control measures would help to ensure that construction impacts would not exceed the NAAQS.

Post-construction, air pollution would be a result of road use from traffic and fixed emissions sources (e.g., buildings). The tailpipe and stack emissions from any equipment of HAPs and criteria pollutant emissions are subject to vehicle and generator regulations such as 40 CFR Parts 80, 85, and 86. As demonstrated in Fairbanks monitoring data, more stringent manufacturer regulations have decreased CO air pollution and show that controllable levels can be reached. Fairbanks is not a good representation of the proposed project background pollution. Fairbanks is in attainment for all criteria pollutants with the exception of $PM_{2.5}$. The proposed project's road traffic tailpipe emissions are on a much smaller scale, and would therefore not be expected to exceed air quality standards.

For fugitive dust air quality impacts from road travel, the project would add 30,000 to 60,000 trips per year (see Appendix H) in an area where there is currently no traffic that would create fugitive dust. The proposed road is planned to be treated with a dust suppressant that would greatly decrease any potential dust entrainment. Use of dust control methods would make the potential for exceeding ambient air quality standards negligible (see Appendix N).

The deposition of fugitive dust particulates is often seen within the first 328 feet (100 meters) from the road, or the dust deposition zone. Based on this, potential dust impacts are more likely to occur on other environmental resources rather than air quality. Discussions on other resource impacts can be found in Sections 3.2.5; Water Resources; 3.3.1, Vegetation and Wetlands; 3.3.2, Fish and Amphibians; 3.3.3, Birds; and 3.3.4, Mammals.

High winds would contribute to the potential of fugitive dust to contribute to regional haze and climate concerns. Monitoring data collected in cooperation with ADEC at Red Dog Mine evaluated total suspended particulate that makes up most of fugitive dust. Total suspended particulate contains all heavy particulates of size 10 microns or less. The Red Dog Mine study (Teck Cominco AK, Inc. 2007) showed that fugitive dust emissions were highly affected by seasonal factors, and measurements were higher when temperatures dropped to near and below freezing and precipitation was low (November to April). The potential for air quality impacts from road construction and operation to contribute to regional haze could be anticipated to be greater during freezing temperatures. Use of a dust suppressant, as committed by ADIEA, would decrease the potential for impacts.

The project is located in the same region as GAAR. The monitors could be used as a gauge, should any increased impacts be detected once the road is in use and mitigation is triggered; however, regional haze is not anticipated to be affected.

GHG emissions would result from vehicle and equipment combustion during construction and road use once construction is complete. GHG emissions from this project would be comparable to emissions from other industrial access roads in Alaska and other ROW authorizations from the BLM. Like those projects, this project would contribute to the accumulation of relatively small emissions worldwide that have together resulted in effects to the global climate.

No Action Alternative Impacts

Under the No Action Alternative, the proposed project would not be developed, and associated impacts on air quality would not occur.

Impacts Common to All Action Alternatives

Impacts on air quality from criteria pollutants, HAPs, and GHGs as a result of the proposed project would be of the same type under all 3 alternatives. Once the project road was open for use, all action alternatives would represent a similar length of vehicle-miles-travelled between the District and Fairbanks. The difference would be in the spatial area that could be affected by new fugitive dust emissions along the alternative routes and the lengths of those routes. Air quality impacts would result from stationary sources such as heating plants and generators at maintenance stations and temporary construction camps. Additional potential air quality impacts would result from installation of communication towers proposed by AIDEA. AIDEA's proposed communication towers would provide coverage over the alternative road spans, and each communication site is anticipated to have a diesel generator, fuel tank, and heated small building. Generators would run continuously 24 hours per day for 365 days per year, and would be a source of combustion emissions that could increase localized emissions of criteria pollutants, GHGs, and HAPs.

All action alternatives are likely to make use of materials with NOA. To the extent that dust containing NOA is generated by the road, levels of fugitive dust with NOA on vegetation, such as berries, are likely to remain fairly constant over time, due to the washing effect of rain. The dust will not just "pile up" on the vegetation. Dust on vegetation could become airborne during dry conditions, when people walk through and disturb the vegetation. Levels of personal exposure to asbestos are impossible to estimate due to variables such as moisture levels, asbestos content of the dust, and differences in activities that might disturb the dust. However, where NOA materials are used, the exposure level would be more than the potential exposures under the No Action Alternative.

The use of sand or gravel materials that have been tested, and are shown to have concentrations of asbestos at levels less than 0.25 percent asbestos by mass (definition of NOA in Alaska law) does not mean that those materials have no asbestos and does not mean that those materials are not capable of releasing asbestos to the air. For the same weight of dust created, having a higher percentage of asbestos would create a higher potential exposure.

Appendix N presents potential mitigation measures and design criteria proposed by AIDEA to reduce the risk of creating airborne asbestos dust, including how the road is constructed and treatments to reduce dust during operations. If commitments in Appendix N are applied, they should effectively reduce air quality impacts.

Alternative A Impacts

The road segment under Alternative A would be the shortest distance (211 miles) and would result in less surface disturbance and earthwork, causing less fugitive dust during construction and operations. The shorter route would require less dust suppressant for treatment and would not create as much potential fugitive emissions, due to less exposed surface area. The nearest communities to Alternative A are Bettles and Evansville, which are 8 miles away and would experience little to no air quality effects. Appendix F (Social Systems Tables and Supplemental Material), Table 1, documents the distances of communities to the alternatives. The short-term construction and the operation of the Alternative A road would have localized air quality impacts, but would not be expected to exceed applicable air quality standards.

Alternative B Impacts

Air quality impacts under Alternative B would be expected to be similar to Alternative A, with the exception of greater potential for fugitive dust and engine emissions due to the longer route (additional 17 miles), which would increase construction time and road miles traveled during use. The nearest communities to Alternative B are Bettles and Evansville, which are 8 miles away and would experience little to no air quality effects. Appendix F, Table 1, documents the distances of communities to the alternatives. The short-term construction and the operation of the Alternative B route would have localized air quality impacts, but would not be expected to exceed applicable air quality standards.

Alternative C Impacts

The impacts of Alternative C on air quality would be similar to impacts under other alternatives, but have greater potential for affecting a larger area over a longer period of time due to more surface disturbance and a potentially longer construction period. As the longest route with the biggest footprint, it would generate the greatest amount of fugitive dust and engine emissions attributable to construction, operations, and maintenance. The nearest communities to Alternative C are Kobuk (2 miles), Hughes (3 miles), and Shungnak (5 miles). Because of the distances and generally windy environment, air quality impacts would be expected to be negligible. Appendix F, Table 1, documents the distances of communities to the alternatives. Alternative C would have localized air quality impacts, but would not be expected to exceed applicable air quality standards.

Mining, Access, and Other Indirect and Cumulative Impacts

The proposed project is located in a remote area and does not contain many sources of emissions other than heating sources, generators, and vehicles in and near communities, and particulate emissions from surface wind erosion, wildfires, and on- and off-road vehicle travel. Remote activities such as on- and off-road travel result in air quality impacts that are comparatively less than fugitive emissions from fires in the area. The cumulative impacts in the area as a result of wildfire would be mitigated from activities such as wildfire management practices. Cumulatively, potential impacts on air quality would result from the proposed project, recreational use, exploration activities, and construction of other roads and transport along roadways. These activities are unlikely to exceed applicable air quality standards. Increased vehicle traffic through Fairbanks would contribute emissions, potentially increasing $PM_{2.5}$ concentrations and furthering the non-attainment status of the area for that pollutant.

The air quality impacts associated with reasonably foreseeable mining activities would be analyzed on a case-by-case basis as part of each site's own permitting process and would be subject to appropriate measures to reduce impacts unique to each proposal. The project area would be considered to be in an attainment area, and for major sources of emissions that a mine could trigger, EPA could require a prevention of significant deterioration permit. An evaluation of project impacts on ambient air quality standards would be required, including analysis of soils, vegetation, and visibility impacts. Permitting and analysis of mines would be expected to help reduce the potential to exceed air quality standards, as emission control technology review would be required.

A recent conventional example of a mine reviewed for air quality impacts was the Donlin Gold Mine (USACE 2018). The potential for increased emissions from mining due to vehicle traffic, fugitive dust, and stationary emission sources was analyzed. Main components evaluated included mining and milling facilities, waste rock dumps, haul roads, tailings facility, generators, boilers, and a waste incinerator. The construction and closure impacts on air quality were predicted through air dispersion modeling methods not to exceed NAAQS. Operational impacts were estimated to be above thresholds requiring more stringent permits, such as a Title V operating permit (required under the Clean Air Act for "major" sources of air pollutants), and to trigger GHG reporting; however, the impacts were anticipated to be below regulatory standards. Impacts from mines in the District will be site-specific and permitted specifically for proposed operations and potential emissions to avoid exceeding air quality standards.

Mine development activities, including operations of equipment, camps, personnel transport, and power production would emit GHGs, contributing to global climate change. These impacts are discussed under Sections 3.2.1, Geology and Soils; 3.2.5, Water Resources; and 3.3.1, Vegetation and Wetlands; and in Appendix H.

The impacts to air quality from any action alternatives, in combination with past, present, and foreseeable activities are expected to increase air emissions including, GHGs, in the region and the State. While the cumulative air quality impacts of any proposed action alternatives would be highly localized and often short term, and would not be predicted to be above applicable air quality standards, the project would contribute GHG in the atmosphere.

3.3. Biological Resources

3.3.1 Vegetation and Wetlands

Affected Environment

Vegetation

The proposed alternatives traverse the lowlands, hills, and mountains within Alaska's Interior and Northern subregions west of the Dalton Highway, between the Brooks Range Mountains to the north and the Yukon River to the south. Alternatives A and B are primarily located within the Kobuk Ridges and Valleys (Kobuk) ecoregion, with minor portions of the routes passing through the Brooks Range and Ray Mountains ecoregions. Alternative C is primarily located within the Kobuk and Ray Mountains ecoregions (see Volume 4, Map 3-7; Nowacki et al. 2001). Appendix E, Table 1, provides a description of ecoregions.

Vegetative communities in this vast and largely roadless planning area are currently predominantly undisturbed. Areas of disturbance include remote villages, small roads, and trails associated with nearby communities, some of which cross the alternatives and Dalton Highway. See Section 3.4, Social Systems, for more details. Forest and woodlands at lower elevations, with black spruce in wetland bogs; white spruce and balsam poplar along rivers; white spruce, white birch, and trembling aspen on well-drained uplands; and shrub communities at higher elevations dominate the Kobuk ecoregion (Nowacki et al. 2001; Fulkerson et al. 2016; BLM 2016a). Black spruce woodlands; white spruce, birch, and aspen on south-facing slopes; white spruce, balsam poplar, alder, and willows on floodplains; and shrub birch and Dryas-lichen tundra at higher elevations comprise the Ray Mountains ecoregion (Fulkerson et al. 2016). Tussocks, shrubs, mixed forest, and alpine tundra on the southern side of the range dominate the Brooks Range ecoregion (Fulkerson et al. 2016).

Mapping and tabular data used in this analysis are based on the Central Yukon Rapid Ecoregional Assessment (REA) GIS. The Central Yukon REA dataset classifies vegetation into 15 vegetation classes, including 7 regionally important community types, referred to as Terrestrial Coarse-filter Conservation Elements (TCEs), based on similar biological and physical characteristics (Boucher et al. 2016). All TCE vegetation types occur in the project area. The most prevalent vegetation types traversed by the alternatives, and the project area as a whole, are upland low-tall shrub and upland mesic spruce forest. Riparian forest and shrub and Alpine and Arctic tussock tundra are the least abundant of the TCE vegetation types. Of all vegetation communities near the project area, Emergent Herbaceous Wetlands, Grassland-Herbaceous, and moss-dominated communities are the scarcest. The Central Yukon REA Final Report (Boucher et al. 2016) and Appendix E, Table 2, describe the vegetation types. Volume 4, Map 3-8, shows the vegetation types in the project area. Appendix E, Table 3, provides percentages of vegetation types shown within the extent of Volume 4, Map 3-7 to provide context of the vegetation communities in the project area.

Wetlands

The USACE has jurisdiction over waters of the United States (of which wetlands are a subset) under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899. The wetlands analysis used Alaska Center for Conservation Science (ACCS) mapping to provide broad context (see Volume 4, Map 3-9). Appendix E, Table 6, provides percentages of aggregated wetland types shown within the extent of Volume 4, Map 3-9 to provide context of the wetland types in the project area.

Wetlands are common in the region (Hall et al. 1994) and along the areas traversed by the alternatives (DOWL 2014a, 2016a). Black spruce and sedge-shrub-peatlands occur throughout the region in lowlands, such as flat to gently sloping valley bottoms and abandoned floodplains (Boucher et al. 2016). ACCS mapping also indicates forested-shrub wetlands are common in lowlands in the project area, particularly along streams and rivers. Permafrost occurs throughout much of the Kobuk ecoregion and discontinuously in the Ray Mountains (Fulkerson et al. 2016). Permafrost could cause poor soil drainage, leading to the presence of wetlands. See Section 3.2.1, Geology and Soils, for details.

Based on available wetland mapping, Palustrine Scrub-shrub (PSS) and Palustrine Forest (PFO) are the most abundant wetland types along the alternatives. Palustrine Emergent (PEM) and Palustrine Moss/Lichen (PML) wetlands also occur along the alternatives and in the project area, but are less common. Palustrine wetlands generally include nontidal freshwater wetlands dominated by trees, shrubs, or persistent emergent vegetation (e.g., grasses, sedges), but can also include waterbodies less than 6.6 feet (2 meters) deep (Cowardin et al. 1979). Refer to Section 3.2.5, Water Resources, for details about waterbodies (e.g., ponds, lakes, streams, rivers) in the project area. Cowardin et al. (1979) and Appendix E, Tables 4 and 5, describe the wetland and waterbody types in the study areas.

Wetland functions are the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of a wetland ecosystem (ASTM 1999). DOWL (2014a) provided a wetland functional assessment for a portion of Alternatives A and B. ABR, Inc. – Environmental Research & Services (ABR 2017), completed a functional assessment for the portions of Alternatives A and B that traverse GAAR. Functional assessments, to date, have not included Alternative C or the eastern 50 miles of Alternatives A and B. These functional assessments report that, where evaluated, wetlands in the study areas provide functions such as fish and wildlife habitat, , sediment removal, nutrient and toxicant removal, flood flow regulation, erosion control and shoreline stabilization, groundwater discharge and recharge, organic matter production and export, rare and native plant diversity, and maintenance of soil thermal regime of wetlands underlain by permafrost. These functional assessments also found wetlands within their respective study areas to provide subsistence (ABR 2017) as well as education, scientific, and heritage services (DOWL 2014a) to varying degrees.

Ecosystem services are commonly defined as the benefits to people that are provided by ecosystems and contribute to human welfare, both directly and indirectly, as well as globally and locally (Costanza et al. 1997). Ecosystem services are derived from the functions provided by wetlands and can include water supply and purification; food production, such as fish; increased productivity of downstream fisheries; reduced impacts from floods; climate regulation through carbon sequestration; mitigation of climate change impacts; cultural benefits, including aesthetic, spiritual, and education opportunities; and recreation and tourism benefits (Woodward and Wui 2001; Millennium Ecosystem Assessment 2005; Kusler 2006). These services also provide economic benefit to society, which could be substantial (Woodward and Wui 2001; Costanza et al 1997). Based on the functional assessments provided by ABR (2017) and DOWL (2014a), many of the ecological services listed above are provided near Alternatives A and B. The capacity to provide these ecosystem services will vary for each wetland, and not all wetlands will provide all of the services listed above at all times.

Although a functional assessment or evaluation of wetland services has not been provided for Alternative C, given the pristine condition of wetlands that occur along all the action alternatives, it is likely that many of the same functions and associated services would be provided by wetlands near Alternative C, although the amount and performance of these functions and associated services would vary. However, because the alternatives traverse relatively pristine terrain, the impacted functions would be greater, the more wetlands that are effected. For these reasons, not having detailed functional assessments is not critical to a reasoned choice among alternatives.

Rare Plants and Ecosystems

The U.S. Fish and Wildlife Service (USFWS 2019) reports no federal Endangered Species Act (ESA) listed plant species in the project area. The ACCS maintains a rare plant list for Alaska; however, no statewide protections pertain to species on the list (see Volume 4, Map 3-10). Appendix E, Table 7, provides a list of potentially rare plants in the project area. The ACCS (2019a) reports Yukon aster within the footprint of Alternative A; the state lists it as S3 (moderate risk of extirpation), it has a global rank of G3 (moderate risk of extinction), and it is a BLM Sensitive Species (BLM 2019; Nawrocki et al. 2013). Available mapping shows additional rare species in the project area, but none located within 0.25 mile (1,320 feet) of affected areas. However, rare plant surveys near the alternatives are limited and have not been performed along the routes of the alternatives. However, given the nature of the terrain, the ecosystems traversed, and the level of survey information that is available, the BLM determined that additional detailed rare plant surveys would not be essential to a reasoned choice among alternatives. Surveys along the alternatives would be necessary to confirm the presence or absence of rare plants in these areas and these could be done during design and permitting to avoid or mitigate for potential effects.

Rare ecosystem records indicate several occurrences of geothermal springs and their associated plant species, ranked globally and in Alaska as a vulnerable ecosystem (Boucher et al. 2016), near Alternative C. The closest spring is at least 0.5 mile from any affected area (Volume 4, Map 3-10; BLM 2013b; also see Boucher et al. 2016 for details on plant species of concern associated with geothermal springs within the region).

Non-native Invasive Plants

Non-native invasive species of plants (NNIS) occur in high concentrations in the project area immediately adjacent to the Dalton Highway (Carlson et al. 2016). Low to moderate concentrations occur in communities, along rivers, in southern portions of GAAR, and in the Ray Mountains. Previous studies documented bird vetch, rated as highly invasive, within the affected area of Alternative C, adjacent to the Dalton Highway (AKEPIC 2019; BLM 2013c; Carlson et al. 2008). Previous studies do not document other NNIS in areas affected by the other alternatives; however, studies document white sweetclover, narrowleaf hawksbeard, meadow foxtail, foxtail barley, pineapple weed, and bird vetch near the alternatives, primarily along the Dalton Highway. These species range from very weakly invasive to extremely invasive (Carlson et al. 2008). The eastern 20 miles (approximate) of the Alternatives A, B, and C alignments are within or adjacent to watersheds[4] having an NNIS likely to cause management concerns and at least 10 non-native species present (BLM 2013d; Carlson et al. 2016). The alternatives also traverse several watersheds with moderate to high infestation vulnerability (BLM 2013e; Carlson et al. 2016). Appendix E, Table 8, lists NNIS recorded near the project area. Volume 4, Map 3-11, provides invasive species occurrence locations and infestation vulnerability ratings.

Carlson et al. (2016) recognize waterweed (*Elodea* spp.) as a serious threat to the ecology of freshwater systems; however, it is not known to occur in the waters crossed by the alternatives. However, some rivers in the study areas, including the Koyukuk, Indian, Melozitna, and Tozitna rivers (Volume 4, Map 3-12; BLM 2013f), are susceptible to *Elodea* infestation.

[4] "Watersheds" are land areas associated with drainage patterns and topographic divides but do not necessarily mean the NNIS are found in or along waterways.

Wildfire Ecology and Management

Wildfires are part of the natural ecology of the project area and are the main driver of vegetation succession. Fire frequency, size, and severity vary based on vegetation, climatic conditions, and topography (BLM 2016a). Wildfires are common in the Kobuk ridges and valleys during warm, dry summers with frequent lightning (ADF&G 2006). The Ray Mountains also experience relatively warm, although moist, conditions with occasional wildfires (BLM 2016a). Wildfires are less common in the Brooks Range (Fresco et al. 2016). Lightning causes the majority of wildfires in these ecoregions, with the most frequent and largest occurring in forested vegetation (BLM 2016a).

The project area generally reflects a natural fire regime (BLM 2016a). BLM's historical fire geospatial data from 1959 to 2018 show frequent fire starts in and around the proposed alternatives and fire sizes ranging from less than 50 acres to hundreds of thousands of acres (BLM 2019; Volume 4, Map 3-13). Note that there are more small starts and fewer large fire size polygons near roads and rivers because these are areas designated for increased fire suppression. See Fresco et al. (2016) for information on fire return intervals (predicted frequency) for the study area ecoregions.

The BLM Alaska Fire Service (AFS; BLM 2016a) provides wildfire protection for the area. Jurisdictional agencies including federal, state, private, municipal, and Alaska Native corporation lands along with the BLM AFS update wildfire management options annually, and the Alaska Interagency Coordination Center (AICC) maintains an electronic map atlas. Federal and state agencies, in cooperation with Alaska Native entities, employ 4 wildfire management options: Critical, Full, Modified, and Limited (AICC 2019). The project area is primarily located in Limited and Modified management, although Full and Critical options surround nearby communities within the project area (BLM 2016a; Volume 4, Map 3-14). Appendix E, Table 9, describes the fire management options. Currently, fire suppression and surveillance efforts in the project area are highly dependent on aircraft based out of Fairbanks and Galena. During times of high activity in the Kobuk and Noatak valleys, Dahl Creek has been set up as a remote fueling site and staging area. See BLM (2016a) and the Alaska Interagency Wildland Fire Management Plan (AICC 2019) for more details on wildfire management.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, development of the project would not happen; therefore, no impacts on vegetation, wetlands, rare plants, ecosystems, wildfire ecology, and wildfire management from road development would be expected. However, further spread and establishment of NNIS along the Dalton Highway and near locations of human development use would likely continue. Additionally, these resources would be impacted by changing climate conditions (see Sections 3.2.1, Geology and Soils, and 3.2.7, Air Quality and Climate, and Appendix H).

Impacts Common to All Action Alternatives

Vegetation Impacts

Construction and operation activities that would impact vegetation include placement of gravel fill, excavation of surface layers during construction and gravel mining, clearing of vegetation, and fugitive dust fallout from construction and operation activities. The primary effects to vegetation from these activities would be reduction of vegetation types that occur in project footprints, and alteration of vegetation communities beyond project footprints, which would result from changes to soil, surface and ground water flow, thawing of permafrost, degradation of vegetation, increased erosion and sedimentation, and introduction of NNIS. Reduction of vegetation types within the project footprint would also result in impact and alteration to fish and wildlife habitat (see Sections 3.3.2, Fish and Amphibians, 3.3.3, Birds, and 3.3.4, Mammals). Although these types of impacts would be common to each action alternative, the vegetation types and acreages impacted would vary based on the location of each alignment. Phases 1 and 2 of the project would have less impact to vegetation because there would be less acreage fill on and alteration to vegetation and they would occur for a shorter duration. Therefore, much of the analysis in this section focuses on Phase 3, which represents the greatest potential for vegetation to be affected because of its larger footprint, higher traffic volumes, and longer duration. Construction impacts would occur during the time each phase is being built. Appendix E, Tables 10 through 15, show the calculated acreages of impact to vegetation and wetlands within the construction daylight limits, the 10-foot construction buffer, and a dust impacts buffer for Alternatives A, B, and C.

Permanent impacts to native vegetation would occur from construction of the main road, landing strips, material and rip-rap sources, and construction access roads, due to vegetation clearing and the placement of gravel fill. Loss of vegetation would result in a number of effects to the surrounding environment, including alteration of adjacent vegetation community composition and loss or alteration of fish and wildlife habitat associated with that vegetation.

Alteration of native vegetation would occur from construction and operation activities that result in changes to soils, altered hydrology, thawing of permafrost, fugitive dust, and other factors. Alterations to vegetation were assessed within 328 feet (100 meters) of roads and ancillary sites, where the majority of impacts from fugitive dust and other construction and operation activities are expected to occur. Research has shown that the greatest impacts to vegetation from dust occurs within 328 feet (100 meters) from the edge of roads (Auerbach et al. 1997; Myers-Smith et al. 2006; McGanahan et al. 2017). Lesser impacts to vegetation could also occur beyond 328 feet (100 meters), although impacts beyond this distance are expected to be minimal and would decrease with distance. Impacts are expected to be greatest closest to the road, particularly within the 10-foot temporary construction zone where vegetation would be subjected to compaction, clearing, and heavy equipment use.

Native vegetation removed within the 10-foot temporary construction zone would result in long-term alteration of vegetation community composition. Removal of native vegetation in this area, particularly in boreal forest, could take decades to recover, or longer (Sullender 2017). Loss of boreal forest could result in the establishment of perennial grass, such as blue-joint, which could occupy a site for many decades (Werner 1996). Although vegetation communities cleared within the 10-foot construction zone reestablish over time, it is unlikely they would recover to their unaltered condition.

Activities within the 10-foot construction zone would impact soil and hydrology, and affect adjacent vegetation. Equipment use could cause rutting, mixing, and soil compaction. These effects could increase soil bulk density (Trombulak and Frissell 2000), hinder root establishment, and reduce water and air infiltration (Passioura 2002; Nawaz et al. 2012), which could reduce plant establishment and growth. Removal of surface layers could cause increased erosion of soils from water or wind, and increased sedimentation. During construction, equipment could physically damage permafrost, or remove the insulating active layer, which could result in changes in thermal regime, causing permafrost thaw (thermokarst) and potentially affecting surface water drainage patterns. In addition, melting of underlying permafrost due to disturbance of insulating vegetation layers could continue long after the initial disturbance ends and could be difficult to reverse (NRC 2003).

As a result of changes caused by permafrost thaw, increased wetness or flooding of adjacent vegetation could occur in some areas; inundation of vegetation not adapted to wet conditions could cause mortality of vegetation and shifts in vegetation communities (Jorgenson et al. 2001). In other areas, permafrost thaw could cause increased drainage, resulting in a shift to vegetation communities better adapted to drier conditions. Alternatives A and B would generally run perpendicular to the slope of surrounding terrain, which could result in impounding surface water and vegetation flooding changing the thermal regime of underlying permafrost. Alternative C also runs perpendicular to slope gradients and through valleys and would also have the potential to impound surface water in those areas, with similar impacts.

Fugitive dust emissions would result from both construction activities and traffic during operation. Fugitive dust deposition would occur throughout the life of the project and would be a long-term impact. Fugitive dust could cause reduced photosynthetic capabilities, increased soil pH, shifting of soil nutrients, decreased biomass, and reduced species richness, and could reduce or eradicate moss and lichen (Auerbach et al.1997; Walker and Everett 1987), all of which could change vegetation community composition. Fugitive dust has been shown to eliminate vegetation within 16 feet (5 meters) of heavily traveled roads (NRC 2003) and eliminate sphagnum moss within 66 feet (20 meters; Auerbach et al. 1997; Walker and Everett 1987). Additionally, fugitive dust deposition along roadsides could also cause early snowmelt along road corridors, which could result in early green-up (Walker and Everett 1987), resulting in changes to vegetation composition. Early snowmelt and reduction or elimination of insulating vegetation and moss layers combined with other road-related effects, such as adjacent ponds absorbing more heat, could result in warming the soil, deepening thaw and creating thermokarst adjacent to roads (NRC 2003). In addition, wind, water, vehicle traffic, and vehicle speed could influence the amount and extent of fugitive dust deposition. More heavily traveled roads have been shown to cause heavier road dust and have higher amounts of dust fallout at greater distances from roads compared to less trafficked roads (NRC 2003). Both vehicle speeds and traffic amounts are expected to be less on access roads and more at ancillary sites. As such, fugitive dust impacts are expected to be greatest along the heavily-trafficked main road and to a lesser extent along access roads and ancillary sites.

An estimated 168 trucks a day (at peak production) would haul mining materials, including copper, zinc, lead, silver, and gold, along the road, which could result in escapement of ore dust during transportation (see Appendix H). Studies show that even with the use of hydraulically sealed lids and truck rinsing procedures, ore concentrates are transported up to 2.5 miles (4 kilometers) from the Red Dog Mine haul road and low levels much farther (Hasselbach et al. 2005; Neitlich et al. 2017). Concentrations of fugitive dust deposition composed of lead have been found to be greatest approximately 33 feet (10 meters) from the road (Hasselbach et al. 2005), but could occur out to 328 feet (100 meters) from the road (Ford and Hasselbach 2001). However, heavy metal dust has also been shown to impact vegetation beyond 328 feet (100 meters), although impacts decrease logarithmically with distance (Neitlich et al. 2017). Heavy metal dust can persist in the soil for many decades (Neitlich et al. 2017), resulting in impacts to the surrounding vegetation and habitat. The effects from ore dust to vegetation include lichen mortality, decreased lichen species richness and cover, decreased moss cover, and degradation of moss species (Hasselbach et al. 2005), which could result in degradation and changes to vegetation community composition. For this project, trucks containing heavy metal ore are proposed to be containerized, which should limit ore dust escapement from trucks.

Other factors that could affect vegetation near the road include the introduction of toxicants and the spread of invasive species. Introduction of toxicants from dust suppressants containing chloride and petroleum products associated with vehicle use and road run-off has the ability to impact vegetation. Due to its longer length, Alternative C would have a greater amount dust suppressant needed and a greater degree of associated vegetation impacts. In addition, construction and operation activities that cause any disturbance to vegetation and soil surface layers would increase the vulnerability of these affected areas to the establishment of NNIS, which, once introduced, have the potential to expand beyond initial disturbance footprints. See the NNIS discussion below.

Impacts to vegetation can be partially mitigated through stabilization and revegetation of soils within construction zones and along the fill slope of roads, dust suppression, and use of BMPs during construction and operations. As a design feature, AIDEA has proposed to work with the Alaska Plant Material Center and the relevant land manager to develop a plan for obtaining native plant seed and/or cuttings to be used for restoration and reclamation needs. Appendix N provides additional details of potential measures to reduce impacts. If Appendix N measures are applied, revegetation of soils can be successful. However, such measures would not reduce the permanent loss to vegetation or the loss in plant diversity. Changes to vegetation due to altered hydrology, compacted soils, and the introduction of toxicants from dust deposition and dust suppressants would remain. Proposed measures to prevent the introduction and spread of NNIS require regular monitoring and eradication measures, and are likely to slow the procession of NNIS but not prevent it.

Wetland Impacts

Construction and operation activities that would impact wetlands include those mentioned above in the Vegetation subsection. Additional impacts on wetlands would also include water withdrawal from aquatic resources. The primary effects to wetlands from these activities would be fill of wetland types and functions performed by those wetlands, and alteration of wetland types and wetland functions beyond project footprints. Although these types of impacts would be common to each action alternative, the wetland types and acreages impacted would vary based on the location of each alternative. In addition, Phase 1 and 2 of the project are expected to have less impact to wetlands because there would be less acreage of fill and alteration. As such, much of the analysis in this section focuses on Phase 3, which represents the greatest potential for wetlands to be affected because of its larger footprint, higher traffic volumes, and long duration. Construction impacts would occur during the time each phase is being built.

Wetland impacts due to fill would occur within the same areas as described above in the Vegetation subsection and would be considered permanent. Wetlands filled in the project area would also result in a permanent reduction of associated biological, hydrological, and biogeochemical functions within the fill footprint.

Alteration of wetlands would occur from construction and operation activities that result in alteration of soil characteristics, hydrologic alteration, changes to vegetation community composition, degradation of permafrost, fugitive dust deposition, introduction of NNIS, and other factors that would affect wetland types and their associated functions. Alteration of wetlands may include conversion from a wetland type to another (changes in vegetation community or hydrologic regime), conversion of wetlands to uplands, and decreased performance of wetland functions. Wetlands would also be impacted within the 10-foot temporary construction zone and by fugitive dust from roads and ancillary sites, as described in the Vegetation subsection above.

Impacts to wetlands within in the 10-foot construction zone from clearing and equipment use would be similar to those described in the Vegetation subsection above. Wetlands and their associated functions could be reestablished over time to some degree (Zedler 2000). Removal of wetland vegetation in this zone, particularly in Forested wetland types, would result in long-term alteration of wetland types due to long recovery times required to reestablish vegetation communities. It is unlikely that wetlands would recover to their unaltered, pre-project conditions after construction.

As described in the Vegetation subsection above, construction activities within the 10-foot temporary construction zone would disturb natural soil structure and hydrology. Additionally, removal of insulating vegetation, poor roadside drainage, and pooling of surface water along the road could increase permafrost thaw (Walker and Everett 1987) and lead to erosion. Thawing permafrost could increase permeability of previously frozen soils and change the hydrology, affecting viability of wetlands across the project area near the road by increasing or decreasing wetland surface area depending upon site-specific conditions (Hinzman et al. 2005 as cited in Rowland et al. 2010). Once disturbed, permafrost-supported wetlands are unable to be rehabilitated to their original condition (BLM 2016a). See Section 3.2.1, Geology and Soils, for more information on permafrost changes. Roads would limit surface water flow and could impound water in some locations. Culverts would be installed at drainages to mitigate restrictions to surface water flow. However, paths of drainages can be difficult to predict, so it is possible that some drainages could be missed or that culvert installation and/or maintenance would be inadequate. Water could be impounded on the upstream side of the road (ABR 2017) and result in conversion of wetlands to waters or increase the moisture regime of wetlands. Conversely, interruptions to natural drainage patterns could convert wetland vegetation communities to drier types on the downgradient side of the road, which could increase shrub wetlands (USACE 2012). AIDEA has proposed design features to ensure cross drainage in wet areas that do not have defined channels, such as culvert placement at approximately 150-foot intervals (see Appendix N).

Fugitive dust impacts to wetlands would be the same as those described in the Vegetation subsection above. Sphagnum moss biomass could be reduced or eliminated along roads due to an increase in soil pH, whereas graminoid species biomass has been found to increase (Auerbach et al. 1997). In addition, road operations and maintenance could cause sedimentation and increased nutrient input to wetlands adjacent to the road, which could add pollutants and further impact wetland soils, hydrology, and vegetation.

AIDEA has proposed water withdrawal from freshwater sources during construction and throughout operations, primarily for dust control. If water withdrawal precludes complete recharge of surface waters, the decreased water levels of ponds and lakes could result in exposure of bare substrate and reduction of shoreline wetlands.

Other factors that could affect wetlands adjacent to the road include those described in the Vegetation subsection above, as well as introduction of toxicants and NNIS.

Excavation and filling of wetlands and waters within the project footprint would result in the impact to the biological, hydrological, and biogeochemical functions performed by those wetlands at that location, and potentially alter the ability of adjacent wetlands to perform wetland functions. Wetland functions that are expected to be altered or lost within the project footprint and altered within 328 feet (100 meters) of the road and ancillary sites as a result of construction and operation of the action alternatives include: wildlife or fish habitat, organic matter production and export, rare and native plant diversity, flood flow regulation, erosion control and shoreline stabilization, groundwater discharge and recharge, and water quality improvement functions, Associated wetland ecosystem services that benefit human welfare would also be lost or altered. Wetland acreage calculations in Appendix E, Tables 6 and 13 through 15, present wetland acreages that provide information on differences among the alternatives and the degree to which the study area is affected.

Impacts to wetlands could be reduced through appropriate bridge and culvert design, as proposed by AIDEA, as well as other minimization and avoidance design measures. Appendix N provides additional details of potential mitigation on BLM-managed lands.

Rare Plants and Ecosystems Impacts

The primary impacts to rare plants would be from construction and operation activities that result in excavation or the placement of fill, trampling from equipment and personnel, fugitive dust deposition, changes to soil characteristics, changes to hydrology, and changes to surrounding vegetation. Additional impacts to rare plants include reduction of overall population size and reduction or alteration of habitat. Impact to rare plants due to project construction would be permanent. Disturbance to individuals or populations of rare plants could continue through the life of the project from operations and maintenance activities. Much of the analysis in this section focuses on Phase 3, which represents the greatest potential for impact or disturbance to rare plants, due to it having a larger footprint, higher traffic volumes, and longer duration than Phases 1 and 2. Construction impacts would occur during the time each phase is being built.

Yukon Aster was recorded approximately within the footprint of Alternative A, which, if present at the time of construction, would result in a permanent impact to that individual or local population. Several additional records of this species are located within the project area, but outside the area anticipated to be directly affected. As such, it is unlikely that this species will become eliminated from the vicinity of the project area, although the risk is acknowledged. In addition, this species is known to occur in Alaska and Canada, and is therefore not considered to be at risk of state or global extinction. Comprehensive surveys have not been conducted along any of the routes of the action alternatives; therefore, the magnitude and context of potential loss or alteration of rare plant species specific to each action alternative are not precisely known[5]. As such, rare plants are not discussed separately by alternative.

Thirteen geothermal springs, considered rare ecosystems (Stout and Al-Niemi 2002), are located within the project area, with the closest approximately 0.5 mile from Alternative C (Volume 4, Map 3-10). Unauthorized access to these rare ecosystems and associated rare plant species could disturb and degrade these ecosystems over the long term. Public access to the area via the proposed road would not be allowed; however, it is possible that once more people know the area, they may visit the area (via airplane, OHV, or snowmobile) and access public lands to visit these geothermal springs. However, potential mitigation measures in Appendix N include design features proposed by AIDEA to monitor road activity and staff gates around the clock to minimize such access. In addition, these geothermal springs could be contaminated by fugitive dust if BMPs are not followed for minimization of fugitive dust such as dust that could escape from trucks carrying ore.

AIDEA would be required to minimize impacts to rare plants, such as through pre-construction surveys and appropriate response measures. Appendix N provides potential measures to minimize impacts to rare plants on BLM-managed lands.

Non-native Invasive Species Impacts

Without mitigation, the spread and establishment of NNIS along all the action alternatives is considered likely. Impacts to the surrounding area from the introduction and spread of NNIS, including alteration to vegetation and wetland communities, would be long-term. Much of the analysis in this section focuses on Phase 3, which represents the greatest potential for introduction of NNIS over time due to it having higher traffic volumes and longer duration than Phases 1 and 2. Construction impacts would occur during the time each phase is being built.

The introduction and establishment of NNIS due to construction and operations could infest locations along the road and ancillary sites from the use of vehicles, airplanes, construction equipment, snow plowing equipment, and fill materials, and from foot traffic via clothing and shoes (BLM 2016a). Because the action alternatives connect to the Dalton Highway, which has large densities of NNIS, it is likely that, without mitigation, over time the alternatives would result in similarly high densities of NNIS along them (Volume 4, Map 3-11). NNIS infestations could result in alteration to native vegetation, including wetland vegetation, and plant community composition, by increasing competition and reducing species diversity. NNIS establishment could also result in degradation of wildlife and fish habitat, degradation or reduction of subsistence food, and degradation of visual resources. If commitments in Appendix N are consistently applied along the proposed alignment, NNIS infestations may remain localized and small

[5]Scoping comments did not identify impacts to rare plants as a significant issue. Based on the rare plants known to inhabit the study area, and the habitat information that is available based on vegetation and other mapping, BLM determined there is sufficient information to make a reasoned choice among alternatives. Comprehensive surveys on routes totaling more than 540 miles would be exorbitant.

enough to be eradicated during seasonal monitoring and removal efforts. The introduction and spread of NNIS is anticipated to be minimized.

The spread of *Elodea* could result in alteration of freshwater ecology, alteration of hydrology, and degradation of recreational resources, and could have potentially strong effects on high-value aquatic resources (i.e., salmon and fish-bearing waterways; Carlson et al. 2016). *Elodea* has the potential to degrade fish habitat and displace native flora and fauna; make boat travel difficult; reduce recreation opportunities; and alter freshwater habitats by decreasing water flow and increasing sedimentation. *Elodea* is known to establish via small fragments and can easily attach to equipment, vehicles, boats, and float planes, and therefore has the potential to spread readily (Carlson et al. 2016). Once introduced, it spreads easily because broken plant segments form new plants and it can survive when frozen in ice, thereby allowing it to spread long distances downstream (ADNR 2019). As such, there is a potential that contaminated construction equipment during in-water work, such as bridge and culvert installation, could spread *Elodea* into waterways or other aquatic habitat. The impacts from the spread of *Elodea* to these affected resources would be considered long-term. Appendix N (Section 3.3.1) provides details of potential measures to minimize the impact of NNIS, including *Elodea*, on BLM-managed lands.

Impacts from the spread of NNIS could be minimized through baseline and periodic surveys as well as implementation of an Invasive Species Prevention and Management Plan (ISPMP) that would include vehicle cleaning and ongoing monitoring and eradication efforts. Appendix N provides details of potential mitigation on BLM-managed lands.

Wildfire Ecology and Management Impacts

Impacts to wildfire ecology and management within the project area would occur from construction, operation, and maintenance of the roads and ancillary sites. Development of the action alternatives through a largely undeveloped and wildfire-driven environment would have long-term impacts to the natural wildfire ecology and to wildfire management. Much of the analysis in this section focuses on Phase 3, which represents the greatest potential for alteration of the natural fire regime and wildfire management, due to it having a larger footprint, higher traffic volumes, and longer duration than Phases 1 and 2. Construction impacts would occur during the time each phase is being built.

Wildfires drive a cycle of vegetation succession on the land. Post-burn, late successional vegetation communities, such as spruce forest, will transition to early pioneering herbaceous vegetation communities, which will later be succeeded by mid-successional scrub-shrub communities, and then late successional vegetation. These cyclical patterns of vegetation succession create a mosaic of different aged vegetation communities in ecosystems maintained by wildfire (BLM 2016a).

The road would create a large, linear, fire break (typically 100 feet as proposed by AIDEA [DOWL 2019a]) across the land, which could prevent the natural spread of some wildfires, particularly wildfires that are small or burning under wet, damp, or low wind conditions; it would have less of an impact on wildfires burning under hot, dry, and windy conditions. Construction and operation activities (i.e., humans adding to fire starts through careless cigarette smoking, hot mufflers, sparks from equipment etc.) could also result in an increase in wildfire frequency due to human-caused ignition of wildfires. An increase in human-caused wildfires, combined with an increase in suppression, could result in more frequent small wildfires occurring near the action alternatives. Additionally, an increase in suppression near infrastructure combined with smaller fires from the road’s fuel break effect could result in a delay of fire return intervals and a buildup of fuels near the project, which could result in more intense and severe wildfires during hot, dry conditions in these areas.

These impacts to this cycle could result in preventing natural patterns of vegetation change at the regional level and in turn affect fish and wildlife habitat. Increased wildfire suppression near infrastructure could ultimately lead to more large and severe wildfires in the project area due to increased fuel loading (Danahy 2013; Steel et al. 2013). Further, burning of organic soils during these larger more severe wildfires could accelerate permafrost degradation, whenever all or nearly all the organic layer is burned (Yoshikawa et al. 2002), which could ultimately result in an increase in thermokarst and long-term changes to the ecology of the area. The construction and operation of roads and ancillary sites could result in long-term changes to the natural fire regime[6] of the project area, from increased human-caused fires, prevention of natural fire spread, and increased fire suppression efforts (DOI 2017).

The construction and operations of roads and ancillary sites through a largely undeveloped environment could result in both short- and long-term changes to wildfire management. Current suppression and monitoring efforts in the project area are supported by aircraft and at times, remote staging locations. Although commercial access may not be permitted on the action alternatives, government access to the road would be anticipated for fire suppression and management activities, such as mobilizing personnel and equipment, which would improve access to suppress wildfires. The road would further improve fire suppression by providing a break in fuels, which would obstruct wildfires.

Fire management options are evaluated on an annual basis and would be altered under any of the action alternatives based on needs for protection of human life and property. Currently, the majority of the project area is located within “Limited” and “Modified” fire management options, which would likely change to “Full” management with “Modified” extending around it at temporary construction camps and long-term maintenance stations to protect human life and structures, and “Full” management around AIDEA’s proposed communication towers that will be on the road long-term (see Volume 4, Map 3-14, and Appendix E, Table 9 for further information on fire management options). According to the BLM (2016a), if sufficient fuels management[7] is lacking, areas that are in a Critical, Full, or Modified fire management option would shift away from a natural regime as a result of fire suppression efforts (BLM 2016a). In addition, federal agencies generally extinguish wildfires that are not natural starts on respective federal lands, due to policy and land management plan objectives, which could contribute to changing the natural fire regime of the area. Suppression efforts on non-federal lands would be determined by the agency with jurisdiction.

Forestry and timber impacts from the project clearing would be addressed using responsible land management measures pertaining to the use and sale of timber on BLM-managed lands. Wildfire impacts would be reduced by employing preventative measures described in Firewise Alaska and by such measures as promptly notifying land managers if a wildfire occurs on or near lands subject to the ROW grant. Appendix N provides additional details regarding potential mitigation. These measures are designed to establish appropriate protocols for forestry, timber and wildfire issues for the construction and operation of the road. They would not completely mitigate the impacts but would be effective in reducing the impacts caused by the construction and establishment of a road and associated facilities.

Alternative A Impacts

Vegetation Impacts

The greatest amount of impacts on vegetation types from Alternative A would be to Upland Low and Tall Shrub communities, followed by Upland Mesic Spruce Forest communities, which are also the most common vegetation types in the project area. The least amount of impacts would be to herbaceous types, including Grassland/Herbaceous, Emergent Herbaceous, and Sedge/Herbaceous communities, as well as

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[6] The natural fire regime of an area has been defined by Heinselman (1978, as cited in Viereck and Schandelmeier 1980) as the total pattern of fires characteristic of a natural region or ecosystem. The pattern is comprised of the following factors: ignition, intensity, size, return intervals, and the general ecological effects on the ecosystem.
[7] Fuels management is the development and implementation of prescribed fire, mechanical, or chemical treatments to fuels in a given area(s) and is designed to meet desired future conditions in areas where wildland fire is being suppressed (BLM 2016a).

Alpine and Arctic Tussock tundra, which are also the least common vegetation types in the project area (see Appendix E, Tables 10 through 12, for distinguishing data comparing all vegetation types for Alternatives A, B, and C).

Alternative A has the smallest development footprint of all action alternatives, resulting in the least overall amount of impacts to vegetation. Alternative A would have the least amount of impacts across all vegetation types, with the exception of Upland Low and Tall Shrub (see Appendix E, Tables 13 through 15, for comparison information on all wetland types).

While Appendix E, Tables 10 through 12, report impacts to Barren Land, Developed, and Open Water, impacts to these vegetation types were not considered for comparison of impacts among the action alternatives for vegetation.

Wetlands Impacts

There is no measurable difference in resilience of certain vegetation communities relative to others in the study area. The greatest amount of impacts on wetlands from Alternative A would be to Scrub-Shrub wetlands, followed by Forested wetlands, which are also the most common wetland types in the project area. The amount of impacts to Scrub-Shrub wetlands, the most common wetland type, would be roughly twice as great as the amount of impacts to Forested wetlands. Palustrine Emergent types are scarce in the area and are therefore considered high-value; they would be the type least affected by Alternative A, in comparison to the other alternatives. Alternative A is the only alternative that could result in impacts to the Nutuvukti fen, a pristine patterned fen, located approximately 0.25 mile downgradient of the development footprint. This fen has been reported to provide many important functions in GAAR such as regulating flood flows; removing sediment, nutrient, and toxicant; and providing habitat for birds, mammals, and fish (ABR 2017). As noted by NPS (2019a), there are few patterned fens in all Interior Alaska, of which Nutuvukti fen is one of the largest. According to NPS (2019a), upstream impoundments, should they occur, could disrupt recharge of this fen. Nutuvukti fen is located within GAAR and is subject to NPS management.

Rare Plants and Ecosystems Impacts

Two geothermal springs are located in the Brooks Range approximately 15 miles north of Alternative A. Based on the distance of these geothermal springs from this alternative, potential impacts are anticipated to be minimal.

Non-native Invasive Species Impacts

Alternative A is the shortest in linear miles of all action alternatives and therefore may present less impact from NNIS introduction and establishment than the other action alternatives. Alternative A crosses two rivers on the eastern portion of the routes that are considered susceptible to *Elodea* infestations. Potential for *Elodea* infestation along these rivers would greatly increase from the construction and operation of Alternative A; however, this alternative crosses fewer susceptible rivers than Alternative C.

Wildfire Ecology and Management Impacts

Many factors could influence wildfire ecology; however, overall length of road that would be developed and the number of structures that would be constructed requiring fire suppression (e.g., maintenance station, communication towers) were used for comparison of impacts among the action alternatives. The length of road that would be developed under Alternative A would be slightly less than Alternative B. The number of structures under Alternative A that would require fire suppression as well as the level of human-caused wildfire occurrence, suppression efforts, and changes to fire management actions are expected to be similar to Alternative B.

Alternative B Impacts

Vegetation Impacts

The greatest amount of impacts on vegetation from Alternative B would be to the most common vegetation types in the project area, including Upland Low and Tall Shrub communities, followed by Upland Mesic Spruce Forest communities. The least amount of impacts would be to the least common vegetation types, including herbaceous types and Alpine and Arctic Tussock tundra, as well as Riparian forest and shrub (see Appendix E, Tables 10 through 12).

The development footprint of Alternative B would be slightly larger than Alternative A, and would result in a greater overall amount of impacts to vegetation. However, the overall distribution of impacts to vegetation community types would be similar between the 2 alternatives, with the exception that Alternative B would impact greater amounts of Upland Mesic Spruce Forest. The amount of impacts across all vegetation types from Alternative B would be far less compared to Alternative C, with the exception of greater impacts to Upland Low and Tall Shrub (see Appendix E, Tables 10 through 12).

Wetlands Impacts

The greatest amount of impacts on wetlands from Alternative B would be to Scrub-Shrub wetlands, followed by Forested wetlands (see Appendix E, Tables 13 through 15), which are also the most common wetland types in the project area. As described under Alternative A, Alternative B would result in a similar amount of impacts to Palustrine Emergent wetlands, which are considered high-value, as mentioned above in Alternative A Impacts. Impacts on Nutuvukti fen from Alternative B are not anticipated, since the fen is located upgradient from Alternative B.

Alternative B would result in slightly greater impacts to wetlands and waterbodies than Alternative A, but less impacts than Alternative C (see Appendix E, Tables 13 through 15). Overall, Alternative B would have more impacts to Forested wetland types than Alternative A, which accounts for most of the differences between these alternatives. The amount of impacts to Palustrine Emergent types (high-value) would be similar to Alternative A, which would be less than half that of Alternative C. Similar to Alternative A, approximately 9 acres within the 328-foot (100 meter) buffer are unmapped; therefore, the extent of impacts to these unmapped areas is unknown.

Rare Plants and Ecosystems Impacts

See Alternative A.

Non-native Invasive Species Impacts

Alternative B is slightly longer in linear miles than Alternative A but shorter than Alternative C; therefore, the area that would be subject to potential for NNIS introduction and establishment would be greater than Alternative A, but less than Alternative C. Potential for *Elodea* infestation along rivers crossed by Alternative B would be similar to that of Alternative A, but would be less than Alternative C.

Wildfire Ecology and Management Impacts

Impacts specific to Alternative B regarding wildfire ecology and management are discussed above under Alternative A, as these routes are anticipated to have similar effects, which would be less than that of Alternative C.

Alternative C Impacts

Vegetation Impacts

Alternative C has the largest development footprint of all action alternatives, resulting in the greatest overall amount of impacts on vegetation compared to Alternatives A and B. Similar to Alternatives A and B, the greatest amount of impact on vegetation from Alternative C would be to the most common vegetation types in the project area, including Upland Mesic Spruce Forest communities, followed by Upland Low and Tall Shrub communities (see Appendix E, Tables 10 through 12). Alternative C would affect substantially more Riparian Forest and Shrub acreage compared to the other action alternatives and therefore would affect more river and stream habitat. Alternative C would also have the highest amount of impacts on other, less common vegetation types in the area, including Alpine and Arctic tussock tundra, and herbaceous communities including Emergent Herbaceous Wetlands, Grassland/Herbaceous, and Sedge/Herbaceous types.

Wetlands Impacts

Alternative C would result in the greatest amount of wetland fill and alteration impacts on wetlands than the other action alternatives. The greatest amount of impacts to wetlands from Alternative C would be to Scrub-Shrub wetlands (see Appendix E, Tables 13 through 15), which is also the most common wetland type in the project area. Alternative C crosses more streams than any other alternative and therefore impacts more riparian wetlands than Alternatives A and B. In addition, Alternative C would impact greater amounts of high-value Palustrine Emergent wetland types than Alternatives A and B combined. Impacts on Nutuvukti fen from Alternative C are not be anticipated, since the fen is located upgradient of Alternative C.

Rare Plants and Ecosystems Impacts

The majority of the geothermal springs in the project area are located near Alternative C, mainly to the south, with the closest geothermal spring located approximately 0.5 mile from the footprint (Volume 4, Map 3-10). Due to the proximity of geothermal springs, Alternative C would pose the greatest risk of potential impacts on geothermal springs and their plant communities from unauthorized access compared to the other action alternatives.

Non-native Invasive Species Impacts

Alternative C is longer in linear miles than any other action alternative; therefore, the area that could have the greatest impact from NNIS from introduction and establishment. In addition, Alternative C would cross, or travel parallel to, more streams and rivers (several of which have been identified as susceptible to *Elodea* infestation) than other action alternatives. As such, Alternative C is considered to have the greatest risk of any of the action alternatives for *Elodea* infestation.

Wildfire Ecology and Management Impacts

Alternative C is longer in linear miles than Alternative A or B, with the greatest number of structures that would be constructed requiring fire suppression; therefore, Alternative C is expected to result in the greatest amount of impacts to wildfire ecology and management compared to the other action alternatives. See Alternative A, above.

Mining, Access, and Other Indirect and Cumulative Impacts

The indirect and cumulative effects from development of mines and associated road access, AIDEA's proposed action, as well as other reasonably foreseeable developments would increase the magnitude of direct impacts discussed above (see Appendix H for more details). Ecosystem changes would occur from the combined development of these actions. These actions would result in wetlands and vegetation being lost as a result. Fugitive dust, changes to soil characteristics, changes to hydrology, thawing of permafrost, and increases in NNIS to the area would result in changes to wetlands and vegetation. Associated wetland functions and ecosystem services would also be altered or lost as a result of these projects. The development and operation of mines and AIDEA's proposed action would result in contamination to surrounding environment due to fugitive dust from trucks hauling ore or spills from trucking accidents, leading to further loss or alternation of vegetation and wetlands. The loss or alternation of rare or high-value wetland types combined with climate-change-induced effects on wetlands could degrade and reduce their occurrence in the area. These projects would also result in loss and alteration (change in the plant communities or degradation of their functions) of tundra types, which are uncommon in the project area, and which could be further threatened from climate-change-induced affects. The cumulative effect of these projects would increase the introduction and spread of NNIS. Some of these impacts to wetlands and vegetation may not be reversed and would be permanent. AIDEA's proposed action, in combination with other reasonably foreseeable actions, would likely have substantial cumulative and long-term impacts to vegetation, wetlands, and associated wetland functions and ecosystem services. Cumulative impacts would be greatest from Alternative C, which would result in greater impacts to wetlands and vegetation than the other action alternatives. In addition, Alternative C is the longest of the alternatives, which would potentially allow NNIS to spread a greater distance. However, this Alternative C would traverse a variety of ecoregions and its impacts would not be concentrated in the southern foothills vegetation communities.

The indirect and cumulative effects from development of mines, indirect road access, and AIDEA's proposed action, as well as other reasonably foreseeable developments, would increase the magnitude of all previously discussed impacts above. The greater length of Alternative C could result in greater fuel loading and over time result in more frequent small wildfires, or more severe large wildfires as compared to Alternatives A and B. More severe wildfires could also impact riverine wetlands and aquatic habitats.

3.3.2 Fish and Amphibians

Affected Environment

The study area for fish includes large and small rivers, tributary streams, lakes, and other aquatic habitats within drainage basins[8] intersected by the project alternatives (Volume 4, Map 3-17). Within the Kobuk-Selawik River basin, these include major rivers such as the Kobuk, Reed, Mauneluk, Kogoluktuk, and Shungnak rivers and Beaver Creek. These rivers in the western portion of the study area generally flow west and drain into Kotzebue Sound in Northwest Alaska. Major rivers in the eastern portion of the study area include the Koyukuk, Wild, John, Malamute Fork Alatna, Alatna, Indian, and Hogatza rivers and Hughes Creek in the Koyukuk River basin, and the Melozitna and Tozitna rivers in the Yukon River Basin. These rivers generally flow south-southwest and contribute to the lower Yukon River Basin. The Ray and Big Salt rivers[9] drain into the middle Yukon Basin. Habitat in the project area supports fish species integral to the subsistence practices of villages throughout the region (Brown et al. 2012; Anderson 2007; Anderson et al. 2004; Braem et al. 2015; see Section 3.4.7, Subsistence Uses and Resources, for details). Section 3.2.5, Water Resources, describes water quality and habitat characteristics for streams and lakes in the study area.

<u>Fish</u>

Researchers have documented more than 20 fish species in the study area (Appendix E, Table 16). Pacific salmon, sheefish, broad and humpback whitefish, Arctic grayling, northern pike, and burbot are major targets of a subsistence, sport, or commercial fishery in the study area or have essential fish habitat (EFH) designated in the study area and are therefore a focus of this section. Based on its cultural importance within the study area, the Alaska blackfish is also discussed. See Section 3.4.7, Subsistence, and Appendix L as well as Section 3.4.2, Transportation and Access, for additional information.

[8] Alternatives A, B, and C traverse the Koyukuk and Kobuk-Selawik river basins (based on USGS hydrologic unit code's 6th level [HUC6]). Alterative C also traverses streams in the Beaver Creek-Yukon and Melozitna-Yukon river basins (HUC6). The Kobuk-Selawik rivers basin contributes to the Northwest Alaska basin (HUC8); the rest contribute to the Yukon Basin (HUC8).
[9] The Ray and Salt river drainages are in the Beaver Creek-Yukon River basin (HUC6).

The Anadromous Waters Catalog (AWC) identifies 4 Pacific salmon species in the study area. Chinook and chum salmon are widely distributed; studies confirm that at least 1 of these 2 species use all major rivers or streams in the study area as well as other tributary streams (Johnson and Blossom 2018a, 2018b). While chum salmon in Clear Creek, a tributary of the Hogatza River in the study area, is on BLM's 'Watchlist,' there are currently no fish species recognized as sensitive by the BLM[10] whose range extends into the study area (Esse and Kretsinger 2009; Kretsinger et al. 1994; BLM 2019). The ADF&G considers Chinook salmon in the Yukon River system as a stock of yield concern[11]. Chinook and chum salmon returns to the Yukon and other rivers in northwest Alaska have declined since the late 1990s, resulting in seasonal restrictions and fishery closures (McKenna 2015). Henshaw Creek stands out as an especially important producer of chum salmon in the Koyukuk River drainage, which is the single largest producer of summer chum salmon in the Yukon River basin. The South Fork Koyukuk River provides habitat for a considerable number of Chinook and chum salmon (BLM 2016a).

Coho and sockeye distribution appears more limited in the Koyukuk River basin by comparison, and unlike chum and Chinook salmon, studies do not document them in the western portion of the study area (Johnson and Blossom 2018a). Coho salmon use extends into the Malamute Fork Alatna River upstream to Mettenpherg Creek, and in the South Fork Koyukuk River upstream to the Jim River (Johnson and Blossom 2018b). Sockeye salmon use the Koyukuk River upstream to Henshaw Creek (Johnson and Blossom 2018b).

Subsistence harvest of adult salmon occurs in July and August when salmon return to study area streams to spawn (Anderson et al. 2004; Braem et al. 2015). Pacific salmon spawn in summer or fall, and eggs incubate through winter and hatch the following spring. Embryo survival depends on water temperature and sufficient water depth throughout incubation. Volume 4, Map 3-17, identifies known Chinook and chum salmon spawning areas; however, spawning likely occurs in other suitable habitats. Studies documented juvenile Chinook, coho, and, to a lesser extent, chum salmon[12] in several study area streams (ABR 2015; ADF&G 2019; Lemke et al. 2013; Scannell 2015).

Habitat in the study area supports several other anadromous and resident fish populations. While several lakes in the study area are capable of supporting fish year-round (Brown et al. 2012), many fish migrate seasonally between mainstem, tributary, and connected off-channel habitats[13] to access preferred feeding, rearing, spawning, or overwintering areas (Brown 2009; Savereide and Huang 2016; Wuttig et al. 2015). The mainstem channels of major streams generally provide overwintering habitat for mixed stocks of several species and serve as a corridor between seasonal habitats (Wuttig et al. 2015).

Sheefish, broad whitefish, and humpback whitefish[14] comprise the majority of the non-salmon subsistence harvest for Koyukuk River communities[15] (Anderson et al. 2004; Brown et al. 2012; see Section 3.4.7, Subsistence Uses and Resources). Sheefish, the largest member of the whitefish family, are an important subsistence harvest resource in this region, and scientists consider them a unique fish species

[10] The 2019 BLM Special Status List includes the Alaskan brook lamprey, Gulkana River steelhead, and Kigluaik Mountain Arctic char as 'sensitive'; Clear Creek chum salmon were candidates for "Sensitive" but did not warrant inclusion so are on the BLM "Watchlist" (BLM 2019).
[11] A stock of Yield Concern is defined as "a concern arising from a chronic inability, despite the use of specific management measures, to maintain specific yields, or harvestable surpluses, above a stock's escapement needs (5 AAC 39.222(f)(42)).
[12] Chinook, coho, and sockeye salmon young typically rear and overwinter in freshwater systems prior to out-migrating to saltwater, while chum salmon often out-migrate soon after emergence.
[13] ABR (2014) describes physical habitat conditions for 11 streams along the northern portion of the study area and discusses potential habitat functions (e.g., spawning, rearing) at each site.
[14] Anadromous forms of sheefish, and broad and humpback whitefish occur in the study area (Brown 2009; Savereide and Huang 2016; Wuttig et al. 2015).
[15] Area residents harvest whitefish from rivers and lakes throughout the year (Anderson et al. 2004; Brown 2009).

in North America (Alt 1994; Braem et al. 2015). Sheefish require specialized spawning habitat limited by water temperature, substrate composition, and specific water quality characteristics influenced by geologic features (Savereide and Huang 2016) (see Volume 4, Map 3-18). They tend to exhibit a high degree of fidelity, not only to spawning reaches but to specific areas within them (Savereide and Huang 2016[16]). Sheefish and whitefish spawn over gravels in flowing water in fall, eggs develop over winter, and larvae emerge in spring, with young dispersing downstream typically during spring floods. Immature whitefish typically rear in a wide range of habitats for several years before migrating upstream to spawn (Brown 2009).

The upper Kobuk River supports "the largest spawning population of sheefish in northwestern Alaska" (Scanlon 2009:7; Taube and Wuttig 1998). The Kobuk is well known for its world-class sheefish trophy fishing. The Alatna River is the most important spawning area for sheefish and other whitefish species in the upper Koyukuk River drainage (Brown 2009). Volume 4, Map 3-18,[17] shows documented sheefish and other whitefish spawning locations. Maintaining spawning habitat is critical to the survival of the Kobuk and Yukon rivers sheefish and whitefish populations because a large fraction of a spawning population may spawn in a small, distinct geographic area. Habitats suitable for supporting rearing, feeding, and overwintering are more widely distributed across a population's range (Brown 2009).

Arctic grayling is a widely distributed resident species and a target of subsistence harvest. During or after spring breakup, grayling move to tributaries to spawn. Since grayling spawn in spring soon after ice-out and young-of-the-year hatch the same summer, they can spawn in streams that may freeze in winter. Volume 4, Map 3-18, shows spawning locations identified in the Koyukuk River drainage (Wuttig et al. 2015). Burbot spawn under the ice over clean gravels in late winter, in water as shallow as 1 foot deep (Mecklenburg et al. 2002; Morrow 1980). Burbot spawn in several major streams in the upper Koyukuk River drainage (Wuttig et al. 2015). The upper Wild River and the North Fork Koyukuk River downstream of Florence Creek are probable spawning areas (Wuttig et al. 2015). Northern pike are also an important target of subsistence harvests in this region (Anderson et al. 2004; see Section 3.4.7, Subsistence Uses and Resources). Northern pike overwinter in relatively deep lakes and rivers, and after ice-out move into shallow, vegetated waters to spawn (Morrow 1980). The Alaska blackfish, found only in Alaska and Siberia, is unique in that it can breathe atmospheric oxygen, survive in poorly oxygenated waters unsuitable for other species, and tolerate extreme cold (Armstrong 1994; Sisinyak 2006). Lemke et al. (2013), ABR (2014), Wuttig et al. (2015), and Kane et al. (2015) provide more detailed habitat and/or fish presence information for many streams and lakes in the study area.

The BLM has identified the Tozitna and Indian rivers as having valuable chum and Chinook spawning habitat (Knapman 1989; Kretsinger and Will 1995). More than 42,000 acres in the Clear Creek and Caribou Creek watersheds (tributaries to the Hogatza River) provide some of the most productive chum salmon production habitat within the Koyukuk River drainage (BLM 2016; Kretsinger et al. 1994). Areas along the Hogatza River also contain high-value salmon habitat within Clear, Caribou, and High creeks. Additionally, the BLM (2016) has identified high-value chum spawning habitat in the Klikhtentotzna River (tributary to upper Hogatza River) and portions of the South Fork Koyukuk River provides habitat for a large number of Chinook and chum salmon. Some of these habitat areas were designated Areas of Critical Environmental Concern (ACEC) in the Resource Management Plan and Record of Decision for the Central Yukon Planning Area (BLM 1986).

[16] See Savereide and Huang (2016) for more information on sheefish in the Kobuk River drainage.
[17] Brown et al. (2012) describe whitefish biology based on several Yukon River basin studies.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act directs federal agencies to consult with the National Oceanic and Atmospheric Administration (NOAA) when any of their activities may have an adverse[18] effect on EFH. EFH refers to "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" for fish managed under a federal Fishery Management Plan (FMP). Pacific salmon are the only FMP-managed fish in the study area (NPFMC 2012). The National Marine Fisheries Service defines freshwater EFH for Pacific salmon as "Freshwater areas used by egg, larvae, and returning adult salmon." The AWC identifies freshwater habitats important for Pacific salmon and NOAA considers such habitats EFH for managed species identified. Chinook, chum, coho, and sockeye salmon have EFH designated in several streams throughout the study area (Volume 4, Map 3-17).

Aquatic Invertebrates

Aquatic invertebrates (small animals such as insects, crustaceans, mollusks, and worms that live in water) are critical components of freshwater ecosystems, serving as vital links in the food chain. They are a main food resource for many fish species, perform important nutrient cycling functions by helping decompose materials in the water, and are indicators of overall stream health. Although data specific to the study area are limited, Scannell (2015) assessed aquatic productivity in the Wild, John, Malamute Fork John, and Koyukuk rivers and examined stomach contents of captured fish. High water conditions during the spring sampling event may have influenced the overall low observation of density and diversity at the 4 sample sites. Scannell (2015) found chironomids (non-biting midges), mites, black flies, caddis flies, mayflies, stoneflies, copepods, and shrews in Arctic grayling stomachs; snails and beetles in humpback whitefish stomachs; and partially digested insect larvae in lake chubs stomachs.

Amphibians

The wood frog is the only amphibian species in the project area and the only amphibian species north of the Arctic Circle. It is common throughout northern latitudes of North America and is uniquely capable of surviving extreme cold during winter dormancy. Wood frogs occur in a wide variety of riparian habitats throughout Alaska and feed opportunistically on a variety of small invertebrates. Breeding pools are generally small and devoid of predatory fish. Wood frogs over-winter on land up to several hundred meters from breeding lakes (ANHP 2019a). Surveys in GAAR identified individual wood frogs near Walker and Nutuvukti lakes, which are near Alternative A (Pyare and Gotthardt 2007). Studies have modeled suitable wood frog habitat throughout the state (ACCS 2019b; Volume 4, Map 3-19).

Habitat reduction and fragmentation due to commercial and residential development have caused population decline throughout much of the wood frog's range. Studies found a high incidence (as many as 19 percent of individuals sampled in some ponds) of abnormalities (e.g., missing, shrunken, or misshapen limbs) among wood frogs in Alaska (Reeves and Green 2006). Studies have linked the chytrid fungus (a fungal pathogen) to amphibian declines worldwide. ABR (2015) also notes it as a concern in Interior Alaska; however, Reeves (2008) notes its occurrence and distribution are not known. Proximity to roads positively correlates with risk of skeletal abnormalities in Alaska wood frogs, possibly due to chemical contamination of gravel and frog habitat, or by the roads facilitating introduction of predators, parasites, or pathogens (Reeves et al. 2008).

[18] An adverse effect means "any impact which reduces quality and/or quantity of EFH."

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The road would not be built and there would not be impacts to fish or fish habitat associated with AIDEA's proposal under the No Action Alternative. Fish and aquatic resources would be affected by changing climate and permafrost conditions (see Sections 3.2.1, Geology and Soils, and Section 3.2.7, Air Quality and Climate) and other reasonably foreseeable future actions, as described in Appendix H.

Impacts Common to All Action Alternatives

Specific activities that would affect fish and amphibians include installing and maintaining bridges and culverts at stream crossings; mining gravel during construction and operations; withdrawing water from aquatic habitats to compact gravel, suppress dust, and supply drinking water for construction and maintenance crews; discharging wastewater to surface water bodies; and placing gravel fill to construct and maintain the roadway embankment and other infrastructure during all 3 project phases. The primary effects to fish and amphibians would result from degrading habitat quality at and downstream of conveyance structures and gravel mine sources near rivers, potentially impeding seasonal habitat connectivity, modifying hydrologic conditions along the entire length of the road embankment, and introducing the potential for accidental spills of petroleum products, mineral concentrates, and other contaminants into aquatic habitats. Of particular concern is the potential for the road to accelerate the predicted rate of climate-driven permafrost degradation, which would further degrade downstream water quality, potentially inhibit fish movement, and may alter species distribution and abundance (O'Donnell et al. 2017; Moquin and Wrona 2015; Evengard 2011). While the AIDEA commits to employing a number of design measures outlined in Appendix N, the implementation of such measures would reduce, but not eliminate, potential impacts to fish and amphibians. A summary of each project element and related effects, in consideration of the proposed design measures, is provided below.

The action alternatives propose to construct bridges across known Chinook and chum salmon spawning habitat[19] in the Yukon River basin and install culverts in more than 1,000 perennial streams known or assumed to support anadromous and/or resident fish. Volume 4, Map 3-17, identifies known Chinook and chum salmon spawning areas; however, spawning likely occurs in other suitable habitats. Bridges and culverts would potentially reduce the amount of anadromous and resident fish habitat and alter habitat function. Properly sized and maintained bridges would have the least effect on fish habitat quality and function. Although culverts can be designed to ensure passage of various life stages of fish, they will still likely alter the characteristics of small stream segments by routing flow underneath the roadway embankment. Replacing natural habitat with culverts and confining flow through culverts and bridges will create localized adverse impacts to fish habitat, which could include reduced habitat complexity and increased sedimentation and scour potential. In some instances, culverts can impact the transport and storage of sediment and wood, which can adversely affect the instream habitat characteristics both upstream and downstream of the structures throughout the life of the road (Limpinsel et al. 2017; Maitland et al. 2016; Daigle 2010; Trombulak and Frissel 2000; NRC 2005; DOWL 2016a, Moore et al. 1999). Sedimentation, especially when increased over naturally occurring background levels,[20] affects habitat quality and function (DFO 2000; Jensen et al. 2009). Increased fine sediments could smother incubating eggs, decrease fry emergence, reduce the amount of suitable habitat for juvenile fish, and

[19] Fish species habitat use data are not available for many streams crossed by the action alternatives; it is likely that salmon spawn in other streams crossed by action alternatives. Studies documented juvenile Chinook, coho, and, to a lesser extent, chum salmon in several study area streams (ABR 2015; ADF&G 2019; Lemke et al. 2013; Scannell 2015) The BLM has evaluated the available fish and fish habitat information and has determined that the sufficient information exists for making a clear distinction among alternatives and a reasoned decision.

[20] Sedimentation and deposition rates naturally fluctuate in rivers in response to flow and weather (e.g., precipitation, snowmelt).

decrease benthic community production (Limpinsel et al. 2017). Elevated turbidity from suspended solids diminishes habitat quality, and may decrease primary production, elevate water temperatures, and affect feeding behavior; large plumes could damage gills and impair organ function (Limpinsel et al. 2017). Appendix N (Section 3.3.2) includes potential measures to minimize these impacts.

Properly sized, installed, and maintained conveyance structures could localize changes to physical habitat. This analysis assumes habitat within a distance of about 5 times the width of properly sized culverts and bridges would be most affected[21]. Habitat function within affected areas may permanently change from existing conditions (Appendix E, Table 17). For instance, the amount and/or quality of spawning and rearing habitat in these areas may be reduced due to scour and/or deposition. Culverts often result in increased fine sediment, dissimilarities between fish species composition and density downstream as compared to upstream, and elevated water temperatures, whereas such differences are less pronounced for bridge crossings (Maitland et al. 2016). Section 3.2.5, Water Resources, discusses water quality and hydrology in more detail.

Maintaining access to seasonal habitats during natural migration periods is critical to sustaining fish populations. Past studies have shown that improperly sized and placed culverts often lead to velocity barriers for upstream migrating fish and even properly designed culverts may lead to locally increased stream velocities at inlets and outlets (Limpinsel et al. 2017; Hotchkiss and Frei 2007; NOAA n.d.; Burford Jr. 2005). As a result of the road intercepting and rerouting the natural overland and stream flow paths of more than 1,000 mapped streams, velocity may increase in some streams and decrease in others. AIDEA has committed to proper culvert sizing and placement to help maintain effective fish passage, habitat integrity, and drainage similar to natural conditions after construction that, along with regular maintenance, would be critical to maintaining fish populations (DOWL 2016a; Appendix N). Throughout operations, routine inspection and maintenance of culverts and bridges would be necessary to ensure fish passage and minimize habitat degradation. Culverts would need to be cleared each year prior to spring breakup to avoid impeding fish movement, particularly for Arctic grayling and other species that migrate under the ice to reach spawning or other seasonal habitats. Installation and maintenance of properly installed crossing structures would reduce, but would not eliminate, impacts to fish habitat.

AIDEA proposes to provide fish passage at all perennial and well-established ephemeral stream crossings (Appendix E, Table 17). ADF&G may require additional surveys be conducted at stream crossings, particularly where fish data are lacking, to inform culvert design during permitting.[22] AIDEA has committed to using culverts that would be designed and maintained to allow fish passage during natural migration periods (DOWL 2016a; Appendix N). Therefore, impacts from conveyance structures may be fairly localized within a given stream but potentially widespread across the region since the road would traverse hundreds of small and large fish streams. All action alternatives could affect fish species abundance and distribution. If culverts do not maintain hydrology and fish passage, consequences to fish populations would result. Design features proposed by AIDEA and measures outlined in Appendix N would significantly minimize potential effects to fish species abundance and distribution.

Activities in streams and along banks would temporarily impact habitat quality, and increased sedimentation and turbidity may be especially pronounced during and shortly after Phase 1 and Phase 3 construction. Piles will be driven or drilled below ordinary high water of several anadromous streams in

[21] Observations suggest habitat within a distance of 5 times the width of the properly sized, installed, and maintained conveyance structures would be most affected; floodplain width assumed to be 3 times the diameter of a culvert width plus a roadway embankment at a 4:1 slope for Phase 3 width both upstream and downstream was used to estimate impacts to floodplains.
[22] The Fishway Act (AS 16.05.841) requires authorization from ADF&G for activities within or across a stream used by fish if such an activity may impede the efficient passage of resident or anadromous fish, which could include ephemeral streams.

winter to support bridge piers and abutments.[23] Impact hammers generate underwater sound pressure levels that may displace, harm, or kill fish and/or incubating eggs exposed to harmful levels (Limpinsel et al. 2017; Stadler 2003; Hawkins 2005). Fish response is difficult to predict, and the extent of injury or harm to fish is difficult to quantify.[24] While some fish may die, impact hammer use would not cause population-level effects. During permitting, ADF&G will establish in-water work timing windows to reduce construction-related impacts to fish for each construction phase.[25] Appendix N provides measures to avoid or minimize potential impacts to fish and invertebrates.

The placement of road embankments would change overland flow, change surface and groundwater flow patterns, and disconnect streams from low-lying, off-channel habitats (e.g., seasonally flooded wetlands, ponds) that would otherwise be accessible to aquatic species (Daigle 2010; Trombulak and Frissell 2000; Creamer 2019; Forman and Alexander 1998). While habitat that maintains a surface water connection to streams for longer duration may have a higher potential to support a broader composition of species, seasonal use of off-channel habitats and ephemeral streams is important for many species. While AIDEA would be required to maintain fish passage in streams crossed by the road, the road embankment would eliminate connectivity to some habitats as a result from altering hydrology across the project area, and may increase competition in those still accessible to fish. Appendix E, Table 17, estimates acres of wetlands and waters[26] that would be eliminated.[27] The potential mitigation measures would lessen, but not eliminate, impacts to fish and aquatic life.

Roads alter the physical, chemical, and biological structure and integrity of aquatic habitat, could contribute persistent sediment loads, and increase rates of natural disturbances such as landslides (DFO 2000). The potential is especially important to consider given the proposed road's spatial location and extent. As permafrost continues to thaw, the potential for large thaw slumps and other physical manifestations of soil instability increases, which may cause sediment releases into spawning and other important fish habitats (Vonk et al. 2015; Cho 2018). Climate models have predicted that warming ground temperatures will continue to decrease the amount of permafrost throughout the region. Constructing and maintaining a road hundreds of miles long across a largely undeveloped area underlain by relatively warm permafrost has the potential to accelerate the predicted rate of permafrost thaw, especially given the shallow roadway design proposed for Phase 1 (Cheek 2008). Even properly designed roads in permafrost-free areas could become major sources of increased sedimentation if not properly maintained (Limpinsel et al. 2017).

The road will introduce the potential for polycyclic aromatic hydrocarbons (PAHs), trace metals,[28] and other toxins to habitats that support sheefish, broad and humpback whitefish, salmon, and other fish harvested for subsistence use, by way of roadway runoff, accidental spills, and dust (Trombulak and Frissell 2000; Trumbull and Bae 2000; VPTI 2015; Nixon and Saphores 2007). Petroleum products are highly toxic to aquatic life, persist in sediments for many years, and are harmful to fish in very small concentrations in water or food ((Limpinsel et al. 2017; Incardona et al. 2004; Reynaud and Deschaux 2006; Brown et al. 2012). Exposure to PAHs could result in injury and mortality for salmon and other

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[23] Abutments for small bridges, in addition to multi-span bridge piers, may be located below ordinary high water (DOWL 2016a).
[24] The effects of noise on individual fish depends on many factors, such as species and size; vertical location of fish and proximity to sound source; water current and depth; substrate composition and texture; peak noise level; noise frequency and rise time; and the presence or absence of predators since injured fish are more susceptible to predation (Limpinsel et al. 2017). Fish response ranges from avoidance to acute and sometimes fatal effects (damage to auditory receptors and rupture of the swim bladder to chronic effects (behavioral changes and long-term stress; Hastings and Popper 2005).
[25] Installing conveyance structures would require temporary stream diversions.
[26] Data necessary to quantify acreage of impacts to fish habitat are not available; therefore, all waters are assumed to support fish.
[27] The impact to vegetation and wetlands near the roadway would also contribute to habitat degradation and increased erosion.
[28] Refined petroleum (e.g., diesel, kerosene) have high levels of metals (i.e., lead, copper) (Akpoveta and Osakwe 2014).

species, and even dissolved PAHs are highly toxic to fish embryos at low concentrations[29] (Carls and Meador 2009; Incardona et al. 2015). Metals are highly soluble in water and fish are extremely vulnerable to metal toxicants in water since their gills are continuously exposed (Price 2014). High metal concentrations disrupt organ function and even low concentrations could lead to mortality[30] (Hughes et al. 2016; Mallat 1985; Wood 2001). Dust would increase fine sediment input and impact habitat quality (Appendix E, Table 17). Calcium chloride, which may be used to control dust, easily leaches out of the soil during precipitation events and is toxic to fish (Barnes and Conner 2014). Calcium chloride inhibits growth of young salmonids; reduced growth rates at critical life stages have the potential to negatively affect recruitment and population dynamics (Hintz and Relyea 2017). The project proposes to employ mitigation measures to reduce the magnitude of potential impacts. The BLM could, for instance not allow the use of calcium chloride and will consider the effectiveness of dust suppression relative to the impacts associated with the dust and the impacts of the calcium chloride use. However, even with the use of hydraulically sealed lids and truck rinsing procedures, ore concentrates are transported up to 2.5 miles (4 kilometers) from the Red Dog mine haul road and low levels much farther (Hasselbach et al. 2005; Neitlich et al. 2017). Once in waterways, toxins may spread even farther. Surface runoff from the road could enter waterways and adversely affect water quality. Even low levels bioaccumulate in fish tissue and could impair fish behavior. Mines would also use the road to transport fuel and toxic processing chemicals[31] that, if spilled, would threaten aquatic life and be especially toxic when combined (Price 2014). Mitigation measures (Appendix N) would minimize, but not eliminate, potential impacts to fish and aquatic life.

Spills have the potential to substantially degrade habitat quality and affect the long-term health of individual fish and fish populations. While the extent of potential impacts of a spill would depend on the material spilled, characteristics of the receiving habitat, and the speed and success of spill response, spills onto the roadway would occur. Habitat located near road crossing sites, which includes spawning, rearing, feeding, wintering, and migratory habitat, would be most susceptible to contamination from potential spills (see Volume 4, Maps 3-17 and 3-18). In the event of a vehicle rollover, lid-locking mechanisms on closed container vehicles could be damaged and toxic ore concentrate released into the atmosphere, across the project area, and into waterways (see Section 3.4.2, Transportation and Access). Such a spill, particularly if near a stream, could substantially alter water chemistry, cause fish mortality, substantially degrade habitat quality and function, and cause population-level effects.

Changes to natural water chemistry parameters may reduce egg survival and affect fish populations (Limpinsel et al. 2017). Sheefish have very specific spawning habitat requirements, influenced in part by geologic features (Gerken 2009). Exposing materials with considerably different geologic composition may influence the water chemistry signature downstream. Even small changes in water quality could have substantial consequences to fish populations. Runoff from the road, even if not contaminated by spills, may alter downstream water chemistry (EPA 2019). NOA and acid-generating rocks occur throughout the study area. While a Yukon River study documented asbestos fibers in tissue of multiple fish species, it is unclear if and to what extent asbestos may be harmful to fish and aquatic life (West and Metsker 1983). Exposure and leaching of acid rock into waterways would substantially degrade habitat quality, alter water chemistry, and affect the health of fish and invertebrate populations. Sheefish and salmon may be most vulnerable to decreases in pH compared to existing levels. AIDEA indicates that cuts in acid rock areas would be avoided, but total avoidance may be difficult to achieve.

[29] Embryo exposure to very low-level crude oil concentrations cause lasting cardiac defects in salmon (Incardona et al. 2015).
[30] Copper is a neurotoxin to fish; exposure to low levels impairs olfactory function and alters behavior (Hughes et al. 2016).
[31] Copper sulfate, hydrochloric acid, lime, methyl isobutyl carbinol, sodium cyanide, sodium diisobutyldithiophosphinate, sodium isopropyl xanthate, sulfuric acid, zinc sulfate, and adipic acid are commonly used in mines (DOWL 2016a).

The elimination and fragmentation of wood frog habitat would likely not cause population-level effects due to the low density and wide distribution of the population. Frogs may be killed by vehicles, during vegetation removal, by soil compaction, from potential chemical contamination, through increased predation,[32] and by introduced parasites or pathogens.[33] The chytrid fungus has decimated amphibian populations in other locations and an infected wood frog was found in Alaska (Reeves and Green 2006), which indicates the fungus has made it to Alaska and could be transferred via the road alternatives to wood frog habitat in the project area. Proximity to roads is correlated with higher rates of wood frog physical malformations (Reeves et al. 2008). The road may act as a vector for the introduction and movement of diseases that could infect wood frog populations beyond the ROW and invasive plant species that could degrade fish habitat quality (see Section 3.3.1, Vegetation and Wetlands).

Removing gravel from a stream channel changes the structure of its natural habitat for aquatic species, sediment transport dynamics and flow processes; degrades quality and habitat function upstream and downstream of mined areas; and alters fish and invertebrate communities (Brown et al. 1998; NMFS 2005). AIDEA proposes to mine gravel from ridges, hillsides, and low-lying areas in floodplains and in some cases directly adjacent to active stream channels. Removing streambed gravel from relic channels in the floodplain will degrade habitat quality by reducing habitat complexity and altering hyporheic zone[34] dynamics,[35] which may affect survival rates of incubating eggs (Kondolf et al. 2002; NMFS 2005). Adverse impacts to fish may be fairly localized during the activity, although the full magnitude of effects is difficult to quantify given the lack of specific gravel extraction methods and plans.[36] Since stream channels naturally meander within their floodplains over time, it is likely that the stream may eventually occupy the mined area, further perpetuating habitat degradation and reducing the availability of suitable spawning habitat.[37] Studies have shown that attempts to mitigate or restore streams impacted by gravel mining can be extremely expensive and may be ineffective because impacts often extend kilometers upstream and downstream of mined sites (Brown et al. 1998; Kondolf et al. 2001). Existing management plans for the Indian River and Hogatza River ACECs indicate that material sites should not be located within the active floodplain of any stream within the existing ACECs (Kretsinger and Will 1995; Kretsinger et al. 1994). If the project were to commit to total avoidance of gravel mining in active floodplains regardless of land ownership and jurisdiction, impacts to fish habitat from gravel mining would be greatly reduced. Locating material sites outside of active floodplains could help to mitigate the project's cumulative impacts to fish and aquatic life. Gravel mining near sheefish and other whitefish spawning areas could have especially negative consequences to fish populations, since these fish have specific spawning requirements and large numbers of fish spawn in relatively small, distinct areas. Blasting to support road construction and gravel mining throughout operations creates sound pressure levels that may harm exposed fish. Limits on the power of explosives would reduce impacts (Kolden and Aimone-Martin 2013; Timothy 2013).

AIDEA will need to obtain authorizations from ADNR and ADF&G for each water source[38] prior to construction. Permit stipulations set forth by ADNR and ADF&G typically limit the quantity of water that can be removed from each source to minimize impacts to aquatic life and ensure suitable habitat is maintained throughout the year. Water withdrawals may kill or injure some small individual fish and invertebrates but would not be anticipated to have population-level effects if typical permit stipulations

[32] The road may result in a localized increase in wood frog predation, as predators are attracted to human infrastructure and roads.
[33] Chemicals and pathogens in gravel or other material has contaminated habitat and cause limb malformations in Alaska.
[34] The hyporheic zone is where surface and groundwater interact beneath and adjacent to streams; it is critical for salmon spawning and egg incubation and regulates biological activity that affects stream health; see Hancock 2002 for more information.
[35] Dewatering mine pits adjacent to streams alters water quality, flow dynamics and may reduce downstream habitat availability.
[36] Increasing fine sediment input in spawning gravels decreases survival of salmonid eggs (Quinn 2005; Jensen et al. 2009).
[37] Small, unconfined streams may be more vulnerable to gravel mining than highly structured large rivers (Brown et al. 1998).
[38] While the water access points have been proposed within GAAR, they have not all been identified outside of GAAR.

are enforced.[39] While water needs would vary for each phase, the types of impacts to fish would be similar though potentially more widespread during times when more water is required. Appendix N provides potential measures to avoid or minimize impacts to fish and aquatic life.

Alternative A Impacts

The road route proposed under Alternative A would cross the Kobuk River and more than 20 of its tributary streams that flow directly into the Kobuk River sheefish grounds, which support "the largest population of spawning sheefish in northwestern Alaska" (Scanlon 2009:7; Taube and Wuttig 1998). The road could introduce contaminants, including but not limited to PAHs, chemicals associated with mining, and toxic ore, into waters known to support sheefish, broad and humpback whitefish, Chinook, chum, and coho salmon, and several other species that are extremely important for subsistence harvest throughout the region. While Volume 4, Map 3-17 identifies known Chinook and chum salmon spawning areas, spawning likely occurs in other suitable habitats. Volume 4, Map 3-18, shows documented sheefish and other whitefish spawning locations. A spill into these waterways has the potential to affect not only individual fish but also the sheefish population[40]. Alternative A would also cross several fish streams that ultimately contribute flow to the Alatna River upstream of documented sheefish and whitefish spawning grounds.

Appendix E, Table 17, which identifies a number of metrics considered in assessing impacts to fish, can be used to make general comparisons of potential impacts between the action alternatives. The Alternative A road route would cross the fewest number of streams and would be considerably shorter in length than Alternative C. Alternative A would cross streams much farther upstream in the drainage basins than Alternative C and would not cross streams within existing ACECs. Because of its location near and upstream of sheefish habitat, Alternative A has a greater potential to directly affect Kobuk River and Alatna River sheefish spawning habitat than Alternative C. Since stream and fish data are not available for all action alternatives at the same resolution, exact comparisons of fish stream crossings among alternatives are not possible. However, the BLM reviewed the information that is available and determined that the difference in resolution among alternatives is not essential to making a reasoned choice among the alternatives. The overall costs of obtaining the same level of fish data for all alternatives would be exorbitant. To disclose impacts, the BLM relied on published data and input from subject matter experts and cooperating agencies in interpreting available data.

Alternative A proposes gravel mine sites in floodplains at several locations, including directly adjacent to known salmon and whitefish streams. Nearly half of the material sites proposed under Alternative A would be located in a floodplain and/or within 500 feet (152 meters) of fish streams (Appendix E, Table 17). Material sites in the floodplains could potentially degrade anadromous habitat quality in the John, Malamute Fork Alatna, Alatna, Kobuk, Reed, Mauneluk, Kogoluktuk, and Ambler rivers and Beaver Creek, in addition to several smaller streams that may support fish (see Maps 2-3, 3-5, 3-6, 3-17, 3-18).

Alternative A would have the smallest footprint and eliminate the fewest acres of waters and wetlands compared to the other action alternatives; impacts to wood frogs and aquatic invertebrates would likely be less than under the other action alternatives (Appendix E, Table 13).

Alternative B Impacts

Similar to Alternative A, Alternative B would cross several fish streams that flow directly into the Kobuk River and Alatna River sheefish spawning grounds, which are shown in Volume 4, Map 3-18. While

[39] Fish can become entrained (pulled into intake pipe) or impinged (suctioned against screen) during water withdrawals. Intake screens and velocity limits typically required by permit stipulations help to prevent most fish from entering the pump (McLean 1998).

[40] Population-level affects include impacts to most or all members of an age class, stock, or an entire population.

Alternative B would include a similar number of crossings as Alternative A, several would be located closer to sheefish and whitefish spawning areas. Alternative B would cross the Reed River within about 7 miles of Kobuk River sheefish spawning habitat. Alternative B would also cross several tributary streams of Jack Beaver Creek, which is located just upstream of important whitefish and sheefish spawning habitat in the Alatna River. The location of crossings relative to sheefish spawning could put this important habitat at risk of degradation and contamination from potential spills. Like Alternative A, Alternative B would not cross streams within existing ACECs. Alternative B proposes a similar number of gravel mine sites in floodplains and/or low lying areas within 500 feet (152 meters) of fish streams as Alternative A, including directly adjacent to known salmon and whitefish streams, as shown in Appendix E, Table 17. Material sites in these areas would impact fish habitat quality in the John, Malamute Fork Alatna, Alatna, Kobuk, Hogatza, Mauneluk, Kogoluktuk, and Ambler rivers and Beaver Creek, in addition to several streams that support fish. While effects to fish, aquatic invertebrate, and wood frogs would be similar, slightly more habitat would be impacted under Alternative B than Alternative A (Appendix E, Table 14).

Alternative C Impacts

The Alternative C route would be much longer than the other action alternatives. Alternative C would cross several more fish streams than Alternative A or B and, due to challenging topography, would be routed along floodplains more often and for longer distances than the other action alternatives. Alternative C would route over 80 miles of industrial road within 1,000 feet of major floodplains and/or streams (identified by the National Hydrology Dataset [NHD]), which may put these waters at a higher risk from potential spills and increased sedimentation. For comparison, about 16 miles and 20 miles of the Alternative A and Alternative B industrial road alignments, respectively, would be routed within 1,000 feet of major floodplains and/or NHD streams.

Alternative C would cross the Kobuk River downstream of sheefish spawning habitat. While the road would still introduce the potential for spills into sheefish, whitefish, and salmon habitat, it would be less likely to directly affect sheefish spawning habitat in the Kobuk River. Alternative C is routed through habitat that was previously identified as a sheefish spawning area; however, recent surveys suggest this habitat may not be used by sheefish for spawning (Brown and Burr 2012).

Alternative C is the only alternative that would cross streams within existing ACECs. Alternative C would cross and run parallel to the Tozitna and Indian rivers within existing ACECs and along the Hogatza River upstream from the existing ACEC. Alternative C would construct more bridges than the other action alternatives, which would damage fish habitat less than culvert crossings. However, the Alternative C route would require installing over 4,000 minor culverts and many more moderate and major culverts, substantially more than the number of culverts proposed by the other alternatives. Since the resolution of available stream and fish data varies across alternatives and crossing locations have not been fully identified for Alternative C, more detailed comparisons among alternatives are not possible. The BLM has evaluated the available fish and fish habitat information and has determined that the sufficient information already exists for making a clear distinction among alternatives and a reasoned decision.

Alternative C also proposes gravel mine sites directly adjacent to known salmon and whitefish streams. Fewer material sites would be located in floodplains and/or within 500 feet (152 meters) of fish streams for Alternative C as compared to the other action alternatives (Appendix E, Table 17). Material sites in the floodplains would degrade anadromous habitat quality in the Ray, Tozitna, Indian, Kobuk, Hogatza, and Ambler rivers, as well as several streams that support fish. Because Alternative C would result in the largest footprint and affect the most acres of waterbodies and wetlands, impacts to fish, aquatic invertebrates, and wood frogs from impacts to habitat would be greater than under the other action alternatives (Appendix E, Table 15).

Essential Fish Habitat Impacts

All action alternatives would reduce the amount and impact the quality of EFH. All action alternatives would construct bridges across documented EFH streams. Several known EFH streams could be adversely affected as a result of gravel mining, depending upon the proximity of the mining activity to the stream and floodplain. Effects to salmon and EFH from installing, operating, and maintaining bridges and culverts and the road, removing gravel from the floodplain of EFH streams, and withdrawing water throughout the life of the project would be similar to those described for all action alternatives. Proposed activities may influence surface and groundwater flow (hyporheic zone) dynamics, which could ultimately influence salmon production rates. Appendix E, Table 17, estimates the number of EFH streams crossed by each alternative and the amount of habitat that may be most affected. It is likely that more streams and wetlands support Pacific salmon than have been identified to date, and would therefore be considered EFH. AIDEA would be required to conduct additional surveys during permitting to supplement existing data.

Alternative C would cross more documented EFH streams and impact more documented EFH than the other action alternatives. Alternative A would have 1 less EFH stream crossing than Alternative B. Note, however, that fish sampling has not been conducted for most streams in the project area. While comparing the number of EFH stream crossings is useful, a detailed and quantitative comparison of potential impacts to salmon and EFH between alternatives would require additional data collection.

Mining, Access, and other Indirect and Cumulative Impacts

The indirect and cumulative impacts from development of mines within the District and secondary access roads, and other development or activities would be additive to the impacts to fish and amphibians described above. Construction of the road is anticipated to lead to the development of large-scale hard rock mines near habitat that is essential for Chinook, chum, and coho salmon; sheefish; broad and humpback whitefish; Arctic grayling; and several other species that are integral to the subsistence practices throughout this region. Mining and its associated activities have the potential, if not properly managed, to substantially impact habitat structure, quality, and function and affect fish species at the population level. Hard rock mining could disrupt natural surface and groundwater interactions and processes, reduce the amount of EFH, likely impact water quantity and quality, affect biodiversity and fish production, and may require treatment of toxic mine water (Hughes et al. 2016; Limpinsel et al. 2017; Woody et al. 2010). Adverse impacts to water quality were found to be common at mine sites and most often caused by failed mitigation (Kuipers et al. 2006; Maest et al. 2005; Woody et al. 2010).

The 4 mine projects discussed in Appendix H are located on tributary streams that drain directly into the Kobuk River sheefish spawning grounds, which is the only sheefish spawning area in the Kobuk River drainage. Two of the state's 11 sheefish spawning locations occur in the study area, and mining-related cumulative impacts could result in population level impacts to sheefish. The road and reasonably foreseeable future development could also negatively affect the Alatna River whitefish spawning grounds, as well as several EFH streams, as described in the previous section. The road could accelerate the predicted rate of permafrost melting, which would further reduce downstream water quality, potentially inhibit fish movement, and may alter species distribution and abundance.

Cumulatively, the road and reasonably foreseeable future development has the potential, if not properly constructed or maintained, to have very substantial, long-term impacts to fish and aquatic life at the population level, which could lead to very substantial impacts on subsistence use practices in the region.

3.3.3 Birds

Affected Environment

Approximately 141 avian species may occur in the project area (Appendix E, Table 18). There is little information on avian species distribution or abundance in the project area, and researchers have completed few avian monitoring studies in this region[41]. The ACCS Wildlife Data Portal interactive range maps (ACCS 2019b), supplemented with species lists and survey reports from GAAR (Degroot and McMillan 2012) and Kanuti NWR (Craig and Dillard 2012, 2013; Harwood 2014; Platte and Stehn 2011) and with nearby breeding bird survey routes (e.g., Caribou Mountain, Kanuti Canyon, Manly Hot Springs, Moose Creek; see Pardieck et al. 2018), inform bird species occurrence in the study area. These studies are incorporated by reference.

The alternatives cross a variety of land cover types, including a wide diversity of avian habitats. Avian species assemblages across Alternatives A, B, and C vary, depending on habitat type. The majority of Alternatives A and B is located in spruce woodlands and scrub. The majority of Alternative C traverses spruce, birch, and aspen forests (see Section 3.3.1, Vegetation and Wetlands). Passerines (perching/song birds) are the most common species group in terrestrial habitats, although species composition varies depending on land cover type and elevation. Waterfowl, gulls, terns, and shorebirds are generally attracted to lakes, rivers, and other wetlands; however, some species prefer alpine meadows and tundra. The majority of avian species are migratory and present only in summer or during migration. Approximately 20 year-round resident species occupy the project area, including ravens, ptarmigan, grouse, chickadees, and dippers (Appendix E, Table 18). Approximately 130 species nest within the project area, including these resident species. Currently, human influence, except for small villages, does not generally disturb avian habitat in the project area.

Approximately 34 species of waterbirds (e.g., waterfowl, loons, grebes, cranes) may occur in the project area (Appendix E, Table 18). Most waterbirds are associated with lakes, streams, and wetlands, which are common throughout the project area (Appendix E, Table 5). The most common waterbirds recorded during aerial surveys in Kanuti NWR include northern pintail, scaup (greater or lesser), and American wigeon (Platte and Stehn 2011). The Central Yukon REA (Trammel et al. 2016) identified areas of waterfowl species richness along Alternative C near the Hogatza and Pah rivers. Red-throated loons, which are on the current BLM list of sensitive species (BLM 2019), are rare in the project area. They breed in tundra wetlands and small boreal ponds, but prefer coastal areas (Barr et al. 2000).

Approximately 17 species of shorebirds and 5 species of larids may occur in the project area. Suitable habitat is relatively rare for gulls and terns, and many of these species are fairly uncommon. Shorebirds are common in wetlands and in suitable habitat along rivers, streams, ponds, and lakes. Some species, such as American golden-plovers, wandering tattlers, and surfbirds, breed in alpine tundra and mountainous areas. Alternative C crosses mountainous and alpine habitat, while Alternatives A and B skirt the edges of these habitats.

Approximately 18 raptor species may occur in the project area, including eagles, hawks, falcons, and owls. Ritchie (2013) conducted raptor nest surveys within 2 miles of the Alternative A and B centerlines and identified golden eagle, peregrine falcon, osprey, and bald eagle nests. The foothills along and north of Alternatives A and B contain cliff-nesting habitat for peregrine falcons and golden eagles. Peregrine falcons and rough-legged hawks may also nest in relatively small, riverine banks along the major rivers

[41] Impacts to birds were not identified as a significant issue based on scoping comments. Based on the species known to inhabit the study area, and the habitat information that is available inferred from vegetation and other mapping, The BLM determined there is sufficient information to make a reasoned choice among alternatives. Obtaining detailed data on species distribution and abundance for 141 species in a project area of this size would be exorbitant.

crossed by project alternatives. Major river drainages and some lakes provide riparian forest stands suitable for bald eagles and osprey, the primary tree-nesting species in the project area. Surveys focused on cliff habitat and large, riparian tree stands (Ritchie 2013). Several other raptor species nest in different habitat types, and surveys likely did not detect them. Aerial surveys in the Kanuti NWR identified bald eagle, osprey, great horned owl, and northern goshawk nests (Craig and Dillard 2012, 2013).

Approximately 67 species of landbirds (e.g., songbirds, woodpeckers, kingfishers, grouse, ptarmigan) may occur in the study area. Passerines comprise 56 of these species and encompass the majority of birds in the study area. In 2005, researchers conducted landbird monitoring in southern GAAR. The most common species observed were fox sparrow, Bohemian waxwing, white-crowned sparrow, dark-eyed junco, ruby-crowned kinglet, and redpolls (Tibbitts et al. 2005). This is consistent with other landbird surveys elsewhere in Interior Alaska (ABR 2014; Harwood 2014). Common ravens are the largest passerine, filling a niche similar to raptors, and are ubiquitous across most of Alaska. Ritchie (2013) identified 6 common raven nests located within 2 miles of Alternatives A and B.

Three species of landbirds are currently on the BLM sensitive species list: olive-sided flycatcher, gray-headed chickadee, and rusty blackbird (BLM 2019). Olive-sided flycatchers breed along forest edges, such as burns, marshes, open water, and open woodlands. They sing from the tops of tall, prominent trees and forage among snags and over meadows (Altman and Sallabanks 2012). Gray-headed chickadees are 1 of 3 resident chickadee species found in the coniferous forests of the project area. Rusty blackbirds are associated with wetlands, such as bogs, muskeg swamps, and beaver ponds (Avery 2013). All 3 species are relatively common in the project area.

Special Status Species

Of the 141 bird species that may occur in the project area (Appendix E, Table 18), 5 are currently recognized by the BLM as sensitive, 7 are BLM watch list species (BLM 2019), 10 are USFWS birds of conservation concern (Bird Conservation Region 2, 3, or 4; USFWS 2008), and 43 are recognized as "At-Risk" by the ADF&G (2015). Appendix E, Table 18, denotes species listed as vulnerable or near-threatened on the International Union for Conservation of Nature (IUCN 2019) Red List of Threatened Species and Audubon Alaska Red or Yellow List species (Warnock 2017a, 2017b). The BLM does not anticipate ESA-listed threatened, endangered, or candidate species to occur in or near the study area. The Bald and Golden Eagle Protection Act protects bald and golden eagles, and the Migratory Bird Treaty Act protects almost all birds, in the project area. The status of species is subject to change; for example, the BLM revises its list of sensitive and watch list species every 3 years.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, the BLM and/or other federal permitting agencies would not issue permits for the Ambler Road, and therefore road construction and use would not occur. There would be no potential direct or indirect impacts on birds associated with AIDEA's proposal under the No Action Alternative. Birds would be affected by changing climate and permafrost conditions, and other reasonably foreseeable future actions as described in Appendix H.

Impacts Common to All Action Alternatives

The impacts on birds from a road could include terrestrial and aquatic habitat reduction and alteration, disturbance and displacement, and injury or mortality. However, due to limited baseline data on bird distribution or abundance in the project area, it is not possible to quantify potential impacts to birds at the species or population level. The types of potential effects would be similar under each action alternative, but the avian resources affected may vary based on the location of each action alternative.

Bird habitat, including potential breeding, nesting, foraging, staging, and stopover habitat, would be lost where vegetation removal and gravel fill placement occur. Rare, habitat-limited, and specialist bird species, such as some special status species and birds with high fidelity to nest sites, could be disproportionately affected by habitat loss. The removal or alteration of uncommon habitat types would have a proportionately greater impact on the species that use them. For example, impacts to cliffs or riverine bluffs, which are rare in the project area, could affect the abundance and distribution of cliff-nesting raptors. Bridge construction is likely to alter some bluffs and cliffs to install abutments, although it is not known whether any specific nesting sites would be affected.

Most habitat loss would occur during Phase 1 construction, with habitat loss expanding during construction of Phases 2 and 3. Traffic operating on the road starting in Phase 1 would create movement, noise, and dust that would degrade adjacent habitat. The habitat adjacent to the existing road that would be affected during Phases 2 and 3 would likely be of lower quality than habitat that is undisturbed, as would be lost during Phase 1 construction. It is likely that most, if not all, species now occurring in the area of the proposed alignments would continue to occur in the area. Individuals would be displaced, and some may not be able to successfully compete to find suitable replacement habitat (e.g., for nesting or foraging) or would end up in inferior habitat (e.g., more subject to flooding or predation). While these impacts are common to all alternatives, Alternative C would result in a greater area of habitat loss than the other action alternatives, as discussed below.

Edge effects describe the alteration of habitat beyond the footprint of the road due to gravel spray, fugitive dust, snow accumulation, noise pollution, light pollution, alteration of hydrologic flow regimes, and various other factors. As described in Section 3.3.1, Vegetation and Wetlands, fugitive dust could be deposited up to 328 feet (100 meters) from the gravel road (Walker and Everett 1987). Fugitive dust deposition could also increase thermokarst and soil pH, and reduce the photosynthetic capabilities of plants in areas adjacent to roads (Auerbach et al.1997). Edge effects could reduce the availability of food sources, the productivity of vegetation, and the quality of potential nesting habitat. Noise and light pollution may extend large distances from the gravel footprint, depending on vegetation type, topography, ambient sound levels, and various other factors (Bayne et al. 2008; see Section 3.2.6, Acoustical Environment, and Appendix D, Attachment A, for more information on noise).

Birds may be disturbed or displaced during construction due to human activity, vehicle and aircraft traffic, pile installation, and other industrial construction activities described in Chapter 2, Alternatives. Construction would occur year-round, but the vast majority of birds are only present from late spring to early fall. The greatest potential impact on birds would occur during breeding and nesting seasons, which generally occur from May through September, although some raptors, geese, and swans may nest earlier. Overwintering and resident species, such as ptarmigan, grouse, ravens, and other species may be disturbed during winter construction. The distance to which disturbance creates behavioral changes in birds varies by species, life stage, the source of the disturbance, and each individual's tolerance or habituation to disturbances (Bayne et al. 2008).

Disturbance and displacement would occur during each of the 3 construction phases, but would likely be greatest during Phase 1 construction when activities would occur in previously undisturbed habitat. Even if much of the construction were completed in winter, birds returning in spring would find habitat gone and would be displaced. Some birds may use the area adjacent to the new road during the spring, only to be disturbed later in the summer when construction activity would resume or operations would occur. Disturbance and displacement of birds would continue through the life of the road due to vehicle traffic, road maintenance activities, and other operation activities. Once constructed, the Phase 1 pioneer road would not be used in spring/early summer (May through July), and therefore behavioral impacts on birds would be less than during the other phases, which include year-round operation. Mitigation measures (Appendix N, Section 3.3.3, Birds) that discourage intentional harassment of birds would only slightly lessen the overall behavioral disturbance impacts that largely result from the use of construction equipment and vehicle use.

During construction, birds could be incidentally injured or killed during the initial removal of vegetation. Vegetation removal for construction would result in habitat loss and create "open areas that may fragment populations of forest-dwelling species," and mowing practices could "directly kill eggs, fledglings and adults attending nests" (Kociolek et al. 2015), which could reduce productivity and abundance at the local population level for some species. However, BLM special status species policy (BLM 2008b) and Alaska statewide land health standards (BLM 2004) afford protections to special status species, including mitigation measures for activity that may result in population declines. The BLM would require that vegetation clearing under its permits be scheduled outside of the breeding season, that any vegetation clearing during the breeding season of special status species include pre-disturbance nest surveys, and that construction include appropriate avoidance measures to prevent impacts to special status species as well as nesting bank swallows (Appendix N, Section 3.3.3, Birds). For most avian species in Interior Alaska, breeding occurs between May 1 and July 15. Canada geese and swans generally nest between April 20 and July 15, and raptors nest much earlier than other species. The majority of surface disturbance is expected to occur during Phase 1 construction. During construction of subsequent phases, vegetation removal would be limited to that along the edge of the road. Generally, this vegetation is of lesser quality and less likely to contain nesting birds.

Birds may collide with vehicles, aircraft, and construction equipment. Erickson et al. (2005) estimated that 80 million bird fatalities per year occur due to collisions with vehicles and approximately 25,000 occur due to collisions with aircraft. Rate of collisions with vehicles range from 2.7 to almost 100 birds per mile of road, depending on traffic volume, adjacent habitat types, and other factors (Erickson et al. 2005). Due to an expected reduction in nesting density and avian activity in proximity to the road over time, the majority of collisions with construction equipment would occur during Phase 1 construction.

During road operation, birds may collide with vehicles, bridges, communication towers, and other structures (Erickson et al. 2005; Loss et al. 2015). The potential for collisions with vehicles is directly related to traffic volume and travel speed (Loss et al. 2014, 2015), which are both expected to increase over time and would be greatest during Phase 3. Birds, especially waterfowl, use rivers and streams as movement corridors. Therefore, the potential for collisions at bridges could be greater than at other points along the road. Birds may also collide with communication towers and other structures. The presence of guy wires on towers and characteristics of warning lights affect the potential for collisions with these structures (Erickson et al. 2005; Loss et al. 2015). The presence of carrion would attract some bird species and result in mortality while they were scavenging on the road (Kociolek et al. 2015).

Predators and scavengers of birds and bird nests include foxes, bears, ermine, raptors, gulls, jaegers, and ravens. Ground-nesting birds, such as most shorebirds and waterbirds, are at particular risk for nest depredation. Linear features and anthropogenic disturbance are known to attract and facilitate dispersal of predators. Lattice-style communication towers provide nesting and perching structures for avian predators, which may increase predation risk. The presence of a road may result in a minor, but widespread, increase in bird mortality due to predation.

Alternative A Impacts

Avian habitat lost or altered due to Alternative A would consist primarily of upland tundra shrublands and mesic spruce forests. Alternative A would affect relatively little alpine habitat (see Appendix E, Table

10). Avian habitat associations lack the refinement, and vegetation mapping lacks the detail necessary to accurately predict impacts at the species level. Overall, Alternative A would result in less habitat reduction and alteration than the other action alternatives.

Alternative B Impacts

Under Alternative B, lost or altered avian habitat would generally be the same as under Alternative A (see Appendix E, Table 11). Slightly more habitat would be lost or altered under Alternative B than Alternative A. Due to the poor granularity of available habitat mapping and lack of refined species habitat associations, it is not possible to pinpoint differences between Alternatives A and B in regard to potential impacts on birds. However, given the size of the study area and available habitat, the lack of detailed information is not relevant to identifying reasonably foreseeable significant adverse impacts.

Alternative C Impacts

Avian habitat affected by Alternative C would primarily consist of upland shrublands and mesic spruce forests. Alternative C crosses more alpine habitat and riparian forests/shrublands than the other action alternatives (see Appendix E, Table 12). This alternative crosses through an area identified in the Central Yukon REA (Trammell et al. 2016) as having high waterfowl species richness. In addition, Alternative C is substantially longer and would result in more avian habitat reduction than the other alternatives. Due to its length, Alternative C would require longer construction periods, more air traffic, and more construction and operation support facilities. Based on this, it is anticipated that Alternative C would result in greater impacts to birds than the other action alternatives.

Mining, Access, and other Indirect and Cumulative Impacts

The indirect and cumulative impacts on birds from development of the District and secondary access roads, and other development and activities in the analysis area (see Appendix H) would be additive to and synergistic with the action alternatives. Habitat loss and alteration due to the reasonably foreseeable development of the District could more than equal that from the road and exponentially increase fragmentation of avian habitat. Disturbance and displacement from mining activity would be in addition to disturbance due to road construction and use. Warming Arctic conditions combined with other cumulative actions may increase wildfires, change the abundance and distribution of forage and nesting habitat, or increase the prevalence and intensity of weather events (Hinzman et al. 2005). The accumulation of impacts on birds would be similar regardless of the action alternative selected.

3.3.4 Mammals

Affected Environment

As many as 38 mammal species may occur in the project area (Appendix E, Table 19). The ADF&G, NPS, and BLM regularly monitor large terrestrial mammals such as caribou and moose (Dau 2015; Jandt 1998; Joly and Cameron 2017). Species occurrence and distribution information for other mammals is based on Cook and MacDonald (2006) and MacDonald and Cook (2009), as well as interactive range maps from the ACCS Wildlife Data Portal (ACCS 2019b) and the NPS Species Checklist (NPS 2019), and are incorporated by reference. Mammalian species presence varies across the project area, depending on habitat type and prey distribution. Most of the alternatives are in low and tall shrub habitats or mesic spruce forests of the Kobuk Valley and Ray Mountains ecoregions (see Section 3.3.1, Vegetation and Wetlands).

Caribou

The project alternatives occur within the ranges of 2 caribou herds: the Western Arctic Herd (WAH) and the Ray Mountains Herd (RMH; only Alternative C). Increased vehicle traffic on the Dalton Highway (under Alternatives A and B) may also affect the Hodzana Hills Herd (HHH). Other nearby herds include the Teshekpuk, Central Arctic, and Porcupine herds north and northeast of the project area (Dau 2015) and the Wolf Mountain Herd south of Alternative C (Volume 4, Map 3-20). Because Porcupine and Wolf Mountain herds do not occur in the project area, they are not anticipated to be affected and are not discussed further. Individuals from the Central Arctic and Teshekpuk herds may enter the project area during migration or while overwintering. Low densities of collared Teshekpuk Herd caribou have overwintered on the Seward Peninsula, near Kobuk, and near Noatak (Parrett 2019). This use is rare, so these herds are not discussed further.

The majority of caribou in the project area are members of the WAH, which ranges over approximately 157,000 square miles (363,000 square kilometers) of northwestern Alaska (Dau 2015; Volume 4, Map 3-20). Human development in the WAH range is currently limited to approximately 40 rural villages and the Red Dog lead and zinc mine, which includes a 70-mile private road and port site (WAH WG 2011).

The RMH and HHH are small, non-migratory caribou herds that inhabit the area north of the Yukon River village of Tanana, within the Ray Mountains and Hodzana Hills, respectively (Volume 4, Map 3-20; Pamperin 2015). No notable human development exists within the RMH range. The Dalton Highway is the primary, notable human footprint within the HHH range (Horne et al. 2014). Due to the isolation of the RMH and HHH ranges, as well as low harvest numbers, little is known about the seasonal distribution and life history of these 2 herds. Compared to the WAH, much less information regarding seasonal distribution, abundance, habitat use, diet, and other life history factors is available for the RMH and HHH. This is because these herds have been a lower priority for research by ADF&G and other agencies due to their small size, isolation, and absence of substantial hunting pressure. The lack of available, specific data means the impact evaluations pertaining to these two herds require a greater dependence on what is known about the WAH and other better studied caribou herds. Because less is known about the RMH and HHH than the WAH, less detail is possible. The BLM considered this lack of data and determined there was sufficient information to make a reasoned choice among alternatives and to disclose relevant impacts.

Major mortality events have occurred during winter throughout the range of the WAH. Winter rain events cause ice and strong winter storms that create wind and deep snow, limiting access to critical winter forage and contributing to episodic population declines (Joly et al. 2010; Joly and Klein 2011). Cows exhibit poor physiological conditioning, lower calf birth weights, reduced calf survival, slower growth of surviving calves, poor body condition of calves, reduced pregnancy rates, and delayed birthing during springs that follow winters with deep snow (Adams et al. 2006; Joly and Klein 2011). Unusually strong winter storms near Cape Thompson during 1994–1995 and 1999–2000 brought cold temperatures, strong winds, ice, and deep snow cover. Research links those conditions to poor body condition in caribou, suggesting that starvation contributed to large die-offs during those years (Dau 2005). As caribou densities hit their peak, competition for food resources could also contribute to localized mortality events in winter range areas, as have occurred in other Arctic caribou populations (Ferguson and Messier 2000; Jandt et al. 2003; Joly et al. 2007).

Caribou are a preferred prey for wolves and can comprise up to 60 percent of the wolf diet, and wolves cause up to 7 percent of the WAH mortality each year (Ballard et al. 1997). Wolves preferentially prey on caribou in Central Alaska, even when moose and sheep are abundant (Dale et al. 1994). Caribou and other ungulates comprise a larger proportion of the grizzly bear diet in Interior Alaska, as compared to coastal bears that consume a diet of mostly salmon (Mowat and Heard 2006). Other carnivores that may prey on caribou include wolverines, coyotes, and golden eagles, but they generally target the very young, very old, or debilitated in a herd (Joly and Klein 2011).

Caribou are an important subsistence and cultural resource for Alaska Natives living within the 42 communities located throughout the WAH range (Appendix F, Table 12). Harvest of WAH caribou occurs primarily through local subsistence or non-local sport hunting in game management units (GMUs) 21D, 22A–E, 23, 24, and 26A. Total harvest of subsistence and sport-hunted WAH caribou in 2014 was approximately 6 percent of the population. This includes a small number of Teshekpuk herd caribou since they and WAH can co-occur during their fall migration (Dau 2015). Local subsistence hunters generally travel by boat on rivers in summer or snow machine in winter, while non-local sport hunters primarily travel by aircraft. Sport hunting of the WAH has occurred for many years, but appears to have increased rapidly since 2000 then stabilized or declined due to regulatory changes and national economic downturn (Fullman et al. 2017). Conflict between local and non-local hunters has arisen due to perceived negative effects of aircraft on caribou behavior and local hunter success. Studies (e.g., Fullman et al. 2017) have not shown that WAH caribou alter their fall migration due to non-local hunting activity, although fine-scale or short-term responses may be altering availability of caribou to local hunters. See Section 3.4.7, Subsistence Uses and Resources, for further information about subsistence hunting of caribou.

Lichens are the primary forage for WAH caribou in late fall and throughout winter, comprising over 70 percent of their diet (Joly and Cameron 2018a). Lichen are a major source of carbohydrates and help caribou survive winter until emergent forage appears in spring (Joly et al. 2012). Studies suggest that caribou with access to lichens have better body condition, may experience less competition for food, and have a better chance of surviving winter (Joly and Cameron 2015; Joly et al. 2015). The RMH and HHH, like other non-migratory, low-density caribou herds, persist with limited lichen consumption (Joly and Cameron 2018a; Thomas and Edmonds 1983; Adamczewski et al. 1988). The RMH appears to select deciduous dwarf shrublands for foraging (Horne et al. 2014).

Fires and overgrazing could result in long-lasting impacts on WAH caribou survival and fitness. Lichens are particularly prone to the effects of fire due to their structure, moisture content, and position atop the tundra canopy. Fires and overgrazing result in a shift from lichen to a cover of fast-growing grasses and herbs that could persist for decades (Jandt et al. 2003, 2008; Joly et al. 2009). Wilson et al. (2014) found that recent fires have removed large portions of high-quality habitat in the eastern half of Alternatives A and B, and large portions of Alternative C intersect past burn areas (Boggs et al. 2012). In northwestern Alaska, dwarf and tall shrub cover has increased substantially over the last quarter century (Joly et al. 2009). Low abundance of quality winter forage could cause caribou to migrate farther in search of suitable habitat, which increases energy expenditure and exposes them to increased predation risk (Joly et al. 2010; Dau 2015).

Herd Size and Trends. Caribou herd populations experience cyclical growth and decline (Appendix A, Figures, Figure 3-1). The WAH experienced a steep decline from 1970 to 1976, when the population dropped from 240,000 to 70,000, and then began a steady increase for several decades (Dau 2015). The ADF&G has conducted aerial photo censuses of the WAH since 1986 and has tracked collared individuals since 1979. The population peaked at more than 490,000 caribou in 2003 (Dau 2015), raising concerns about potential overgrazing (Joly 2011). The WAH then experienced another decline. Reasons for the decline are uncertain, but could be due to declines in lichen cover in their winter range or severe winter weather events. In 2007, studies estimated the population at 377,000 individuals, and it continued to decline at approximately 4 to 6 percent per year, until 2011, when it reached 325,000 animals (Joly 2011). Between 2011 and 2013, the population dropped to 235,000, which is an average annual decline of 15 percent. This steep decline was due to very high mortality in winter 2011–2012 and low recruitment during 2012 and 2013 (Dau 2015). The population continued to decline through 2016, when surveys estimated it at 201,000. However, the most recent photo census in 2017 estimated the WAH at 259,000 caribou (Volume 4, Figure 3-21). The ADF&G did not complete a photo census in 2018 because caribou never suitably aggregated on their summer range, and poor weather prevented surveys during fall migration. Due to recent severe winter conditions, the adult female mortality rate may be among the worst since 1985, leading ADF&G biologists to predict a population decline during 2018 (Romanoff 2018).

In 1983, the ADF&G surveyed the RMH for the first time and counted 400 caribou. Between 1994 and 2012, the long-term population size was between 656 and 1,564 animals (Horne et al. 2014). Unlike the larger herds in Alaska, the RMH and HHH populations remain relatively consistent and do not experience cyclic fluctuations. A July 2018 survey, the most recent conducted, counted 812 caribou (Longson 2019). Radio telemetry data from 2005 to 2009 estimated the HHH at 1,000 to 1,500 animals (Horne et al. 2014; Pamperin 2015). The RMH and HHH appear to be stable and comparable in size (Appendix A, Figure 3-2). Hunter and subsistence harvest is low for both herds due to limited access and a short season (Pamperin 2015). Predation appears to be the primary factor limiting herd growth, although body size appears to have declined over time (Pamperin 2015).

Life History and Seasonal Distribution. Caribou occupy different types of habitat throughout their range, depending on season. They use their ability to efficiently travel long distances to access areas with abundant forage plants, minimize predation, and escape insect harassment. Caribou make some of the longest terrestrial migrations on the planet (Joly et al. 2018), and the WAH is the most wide-ranging caribou herd in Alaska. Though the WAH migration has increased in variability in recent years, the WAH has exhibited the same general movement patterns for the last 50 years (Dau 2015). Their total distribution extends from the Chukchi Sea coast east to the Colville River, and from the Beaufort Sea coast south to the Seward Peninsula and Nulato Hills. This range encompasses most of the project area, which the WAH generally uses during migration and as winter range (Volume 4, Map 3-21; Dau 2015).

Spring migration appears to coincide with average daily ambient temperatures above freezing (Dau 2015). Pregnant cows from the WAH begin their spring migration in early May, while bulls and non-maternal cows begin in mid-May (Dau 2015). Joly and Cameron (2017) found that the average date collared cows crossed the Kobuk River, which is approximately the same latitude as Alternatives A and B, is between late April and late May. The relatively large spread of dates may be due to the different timing of pregnant and non-maternal cows. The mapped migratory range (ADF&G 2017) generally overlaps with the western half of Alternatives A and B and the western one-third of Alternative C. The mapped peripheral range, which receives consistent but lower density use, generally covers the eastern half of Alternatives A and B, and the middle one-quarter of Alternative C (Mileposts [MP] 154 to 245; Volume 4, Map 3-21).

Pregnant cows head directly to the Utukok Hills, near the headwaters of the Colville River, to give birth in dense aggregations (Volume 4, Map 3-20). Bulls and non-pregnant cows migrate to the Wulik Peaks and Lisburne Hills (Dau 2015; Joly and Cameron 2017; Romanoff 2018). Moist dwarf-shrub and moist low-shrub vegetation typically dominate calving grounds (Kelleyhouse 2001); however, caribou seem to prefer foraging on flower buds of tussock cottongrass (*Eriophorum vaginatum*; Kuropat 1984), which seems to be important to lactating cows (Eastland et al. 1989; Kelleyhouse 2001). After calves are born in early June, cows and calves travel to mix with the rest of the herd in the Lisburne Hills.

During summer, the WAH uses the western North Slope and central to western Brooks Range (Dau 2015; Joly and Cameron 2017). Mosquitoes and parasitic oestrid flies (warble fly and nose-bot fly) harass caribou during the early and middle summer months (Person et al. 2007; Dau 2015). In response to insect harassment, caribou form large aggregations and move rapidly towards the coast or other insect-free habitat such as river bars, dunes, drained-lake basins, and late snow-covered ridge tops (Murphy and Lawhead 2000). Habitat selection becomes secondary to escaping insect harassment, and caribou typically feed less often and use areas with lower-quality forage (Person et al. 2007). Caribou infested with oestrid fly larvae could suffer poor body condition and lower pregnancy rates (Hughes et al. 2009; Cuyler et al. 2010). Summer and insect relief season forage is predominantly sedge-grass meadow, dwarf shrub, and willows (Kuropat 1984). In late summer, as insect harassment subsides, the herd becomes more dispersed across the North Slope and Brooks Range, with some individuals traveling as far east as the Dalton Highway (Dau 2015; Joly and Cameron 2017; Joly et al. 2018).

The WAH begins a widely dispersed fall migration during August, moving south and southwest toward their winter habitat through November (Dau 2015). On average, the WAH crosses the Kobuk River from early to mid-October (Joly and Cameron 2017). The project area is located within the eastern approximately one-quarter of known WAH caribou fall migration routes. Roughly 13 to 68 percent of the herd may pass through the project area during fall migration, between September and January, depending on the year (Joly et al. 2016; Joly and Cameron 2017). Rut occurs within the dispersed herd during fall migration, though there is no specific location of the rut (Dau 2015).

Most WAH caribou winter on the Seward Peninsula or in the upper Kobuk and Koyukuk river drainages (Volume 4, Map 3-21; Dau 2015). Studies have observed collared caribou during winter in the Buckland Valley, Selawik, and Nulato Hills (Jandt et al. 2003; Joly et al. 2006; Joly 2019). A small portion of the WAH occasionally winters on the North Slope near Point Lay, Atqasuk, or Umiat. In recent years, studies have observed a larger portion of the WAH wintering in the central and western parts of the Seward Peninsula (Romanoff 2018). The mapped WAH winter range (ADF&G 2017) overlaps with approximately 50 miles of Alternatives A (MPs 155 to 199) and B (MPs 172 to 216) on the western portion of those routes. The mapped winter range overlaps with approximately 77 miles of Alternative C (MPs 244 to 321; Volume 4, Map 3-21). Wilson et al. (2014) found that 24 of 80 (30 percent) collared WAH caribou spent at least a portion of 1 winter (of 4 studied) within 15 miles of Alternatives A and B.

On their winter range, cows from the WAH prefer northwest- and southwest-facing slopes, and avoid flat terrain (Wilson et al. 2014; Joly 2011). Independent of lichen abundance, caribou preferred scrub, shrub, and sedge habitats over deciduous and mixed forests (Joly 2011). During winter, habitat selected by WAH caribou has up to 3 times the lichen abundance of unused habitat, and they select areas with fewer tall shrubs (Joly et al. 2007, 2010).

Unlike the WAH, the RMH and HHH do not undertake major migration and range within much smaller areas (Hollis 2007; Horne et al. 2014). Researchers once thought the 2 herds were a single herd, but telemetry data indicated little to no overlap between the herds, and studies identified the HHH as a distinct herd in 2007 (Hollis 2007). Separation of the RMH and HHH appears to be based on habitat selection and the presence of dwarf shrub forage, moderate slope, and lack of wetlands; the presence of a road did not seem to be a driver (Horne et al. 2014). While the availability of lichen as winter forage is important to the WAH, non-migratory herds such as the RMH and HHH may not depend as heavily on lichen abundance to support energetically expensive migrations (Joly and Cameron 2018), although studies on RMH and HHH diet have not been conducted.

The RMH range is roughly bounded on the south by the Yukon River, on the east by the Dalton Highway, and includes the entirety of the Ray Mountains. The northern extent of the range is located in the Kanuti Flats. RMH calving distribution is not well delineated. Studies have found that some caribou from the RMH calve on the southern slopes of the Ray Mountains in the upper Tozitna drainage, while other studies have suggested they calve on the northern slopes near Kilo Hot Springs (Jandt 1998). During summer, studies found the RMH caribou in the alpine zones of the Ray Mountains, such as Spooky Valley and Mount Henry Eakins. RMH caribou winter on the northern slopes of the Ray Mountains near the headwaters of the Kanuti-Kilolitna River (Jandt 1998; Hollis 2007; Pamperin 2015). Groups of 200 to 400 RMH caribou are typical during winter (Jandt 1998).

Caribou from the HHH are typically concentrated near the headwaters of the Hodzana, Dall, and Kanuti rivers on the east side of the Dalton Highway (Hollis 2007). Occasionally, studies found HHH caribou west of the Dalton Highway. The Dalton Highway intersects the southeast portion of their range during all seasons (Horne et al. 2014; Pamperin 2015).

Other Large Herbivores

Information on moose abundance and distribution in the project area is highly limited[42]. Moose abundance and density in the project area are low. Population estimates do not appear to be meeting management objectives, natural mortality is high, and harvest is currently restricted (Joly et al. 2017; Stout 2018). Moose density within GAAR in 2015 was approximately 0.16 moose per square mile (0.06 moose per square kilometer), which suggests there has been little change in abundance from 2004 to 2015 (Sorum et al. 2015). This is consistent with density estimates in the upper Kobuk River drainage (Saito 2014). Population estimates between 2000 and 2013 in GMU 23 (which overlaps the western half of the project area) indicate moose densities ranged between 0.03 and 0.59 adult moose per square mile (Saito 2014). In GMU 24 (which overlaps the eastern portion of Alternatives A and B and the central portion of Alternative C), densities were approximately 0.48 moose per square mile (Longson 2019). The observed moose densities are low, particularly in the western and northern portions of the project area (Joly et al. 2016). However, densities are comparable to those in other areas surveyed throughout northwestern Alaska and are likely regulated by wolves and bears (Lawler and Dau 2006; Reimer et al. 2016).

Moose in the project area select habitat with high canopy cover or 11- to 30-year-old burn areas (Maier et al. 2005). During winter, they select lower elevation areas close to rivers, except females with calves, which select more forested areas (Joly et al. 2016). Moose prefer tall shrub and riparian habitats in early successional stage areas with new or young vegetation (Joly et al. 2012). In the project area, winter concentration areas are present along major river drainages where riparian habitat is abundant (ADF&G 1973). Moose are also an important subsistence resource for residents within the communities of the Koyukuk and Yukon river drainages (Lawler and Dau 2006).

Muskox and Dall sheep are present in northwestern Alaska, but it is unlikely either species would occur in the project area. The nearest herd of muskox is located in the Cape Thompson area. Aerial surveys sighted a small population of muskox within the last decade in GAAR, likely comprised of individuals that have dispersed because of range expansion of other herds (Lawler 2003). Individual or small groups of muskox have been reported infrequently near Ambler and Kobuk, but these are considered rare sightings (Parrett 2019). Dall sheep occur within the steep mountain slopes, alpine ridges, and meadows of the Brooks Range (Reimer et al. 2016). Individuals occasionally seek shelter in lowland forests, particularly during heavy snow events, but are unlikely to occur in the project area.

Large Carnivores

In this analysis, large carnivores include bears, foxes, wolves, and wolverines. Small carnivores (e.g., ermine, river otter) are discussed below under Small Mammals. Black bears and wolves are the most common large carnivores in the project area. Most species in this group are opportunistic mesocarnivores that inhabit large home ranges and a variety of habitats. For example, studies found that wolves in Alaska occupy ranges in excess of 1,100 square miles (3,000 square kilometers; Ballard et al. 1998). All the large carnivore species prey on or scavenge caribou and moose, but only wolves and grizzly (brown) bears regularly prey on adult ungulates. Caribou are preferred prey when in high abundance within their territories; however, wolves target moose during winter when caribou are absent (Ballard et al. 1997). In addition to moose and caribou, wolves also prey on voles, lemmings, ground squirrels, and snowshoe

[42] Impacts to moose were not identified as a significant issue based on scoping comments. Based on habitat information inferred from vegetation and other mapping, and consultation with cooperating agencies, The BLM determined there is sufficient information available to make a reasoned choice among alternatives.

hares (Stephenson 1979). Grizzly bear density in the western Arctic is positively correlated with caribou density (Reynolds and Garner 1987), but abundance and distribution in the project area are largely unknown, particularly along Alternative C (Young 2015)[43]. Grizzly bear activity along Alternatives A and B peaks in August and September, when they are positively associated with salmon streams (Joly et al. 2016). Grizzly bears den at middle to high-altitude ranges of the Brooks Range (Joly et al. 2016) and Ray Mountains (Jandt 1998, Eagan 1995). Black bears are important subsistence species and furbearers are targets of trapping for local communities. The current population trends of large carnivores in or near the project area are largely unknown due to low density, large ranges, cryptic nature, and high mobility of the various species.

Small Mammals

Small mammals, including shrews, lemmings, voles, ground squirrels, and weasels, are important prey for predatory birds and carnivorous mammals in northwestern Alaska. Many small mammal species have cyclical population fluctuations reflected, with a short temporal lag, in the population fluctuations of their predators. For example, fox and lynx populations in northern Alaska are highly volatile and are closely associated with snowshoe hare abundance (Ruggiero et al. 1999; Yom-Tov et al. 2007). Furbearers, particularly lynx and fox, are harvested by trappers throughout the project area, but harvest numbers are relatively low throughout the region. Arctic ground squirrels hibernate during winter, while lemmings, voles, weasels, and shrews are active year-round. Most of these species are widely distributed and relatively common in a variety of habitats. Little brown bat is the most widely distributed bat in Alaska; however, its presence within the project area is limited by the lack of preferred roosting habitat of buildings and forested areas (Parker et al. 1997). Cook and MacDonald (2006) and MacDonald and Cook (2009) describe the habitat preferences of small mammals. The current population trends of small mammals in or near the project area are unknown due to a lack of research. However, given the size of the study area and overall habitat availability, the BLM determined the missing information is not relevant to reasonably foreseeable significant adverse impacts.

Special Status Species

The ESA does not list any terrestrial mammals known or suspected to occur within the project area. The BLM designated the arctic ground squirrel and little brown bat, each of which occurs in the project area, as watch list species (BLM 2019), and the State lists 16 mammal species as Species of Greatest Conservation Need (ADF&G 2015; Appendix E, Table 19). Neither designation is associated with additional protections or stipulations.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, the BLM and/or other federal permitting agencies would not issue permits for the Ambler Road, and therefore road construction and use would not occur. There would be no road impacts associated with AIDEA's proposal on mammals under the No Action Alternative. Mammals would be affected by changing climate and permafrost conditions, and other reasonably foreseeable future actions, as described in Appendix H.

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[43] Impacts to bears were not identified as a significant issue based on scoping comments. Based on habitat information inferred from vegetation and other mapping and consultation with cooperating agencies, The BLM determined there is sufficient information available to disclose impacts commensurate with the anticipated impacts and to make a reasoned choice among alternatives.

Impacts Common to All Action Alternatives

Potential impacts to mammals from construction and operation of the action alternatives could include habitat loss, alteration, and fragmentation; behavioral disturbance and displacement; and injury or mortality. The nature of the impacts is similar for each action alternative, but the magnitude of the impacts would vary based on differences in location and design of the action alternatives. See Appendix F, Table 21, Potential impacts to terrestrial mammals.

Caribou Impacts

Construction of the action alternatives would result in the loss of caribou habitat in areas of vegetation removal and placement of gravel fill. Loss of caribou habitat by herd, range, and action alternative is shown in Appendix E, Table 20. The reduction of lichen-dominated vegetation types would result in disproportionately greater impacts on WAH caribou than the reduction of other vegetation types. Available land cover mapping is insufficient[44] to describe the distribution of lichen-dominant vegetation types throughout the project area (see Section 3.3.1, Vegetation and Wetlands), and so it is not possible to quantify potential impacts to this important habitat. Each of the action alternatives would permanently remove winter, migratory, and peripheral range of the WAH caribou. During winter, forage can be limited and travel can be difficult due to snow cover. Loss of winter range would be more detrimental to the WAH than loss of migratory or peripheral range. Habitat lost from any of the action alternatives would represent no more than 0.005 percent of the 92.2-million-acre WAH total range. Although habitat loss would occur under each action alternative, Alternative C would result in the greatest area of habitat loss, as discussed further below and in Appendix E, Table 20.

Between 2009 and 2019, a total of 206 Global Positioning System (GPS) collars were deployed on female WAH caribou at Onion Portage in Kobuk Valley National Park. The collars provided multiple locations for each caribou, which were used to approximate seasonal range use for the sampled cohort; both 50 and 95 percent utilization distribution kernels were produced using GIS (Joly and Cameron 2018; Joly 2019). Winter (December 1 – March 31) and fall (September 1 – November 30) utilization distribution is shown in Volume 4, Map 3-23. Using this data results in smaller ranges because the data is based on a smaller number of individuals and fewer years. As such, the 50 and 95 percent fall and winter contours should be interpreted as supplemental to rather than superseding the ADF&G range maps. Habitat loss within the 95 percent contours for both fall and winter are provided in Appendix E, Table 20, for each alternative. None of the action alternatives would directly affect winter or fall high-density (50 percent utilization distribution) range use for the WAH (Volume 4, Map 3-23), as approximated by the utilization distribution contours. However, because WAH range use is dynamic, seasonal herd concentrations may overlap with the action alternatives in any given year.

Impacts from physical and chemical alteration of caribou habitat from gravel spray, fugitive dust, thermokarst, drifted snow, or contamination of vegetation and soils are highest within 328 feet (100 meters) of the gravel footprint (Walker and Everett 1987). However, decline in percent cover of lichens has been detected up to 3,280 feet (1,000 meters) from gravel roads used for mining (Chen at al. 2017). Depending on the value of the habitat and magnitude of the effect, habitat alteration could result in anywhere from negligible functional effects on caribou or could be equivalent to habitat loss.

The presence of a road could result in an increase in human-started fires, but would also change fire management priorities and resource allocation (see Section 3.3.1, Vegetation and Wetlands). Therefore, in proximity of the road, fires may be smaller and of shorter duration. Loss in caribou browse due to fires may be less common in the project area as a result of the road.

[44] The BLM determined that the cost of obtaining this data would be exorbitant but has summarized the credible scientific evidence that is available.

Each action alternative would fragment the WAH caribou range. The effects of this fragmentation, although small relative to the total range of the WAH, would be pronounced because the range is currently largely unaltered from a natural state. Fragmentation may result in reduced dispersion of individuals across the winter range and subsequent crowding in smaller habitat fragments (Dyer et al. 2002). A Fish and Wildlife protection plan would include several measures to minimize habitat fragmentation for mammals (Appendix N, Section 3.3.4, Mammals).

Construction and use of the road would cause behavioral disturbance to and displacement of caribou due to human activity, including noise and light pollution (Murphy and Lawhead 2000; Shideler 1986). Behavioral disturbance could result in an increase in energy expenditure due to higher stress levels and an increase in startle and flight responses. Behavioral changes could result in reduced foraging rates and decreased mating success. Noise could also inhibit predator detection and intraspecific communication (Barber et al. 2010; Brown et al. 2012).

Caribou are most susceptible to disturbance during calving and post-calving (summer), when behavioral changes and displacement have been detected up to 2.5 miles (4 kilometers) from industrial activity on the North Slope (Cronin et al. 1994; Cameron et al. 1992). Outside of calving and post-calving, displacement from suitable habitat is common up to 0.6 mile (1,000 meters) from disturbance (Cronin et al. 1994; Johnson and Lawhead 1989), even with relatively low activity levels. Other studies have identified larger displacement zones: up to 6 miles (9.6 kilometers) from various forms of disturbance (Edmonds 1987; Duchesne et al. 2000; Nellemann et al. 2003; Cameron et al. 2005; Schaefer and Mahoney 2007; Vors et al. 2007; Leblond et al. 2011). Displacement distance is related to disturbance intensity and other factors. Leblond et al. (2013) found that caribou avoidance of a highway occurred up to 3.1 miles (5,000 meters) during and after modifications to increase vehicle traffic. Disturbance during winter could result in reduced movement rates, constricted home range size, and less range fidelity (Faille et al. 2010). Displacement from winter range could affect access to forage and subsequently reduce fitness at a time of year when forage may already be limited due to snow conditions (Joly et al. 2010; Joly 2011). Implementation of construction timing windows recommended by the BLM and other land managers (Appendix N, Section 3.3.4, Mammals) could reduce, but would not eliminate, impacts to caribou during sensitive periods.

The strongest reactions to human activity, as measured in displacement distance, occur in response to humans on foot (Curatolo and Murphy 1986; Lawhead et al. 1993; Cronin et al. 1994). Although experience in the North Slope oil fields indicates that caribou may habituate to some industrial activities (maternal caribou being a notable exception), WAH and RMH caribou generally have had less exposure to industrial development than the Central Arctic Herd, so they may be less likely to habituate quickly.

During construction, the most disturbing stimuli to caribou would be construction equipment and air traffic. Caribou are more prone to displacement from areas with consistently high levels of disturbance, such as material sites, camps, and airstrips. Low-level aircraft may cause flight responses or temporary changes in caribou behavior (Maier et al. 1998; Reimers and Colman 2006). However, Fullman et al. (2017) found that terrain and land cover characteristics were a greater influence on WAH caribou movement than aircraft. During road operation, the most common disturbing stimuli would be vehicle traffic. Moderate to high traffic volumes (more than 15 vehicles per hour) have been shown to delay or deflect large groups of caribou (Curatolo and Murphy 1986; Lawhead and Murphy 1988; Cronin et al. 1994). During Phase 1 operation, the pioneer road would see low traffic volumes and slow travel speeds. During Phase 2 operation, the use of pilot cars and convoys would limit displacement impacts on caribou. During Phase 3 operation (a 2-lane road), traffic volume is difficult to predict without actual mine proposals and is dependent on mine development. This EIS predicts a range of potential traffic volumes, from 104 to 168 trucks per day during Phase 3 operation (Appendix H), or 5 to 7 trucks per hour on average. Disturbance and displacement of caribou would be greatest during construction of Phase 1 and during operation of Phase 3.

Caribou that encounter the road may be impeded, causing delays in crossing the road, deflection of movements, or potentially prevention of crossing the road entirely by some individuals. Steep road embankments may prevent caribou from crossing, thereby furthering the effect of the impedance. During winter, steep snow banks may prevent caribou movement and reduce road crossings except on BLM-managed lands where this potential impact may be partially mitigated. Potential mitigation measures and design features proposed by AIDEA, such as requiring vehicles to wait for caribou to cross, should reduce, but not eliminate, these impacts. Restrictions on activity and cessation of traffic on BLM-managed land would have little effectiveness due to the small amount of BLM-managed land on each alternatives A and B (Appendix N, Section 3.3.4, Mammals). Examples from across the globe suggest that disruptions in ungulate migration often cause rapid population collapse (Bolger et al. 2008). However, in Alaska, the Central Arctic Herd has maintained connectivity between winter and summer ranges despite being intersected by the Dalton Highway (Nicholson et al. 2016), the Fortymile Herd has maintained movement and migration patterns despite being intersected by multiple highways and roads (Boertje et al. 2012), and the Nelchina herd has generally maintained the minimum population objective set by ADF&G, despite crossing multiple highways annually (ADF&G 2016). In Alberta, roads are a semi-permeable barrier to woodland caribou, with the greatest barrier effect evident during late winter (Dyer et al. 2002).

Local residents indicate that the historical caribou distribution in the project area shifted following the construction of TAPS and the Dalton Highway. Prior to construction of the pipeline and road, caribou migrated through the eastern portions of the project area, near Bettles, Alatna, and Allakaket. Following construction, residents say that the caribou stopped coming through this area (WAH WG 2015, 2016). These observations could be due to the TAPS and the Dalton Highway, but may not necessarily have been of WAH caribou. Seasonal distributions of the HHH, Central Arctic Herd, or Porcupine Herd may also have been influenced by pipeline or road development. Alternatively, the observed changes could be explained by shifts in range use as a result of natural perturbations.

In a study of the 55-mile DeLong Mountain Transportation System (DMTS) road that services the Red Dog Mine, 8 of 28 GPS-collared caribou (29 percent) altered their movements near the road during fall migration and took approximately 10 times as long to cross the road. However, crossings by most collared caribou (71 percent) did not appear to be delayed, and connectivity to seasonal ranges was maintained (Wilson et al. 2016). Dau (2013) reported direction changes, increased travel time, and increased travel distance in WAH caribou that encountered the DMTS road during fall migration, though similar deflections and delays are reported along rivers and other natural linear features. The locations where GPS-collared WAH caribou crossed the action alternatives have been mapped since 2009. The number of collared caribou that crossed the action alternatives ranged from 12 to 20 percent (Joly 2019). However, many caribou crossed the same alternative multiple times in a single season. Results of the analysis are described separately for each action alternative below.

Although delays and deflections of individuals may occur, and changes to localized movement patterns may result, the migratory patterns of the WAH as a whole would likely remain intact. Although caribou generally do not use specific migratory or seasonal movement paths every year, in most years, the majority of WAH caribou migrate west of the proposed action alternatives (Dau 2015). Impacts to winter movements of WAH caribou would be localized and limited as movement rates are lowest during mid to late winter (Joly 2011). The majority of WAH caribou winter on and near the Seward Peninsula, southwest of the action alternatives (Volume 4, Map 3-22). However, it appears that winter abundance is shifting towards the Brooks Range and other areas north of the project area (Parrett 2019). The potential impacts on WAH caribou are described separately for each action alternative below. The potential impacts on RMH caribou are described under Alternative C, below, and potential impacts on HHH caribou are discussed under Alternatives A and B, below.

As described in Appendix N, Section 3.3.4 (Mammals), potential mitigation includes several measures intended to reduce disturbance to caribou and facilitate movement across the road. These measures will be similar to those currently used on the DMTS road. Although these measures should be effective in reducing some of the behavioral disturbance and displacement impacts described above, available literature from the DMTS road (Wilson et al. 2016) suggests that the measures are not be entirely effective and behavioral disturbance, as well as displacement, should be anticipated.

Injury and mortality of caribou may occur as a result of the road and airstrips. Although preventive measures would be taken to reduce collisions (Section 2.4.3, Features Common to All Alternatives), caribou may be struck by aircraft and trucks and other vehicles. The potential for vehicle collisions would be greatest during operation, particularly during Phase 3 when traffic volumes and travel speeds are the highest. Caribou may be attracted to the road as a movement corridor, to escape insect harassment, or during spring when the roadsides are the first to green up (Murphy and Lawhead 2000). The potential for collisions is highest in areas with limited sight lines. Collisions on the DMTS road are rare: 11 caribou fatalities were reported between January 2004 and November 2017 (Teck 2018). Caribou density along the DMTS is likely much higher than within the project area, except possibly the westernmost 40 to 50 miles of each action alternative. However, the DMTS road is located in open tundra; higher collision rates could be expected in forested or mountainous sections of the action alternatives, such as within the Ray Mountains or foothills of the Brooks Range, where sight lines are reduced.

Changes in hunter use may occur as a result of the road. While not allowed, trespass use of the road by sport or subsistence hunters, should it occur, could increase harvest close to the road. Alternatively, harvest may be reduced near the road because legal sport hunters may avoid the road to have a more natural experience or sport and subsistence hunters may avoid the road so as not to trespass while pursuing game (see Section 3.4.7, Subsistence Uses and Resources). Predators may use the road corridor to more efficiently gain access to caribou, which could increase predation. Although unlikely, the road may prevent caribou from escaping wildland fires, resulting in fatalities. Roadside forage or waterbodies may become contaminated from chemicals associated with road construction and maintenance or deposition of mining byproducts released from trucks hauling ore (Neitlich et al. 2017; Hasselbach et al. 2005).

Other Large Herbivore Impacts

Construction of the action alternatives would result in the loss, alteration, and fragmentation of moose habitat. Habitat disturbance can be beneficial to moose as it increases early successional browse availability. Moose abundance and density in the project area are low, particularly in the western half of the project area. Population estimates do not appear to be meeting management objectives, natural mortality is high, and harvest is currently restricted (Joly et al. 2017; Stout 2018). The locations of important calving and overwintering areas are not well known at this time. For these reasons, impacts to important habitat areas are possible, may reduce productivity, and may result in localized population declines. Changes in population or demography would likely require changes in management strategies that may reduce harvest quotas or lead to implementation of predator control measures. Potential mitigation measures include a Fish and Wildlife protection plan and several measures to minimize habitat fragmentation for mammals (Appendix N, Section 3.3.4, Mammals).

Loss or alteration of muskox and Dall sheep habitat would not occur because both species rarely occur in the portions of the project area proposed for road development.

Disturbance and displacement of moose would likely occur, but the displacement distance and duration would be small. Although moose tend to avoid roads, landscape features and browse availability are greater determinants of moose distribution in forested terrain (Bartzke et al. 2015). Moose also tend to habituate relatively quickly to anthropogenic disturbances (Harris et al. 2014). Increased traffic volumes on the DENA road during the late 1990s did not appear to change abundance, distribution, or behavior of moose in the road corridor (Burson et al. 2000). In Norway, habitat alteration caused only minor changes in moose behavior but did result in greater separation of seasonal ranges (Andersen 1991). Steep road embankments may prevent moose from crossing the road. BLM restrictions on activity during moose calving (Appendix N, Section 3.3.4, Mammals) would be ineffective at reducing potential disturbance to moose during this sensitive period because the amount of BLM-managed land intersecting each alternative is small and the locations where moose calving occurs is unknown or difficult to predict.

Although human activity may be noticeable to Dall sheep or muskox that are relatively close to the road, it is unlikely they would elicit behavioral reactions.

Injury and mortality of moose may occur as a result of the road, primarily due to trucks striking moose. As discussed for caribou, above, the potential for vehicle collisions would be greatest during Phase 3 of operation when traffic volumes and travel speeds are the highest. Snowpack depth and proximity to winter range are positively correlated with collisions along railroads (the greater the snow depth, the higher the potential for collisions; Modafferi 1991). Moose may be attracted to the road as a movement corridor or during spring when the roadsides are the first to green up. Mowing and trimming of vegetation adjacent to the roads may increase new green browse for moose and attract them to the roadside. Moose often travel along riparian corridors and may cross the road close to or on bridges where it is not possible for trucks to avoid collisions. Due to the low density of moose in the project area, collisions would likely be rare, but given the small population, even the loss of a few individuals could be detrimental.

Moose hunters often float rivers such as the Koyukuk, John, or the Malamute Fork Alatna. The presence of an industrial access-only road may deter recreational use and lower moose harvest rates in these areas. In addition, changes in the abundance or distribution of large carnivores may change moose predation rates. Predation, particularly high levels of calf predation, appears to be the limiting factor for this moose population (Joly et al. 2017, Longson 2018); therefore, a reduction in predators could increase the moose population. However, hypothetical changes in distribution may also increase predation in or near the project area.

Muskox and Dall sheep are unlikely to occur on or near the road, and therefore are unlikely to suffer injury or mortality as a result of the action alternatives.

Large Carnivore Impacts

Construction of the action alternatives would result in the loss, alteration, and fragmentation of habitat for large carnivores. Wolves, grizzly bears, black bears, and foxes are opportunistic predators with large ranges. For this reason, they are generally resilient to habitat loss unless it affects their prey. Changes to caribou or moose distribution and abundance could have cascading effects on bears and wolves. Wolf prey density in the project area is considered low (Johnson et al. 2017) and the availability of food resources for bears is limited (Hilderbrand et al. 2019); therefore changes in abundance may reduce fitness and productivity. Fragmentation of large ranges may alter distribution and predation patterns. Among potential mitigation measures is a Fish and Wildlife protection plan and several measures to minimize habitat fragmentation for mammals (Appendix N, Section 3.3.4, Mammals) would help to minimize impacts.

Large carnivores may increase movement rates and movement duration due to road disturbance. Gardner et al. (2014) found that female bears with cubs that regularly moved between habitat patches early in the spring and those that were active during early morning, incurred higher cub mortality. Denning bears may be disturbed by nearby road construction, which may in extreme cases cause den abandonment, but would most likely only result in temporary spikes in heart rate and respiratory rate (Reynolds et al. 1983). The likelihood of disturbance to denning bears would be slightly reduced because AIDEA would be expected to obtain locations of known bear dens and plans to avoid known bear dens, on BLM-managed lands (see Appendix N, Section 3.3.4, Mammals). Wolverine distribution could be affected by roads (May et al. 2006), and they are less common near human infrastructure (Gardner et al. 2010), however, wolverines also tend to avoid human activity by selecting for high elevation habitat.

Injuries or fatalities of large carnivores due to vehicle collisions are possible, but would be rare. Bears and foxes may be attracted to human activity areas by real or perceived availability of food sources, such as trash. Use of disturbed areas by bears increases mortality rates (Berland et al. 2008). Bears and foxes may be killed in defense of life and property if they threaten people or become a nuisance. Measures to ensure properly secure wildlife attractants and to discourage feeding of wildlife by AIDEA employees (Appendix N, Section 3.3.4, Mammals) would be effective in reducing human-wildlife conflict. Changes in distribution of hunting and trapping, or interference with long-established traplines, due to the road may increase or decrease harvest levels for some large carnivores.

Small Mammal Impacts

Construction of the action alternatives would result in loss, alteration, and fragmentation of habitat for small mammals. At the individual level, habitat loss and alteration may cause abandonment of habitat. Small mammals often occupy relatively small or restricted home ranges. Loss or fragmentation of this habitat could have severe consequences at the individual level. Some small mammals may be unable to disperse to available adjacent habitats. Changes in distribution may cause increased competition for resources or increased risk of predation. Although it is unlikely these impacts would accumulate to cause changes at the population level, currently available information on habitat value for most small mammal species is unavailable. Therefore, potential impacts cannot be quantified.

Small mammals may be locally displaced from suitable habitat. They may move in to lower quality habitat where competition for resources or risk of predation increases. In general, it is assumed that small mammal habitat is abundant and widespread across the project area, and alternate habitats are available for most small mammals. However, due to a lack of habitat association and fine-scale habitat mapping, impacts to small mammals from disturbance and displacement is difficult to predict.

Construction and use of the road would result in mortality of small mammals. Removal and compaction of top soils would crush burrowing mammals. Contamination of soils or waterbodies, even in small amounts, may cause injury of small mammals. Changes in the distribution of trapping due to the road may increase or decrease predation of some small mammals in the project area. Use of the road would result in mortality of small mammals when they attempt to cross the road. The presence of linear infrastructure may attract foxes, ravens, or birds of prey, which would increase predation rates on small mammals. While the construction and operation of the road would consistently remove individuals from the population, the road would not affect small mammals at the species population scale. However, increased carrion would attract predators and result in mortality of these species while they scavenge on the road.

Alternative A Impacts

Caribou Impacts

Alternative A would result in the smallest gravel footprint and least amount of caribou habitat loss and alteration of the action alternatives. Impacts to WAH caribou range would be similar to Alternative B, but Alternative A would affect more winter range used by collared caribou (Joly 2019; Appendix E, Table 20).

Between 2009 and 2019, there were 168 crossings of the proposed Alternative A by 28 collared WAH caribou. This includes 62 crossings by 19 caribou during fall migration (September 1 to November 30) and 97 crossings by 13 caribou during winter (December 1 to March 31). During the 10-year study, approximately 14 percent of collared caribou crossed Alternative A. All crossings occurred west of MP 33 with a high density of crossing locations located near MPs 103 to 110 (Alatna Portage area) and 190 (Ambler Lowlands; Joly 2019; Joly and Cameron 2018b).

Increased traffic on the Dalton Highway could disturb or displace HHH caribou under Alternative A. Average daily traffic levels between the Yukon River and Gobblers Knob ranged from 180 to 250 vehicles between 2012 and 2017, with an average of 217 daily vehicles (DOT&PF 2017). Approximately two-thirds of these are commercial trucks as opposed to private vehicles (HDR 2018). Although few HHH caribou occur near the Dalton Highway, increases in traffic volume of 160 to 238 trucks during Phase 3 operation (Appendix H) or an increase of 74 to 110 percent over current levels, may adversely affect this herd. HHH Caribou may avoid using habitat west of the Dalton Highway, which could lead to avoidance of high-quality habitat and increased competition for resources in a restricted, lower-quality range. The potential for vehicle collisions with caribou would increase proportionally to traffic volume. Travel speeds would likely be higher than those on the Ambler Road, which would also increase the risk of collisions. The effects of increased traffic on the Dalton Highway may be amplified due to the relatively small population size and small range of the HHH.

Other Large Herbivore Impacts

Alternative A would result in the least amount of habitat lost or altered out of the action alternatives. In a study of 37 collared moose in and near the project area conducted between 2008 and 2013, 6 moose (16 percent of those collared) crossed the proposed Alternative A route a total of 156 times (Joly et al. 2016) Moose density is very low along the western half of Alternative A, including where Alternatives A and B diverge. Therefore, there is little to no difference in potential effects on moose between Alternatives A and B.

Large Carnivore Impacts

Alternative A would result in the smallest area of habitat loss and alteration of the 3 alternatives. In a study of 41 collared grizzly bears between 2014 and 2015, 17 bears crossed Alternative A a total of 209 times. Crossing rates were similar between Alternatives A and B, and most crossings were close to salmon streams. Grizzly bear dens have been identified in the southern Brooks Range above Alternatives A and B (Joly et al. 2016). Both Alternatives A and B avoid alpine habitat and therefore would not directly affect grizzly bear dens, but disturbance from road construction and use may affect denning bears in this area.

Small Mammal Impacts

Impacts on small mammals would be similar between Alternatives A and B, except that under Alternative A, slightly less habitat loss and alteration would occur than under Alternative B.

Alternative B Impacts

Caribou Impacts

Alternative B would result in 15 percent more habitat loss and alteration than Alternative A, but much less than Alternative C. Alternative B would affect slightly more ADF&G-mapped migratory and peripheral range than Alternative A, and less than half as much habitat used by collared caribou in the winter (Appendix E, Table 20). Despite these differences, the functional effect of Alternatives A and B on caribou would likely be the same.

Alternative B follows the same alignment as Alternative A for 73 percent of its route, and therefore would have similar impacts on caribou. Between 2009 and 2019, there were 127 crossings of proposed Alternative B by 27 collared WAH caribou. This includes 65 crossings by 21 caribou during fall migration (September 1 to November 30) and 54 crossings by 10 caribou during winter (December 1 to March 31). During the 10-year study, approximately 12 percent of collared caribou crossed Alternative B. All crossings occurred west of MP 33 with the highest density of crossings near milepost 208 (Ambler Lowlands). Where Alternatives A and B diverge, near GAAR, Alternative A was crossed a total of 64 times by 10 caribou, as compared to 24 crossings by 8 caribou across Alternative B (Joly 2019; Joly and Cameron 2018b).

Potential impacts to the HHH due to increased traffic volumes on the Dalton Highway may occur, and would be identical to those described above for Alternative A.

Other Large Herbivore Impacts

Moose densities are low across the project area. Therefore, potential impacts to moose from Alternative B would be similar to Alternative A, except slightly more habitat loss would occur under Alternative B.

Large Carnivore Impacts

In a study of 41 collared grizzly bears between 2014 and 2015, 16 bears crossed Alternative B a total of 192 times. Impacts to other large carnivores would be similar between Alternatives A and B, except slightly more habitat loss would occur under Alternative B.

Small Mammal Impacts

Impacts to small mammals would be similar between Alternatives A and B, except that under Alternative B, slightly more habitat loss and alteration would occur than under Alternative A.

Alternative C Impacts

Caribou Impacts

Of the action alternatives, Alternative C would result in the largest gravel footprint and most caribou habitat loss and alteration. While Alternative C would affect the least amount of WAH caribou range, it is the only action alternative that would affect RMH caribou range (Appendix E, Table 20).

Collared WAH caribou crossed Alternative C more often than Alternatives A and B. Between 2009 and 2019, there were 168 crossings of Alternative C by 41 collared WAH caribou. This includes 70 crossings by 32 caribou during fall migration (September 1 to November 30) and 43 crossings by 12 caribou during winter (December 1 to March 31). During the 10-year study, approximately 20 percent of collared caribou crossed Alternative C. All crossings occurred west of MP 167 and the highest density of crossings was between MPs 300 and 307, just south of the Kobuk River (Joly 2019).

Unlike Alternatives A and B, Alternative C would intersect the range of the RMH and result in the loss of known summer and year-round range (Appendix E, Table 20). The RMH is a small, non-migratory herd that occupies a relatively small and isolated range centered on the Ray Mountains. Little is confidently known regarding the seasonal distribution, migratory routes, diet, or other important life history and habitat use of this herd. Impacts from habitat loss and alteration, disturbance and displacement, and injury and mortality as described above could be more pronounced and of higher consequence to this herd than the WAH. Furthermore, the RMH population growth is limited by predation (Pamperin 2015). Impacts from Alternative C that affect the population could be detrimental to the long-term viability of the herd.

Habitat loss would affect about 0.08 percent of the approximately 2.5-million-acre RMH range, including 0.23 percent of available summer range (Appendix E, Table 20). There currently is no noteworthy anthropogenic disturbance located in the range of the RMH. Fragmentation of an already restricted range could constrict movement, increase crowding, and increase competition for limited forage (Vors et al. 2007).

Alternative C follows the upper Tozitna River drainage, which could be important winter, calving, or summer habitat, as caribou were found there in each of those seasons during monitoring in the late 1980s and early 1990s (Hollis 2007; Pamperin 2015). Jandt (1998) identified the south slopes of the upper Tozitna River drainage as a core calving area. Alternative C would remove approximately 984 acres of alpine habitat in the Ray Mountains (Appendix E, Table 12), which Jandt (1998) found to be heavily used during summer. Although this herd is non-migratory, they do undertake relatively short movements based on seasonal forage availability. Alternative C may impede access to important habitats. Implementation of seasonal restrictions on construction activities, specifically during calving (Appendix N, Section 3.3.4, Mammals), would be important to reduce impacts to RMH caribou.

Other Large Herbivore Impacts

Alternative C would result in more habitat loss and alteration than the other action alternatives. Alternative C would cross more streams and would parallel rivers for large portions of the route. Moose densities are moderate to high in this region, and moose may be locally abundant (BLM 2016a). Therefore, impacts to moose may be greater than for Alternatives A and B. However, the extent of the impacts and relative magnitude cannot be predicted because little is currently known about moose distribution, abundance, or habitat use near Alternative C.

Large Carnivore Impacts

Alternative C would result in more loss and alteration of habitat for large carnivores than the other action alternatives. Grizzly bear denning sites have been observed in the mountains surrounding the upper Tozitna River drainage (Jandt 1998). The Ray Mountains represent a somewhat isolated patch of medium quality grizzly bear denning habitat in Interior Alaska (Eagan 1995 as cited in BLM 2016a). Loss and alteration of habitat as well as disturbance from Alternative C could reduce or redistribute denning in this area. Construction and use of a road through alpine habitat may affect wolverines more under Alternative C than the other action alternatives.

Small Mammal Impacts

Alternative C would result in the largest amount of habitat loss and alteration of the action alternatives. Therefore, impacts to small mammals would be similar in nature to those described above, but would be greater than the other action alternatives.

Mining, Access, and other Indirect and Cumulative Impacts

The indirect and cumulative impacts from development of mines within the District and secondary access roads, and other development or activities elsewhere in the WAH range would be additive to the impacts to caribou described above and synergistic with the action alternatives. Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (Appendix H, Table 2-11) and exponentially increase fragmentation of migratory and winter range. Similar impacts on caribou as described above could occur from additional roads. However, the resulting road networks could increase the magnitude of impacts on caribou, and mining activities could result in a greater intensity of disturbance and displacement. These activities would occur in addition to habitat loss and human activities in WAH summer range or elsewhere on their migratory range. Finally, climate change, would act synergistically along with other cumulative actions, and may increase wildfires, alter predator-prey dynamics, change browse availability and distribution, or increase the prevalence of extreme winter weather events (Hinzman et al. 2005).

Besides the pervasive effects of climate change, project impacts to RMH caribou would only be affected under Alternative C. Four clusters of State mining claims are noted in the Ray Mountains (see Volume 4, Map 3-25). Under Alternative C, the development of these mining claims would be more likely to occur because of easier access. Development of mines in the Ray Mountains would result in indirect and cumulative impacts on RMH caribou. Due to the small population and restricted range of the RMH, development on this scale could affect the long-term viability of the herd.

Reasonably foreseeable actions not associated with AIDEA's proposal would affect caribou and caribou habitat. The impacts of climate change on caribou, described above, would occur equally under the action alternatives and No Action Alternative.

The indirect and cumulative impacts from development of the District and secondary access roads, and other development or activities to other large herbivores throughout the analysis area would be additive to and synergistic with the action alternatives (Appendix H). Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (Appendix H, Table 2-11) and exponentially increase fragmentation of ungulate habitat. Similar impacts on moose as described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on moose, and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on Dall sheep alpine habitat and approach the periphery of muskox range. Climate change would act synergistically with other cumulative actions and may increase wildfires, change browse availability and distribution, or increase the prevalence of harsh winter weather events (Hinzman et al. 2005). Climate change would be additive to the development of mines by reducing suitable habitat for Dall sheep. Reintroduction of Dall sheep to the Ray Mountains has been discussed (BLM 2016a). Alternative C would directly impact Dall sheep if they were present, or the presence of a road and its impacts on sheep may preclude reintroduction.

The indirect and cumulative impacts from development of the District and secondary access roads, and other development or activities to large carnivores throughout the analysis area would add to those from the action alternatives (Appendix H). Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (Appendix H, Table 2-11) and exponentially increase fragmentation of carnivore habitat. Similar impacts on large carnivores as described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on carnivores and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on wolverine alpine habitat and potential grizzly bear denning habitat. Climate change would act synergistically with other cumulative actions and may increase wildfires, change prey abundance and distribution, or increase the prevalence of harsh winter weather events (Hinzman et al. 2005).

The indirect and cumulative impacts from development of the District and secondary access roads, and other development or activities to small mammals throughout the analysis area would add to those from the action alternatives (Appendix H). Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (Appendix H, Table 2-11) and exponentially increase fragmentation of small mammal habitat. Impacts on small mammals similar to those described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on small mammals and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on the alpine habitat of arctic ground squirrel, hoary marmot, and pika, which would be additive with climate change and impacts to alpine habitat under Alternative C. Climate change would act synergistically with other cumulative actions and may increase wildfires, change predator abundance and distribution, or increase the prevalence of harsh winter weather events (Hinzman et al. 2005).

3.4. Social Systems

3.4.1 Land Ownership, Use, Management, and Special Designations

Affected Environment

Land Ownership, Use, and Management

The study area consists of federal, state, Native, and other private lands. Volume 4, Map 3-24 shows land ownership and Appendix A, Figures 3-3, 3-4, and 3-5, show land use and management boundaries in the study area. The following provides context:

- Alternative A crosses state-owned/managed lands (59 percent); federal lands under jurisdiction of the BLM (12 percent) and NPS (12 percent); lands owned by 2 Alaska Native corporations (15 percent); and “other” (2 percent), which includes rivers/water and local government lands;
- Alternative B crosses state-owned/managed lands (64 percent); federal lands under jurisdiction of the BLM (11 percent) and NPS (8 percent); lands owned by 2 Alaska Native corporations (13 percent); and “other” (4 percent), which includes rivers/water and local government; and
- Alternative C crosses state-owned/managed lands (2 percent); federal lands under jurisdiction of the BLM (82 percent); lands owned by 2 Alaska Native Corporations (15 percent); and “other” (1 percent), which includes river/water and private lands.

The *Ambler Mining District Access Environmental Overview Memorandum* (DOWL 2011b) generally describes the affected environment for land ownership, use, and management. Since its inclusion in the *Overview Memorandum*; however, the ADNR has updated the *Northwest Area Plan for State Lands* (ADNR 2008), which covers a portion of the study area. This section summarizes the land ownership, use, and management of the study area, including any updates since the *Overview Memorandum* (DOWL 2011b).

Federal Lands. Land ownership in the study area is mostly federal, under the jurisdiction of the BLM, NPS, or USFWS depending on the land designation[45]. These agencies manage some federal land in the study area as either National Park and Preserve or Wildlife Refuge. Congress provided for road access across the Kobuk Unit of GAAR in the Alaska National Interest Lands Conservation Act (ANILCA) Section 201(4)(b). See explanation in Section 1.2.2, Project Development Background and History. The BLM has resource management plans (RMPs) that provide a framework for management of lands under their jurisdiction (incorporated as follows by reference). The Kobuk-Seward Peninsula Resource Management Plan, Draft EIS (BLM 2006), applies to the western portion of the study area (see Appendix A, Figure 3-3). This plan presents the goals and objectives, land use allocations, and management actions covering public lands in the Kobuk-Seward Peninsula Planning Area. The *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) covers most of the study area, and the *Utility Corridor Resource Management Plan/Environmental Impact Statement Record of Decision* (BLM 1991a) covers the TAPS corridor at the eastern edge of the study area (see Appendix A, Figure 3-3). The Central Yukon and Utility Corridor RMP boundaries include 24 remote villages, 15 of which have tribal entities, and 3 Alaska Native Claims Settlement Act (ANCSA) Regional Corporation boundaries (Doyon Limited, Arctic Slope Regional Corporation, Inc., and NANA, Inc.). The BLM currently is developing an RMP that encompasses the Central Yukon and Utility Corridor RMP boundaries

[45] The State of Alaska has filed selection applications for federal lands in the project area. The results of whether and when the selection and transfer will be approved are not known at this time.

When the BLM conveys land to a Native corporation under ANCSA, it may reserve rights known as 17(b) easements to the United States (BLM 2016b). The BLM established most 17(b) easements to provide for access to public lands and major waterways. There are multiple 17(b) easements within 5 miles of a proposed project alternative (see Volume 4, Map 3-27 and Appendix F, Table 2).

State Lands. The state manages most of its lands for multiple uses. Area land use plans govern management of state lands (incorporated as follows by reference). These plans provide management intent, land-use designations, and management guidelines that apply to state lands in the planning area. The *Northwest Area Plan* (ADNR 2008) covers the western portion of the study area (see Appendix A, Figure 3-4). In general, the plan indicates the state should keep its land in this area in public ownership and opens the area to mineral entry and development, and mineral, coal, or oil and gas leasing; however, land uses need to be consistent with the specific management intent of each unit (see ADNR 2008 for details). The *Yukon Tanana Area Plan* (ADNR 2014) covers the eastern portion of the study area, which is in the plan's Lower Tanana region (see Appendix A, Figure 3-4). In general, "the overall management intent for this region is to dispose of some land for agricultural and settlement, retain land with forestry values and (it is recommended) incorporate some of these into the Tanana Valley State Forest, and retain state land associated with mineral, habitat, and public recreation and to manage state land consistent with these values" (ADNR 2014:3-20).

Native Lands. The study area includes lands owned by NANA Regional Corporation, Inc. and Doyon Limited, regional corporations established under ANCSA. Within each of the regions are village corporations that own the surface estate around their respective villages. In general, the regional and village corporations provide social and economic opportunities to their shareholders. Another land ownership consideration is lands granted under the Native Allotment Act of 1906, providing for the grant of up to 160 acres to individual Alaska Natives. The Secretary of the Interior grants Native allotments, typically as restricted-title properties.

Other Lands. The western portion of the study area is located within the Northwest Arctic Borough (NAB; see Appendix A, Figure 3-5), a first class borough under AS 29. The NAB provides planning, platting, and land use regulations for borough areas (including within cities). Most of the study area is outside an organized borough[46]. There are several second-class cities and unincorporated communities within 50 miles of the proposed project alignments (see Appendix F, Table 1).

Subsurface Rights/Mining Claims. Under Alaska law, surface and subsurface property ownership are separate rights. The State of Alaska typically owns the subsurface rights to state- and privately owned property (excluding Native owned), while the BLM manages the subsurface rights on federal public lands. There are many mining claims in the project area, primarily clustered in the District (see Volume 4, Map 3-25). Mining claims grant the claimholder exclusive rights to locatable minerals, but not sand and gravel resources, in their claim area. Mining claims do not allow the claimholder to restrict access to public lands. Mineral rights often take priority over other rights, except on those areas considered "withdrawn" from mineral entry such as national parks, national monuments, and Wild and Scenic Rivers. Regional and village corporations own surface estate lands, but ANCSA conveyed subsurface rights to regional corporations.

Revised Statute 2477. Section 8 of the Mining Law of 1866 addresses Revised Statute 2477 (RS2477), which grants a public ROW across unreserved federal land for transportation purposes. To qualify as a RS2477 route, it must have been constructed or used when the land was unreserved federal land. The

[46] Note: there has been reported interest by some communities in the project area to form a new borough or be annexed by an existing borough. A formal request for a new borough or annexation has not been filed with the State's Local Boundary Commission as of June 18, 2019.

State of Alaska has identified more than 600 possible RS2477 routes, including several in the study area (see Volume 4, Maps 3-25 and 3-27); see also Section 3.4.8, Cultural Resources). ADNR records indicate there are several trails that are qualify as RS2477 ROW with 5 miles of the proposed project alignments (see Appendix F, Table 3).

Special Land Management Designations including Parks, Refuges, Protected Areas, Wilderness, and Wild and Scenic Rivers

Volume 4, Map 3-26, shows the special designation lands described below.

Wilderness and Wilderness Study Area. Congress designated GAAR, except the National Preserve portion, as Wilderness. Congress also designated the northern portion of the Selawik NWR as Wilderness, which abuts Wilderness in the southern portion of Kobuk Valley National Park, located approximately 8 miles west of Ambler. The BLM assessed its lands in much of the project area and determined most have "wilderness characteristics." However, the BLM does not manage these lands for these characteristics, so this analysis does not consider them further. See Section 3.4.3, Recreation and Tourism, regarding wilderness recreation experiences. No designated Wilderness Study Areas occur in the project area.

Areas of Critical Environmental Concern and Research Natural Areas. Through the existing RMP process, the BLM designated 11 ACECs and Research Natural Areas (RNAs) in the project area, as listed in Appendix F, Table 4, and shown on Volume 4, Map 3-26 (see *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* [BLM 1986] and *Utility Corridor Resource Management Plan/Environmental Impact Statement Record of Decision* [BLM 1991a]). As currently defined, ACECs (43 CFR 1610.7-2) protect areas where there is a historic, cultural, or scenic value; fish or wildlife resource; or another natural system or where there is a natural hazard present that has substantial significance and value or cause for concern and requires special management (BLM 2015). In BLM's existing project-area plans, the BLM considers RNAs together with ACECs. RNAs (43 CFR 8223) provide management and protection of lands with natural characteristics (e.g., plants, animals, geology, soil, water) that are unusual or of scientific or other special interest. The federal government intends RNAs to be used for research and education.

Special Recreation Management Areas. The Dalton Highway "inner corridor" from the Yukon River to areas north of the Brooks Range is a Special Recreation Management Area (SRMA) governed by a recreation plan (BLM 1991b). See also Section 3.4.3, Recreation and Tourism.

National Park System Units. GAAR occurs across the northern part of the project area and includes designated Wilderness. Kobuk Valley National Park is at the western edge of the project area and includes designated Wilderness; however, this analysis does not address it further because of lack of anticipated effects from the proposed project.

National Wildlife Refuge System Units. The Kanuti, Koyukuk, and Selawik NWRs occur in the project vicinity. This analysis does not describe these NWRs further because of lack of anticipated effects from the proposed project. The Selawik National Wild River, located within Selawik NWR, is an exception and is addressed in the next paragraph.

Wild and Scenic Rivers. Congress has designated those portions of the Alatna (main stem), Kobuk, John, Tinyaguk, and North Fork Koyukuk rivers that are within GAAR as parts of the National Wild and Scenic River System (WSR). These designated WSRs are located in the project area, and Alternatives A and B would cross the Kobuk WSR. See also Section 3.4.3, Recreation and Tourism, which addresses river users who continue on these rivers beyond the WSR designations. The Selawik National Wild River is part of Selawik NWR, located on the western side of the project area. The headwaters, including lakes that provide for fly-in access, are closest to the proposed alternatives. The Selawik National Wild River is 1 of 2 spawning areas for sheefish in northwest Alaska. Low divides connect the upper river to the Koyukuk watershed, and humans have used them for hundreds of years as a transportation route (USFWS n.d.). Hot springs occur in this area. Residents of nearby communities typically access them by snowmobile and have bath houses/cabins there.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any impacts to land use, management, or ownership, including special designation lands. Small-scale mining and exploration activities would likely to continue.

Impacts Common to All Action Alternatives

All action alternatives would cross land of multiple owners. The BLM has authority only over BLM-managed lands. Management relative to the proposed road, including permit stipulations and mitigation measures required to minimize environmental impacts, would be the responsibility of each landowning entity.

While the location and quantity of the impacts would vary under each action alternative, the type of impact would be similar, except with respect to GAAR and the Kobuk WSR, which Alternative C would not affect. No change in the broad pattern of underlying land ownership is anticipated as a result of the project because the ROW is proposed to be an easement. Appendix F, Table 5, shows the amount of land by owner that would be within the project ROW[47]. Alternative C affects more acres of land then the other action alternatives, especially BLM-managed land. The project would convert land within the ROW from its existing use (e.g., largely undisturbed, natural habitat, low-intensity recreation, subsistence) to a transportation use during Phase 1. The land generally would be unavailable for other uses, including public access, except at designated crossings, during the project's lifespan. After reclamation, land use would be largely restored to its current use.

The proposed action is generally consistent with the state and federal management plans for the area (see Alternative A and B discussion below). All action alternatives would require a Title 9 permit from the NAB. The permit may require stipulations to address potential land use conflicts.

The road would not have public access, which would limit the potential for future development along the road. The road may make it easier to transport construction material; AIDEA indicated in its application that "some commercial uses may be allowed under a permit process" (DOWL 2016a; refer to Appendix H, Section 2.2.2 (Commercial Access Scenario), for details about commercial access). Communities may find it feasible to build new community facilities, housing, or other infrastructure, expanding the community's footprint and changing land use locally.

Appendix F, Table 4, identifies the special designation lands and amount of land each alternative would affect. Roads and traffic generally are not desirable in special designation areas. They are not normally allowed in designated Wilderness and may be subject to extra stipulations in other areas. All alternatives would leave the Dalton Highway within the SRMA, although at different locations.

[47] Note: the ROW is generally 250 feet wide, centered on the road centerline, except where the toe-of-slope is outside that limit. In those locations, the ROW boundary was considered for this analysis to be 10-feet beyond the toe-of-slope limit to provide space for construction and maintenance access.

Potential mitigation measures include a requirement that AIDEA prepare a Public Access Plan addressing the transportation facilities that need to cross the ROW, such as RS2477 trails (see Appendix N).

Alternatives A and B Impacts

Alternatives A and B cross GAAR, through the Kobuk Unit of the National Preserve. Typically, a road through these lands likely would not be considered a compatible land use, but Congress provided for a road to the District across the National Preserve in ANILCA 201(4)(b) (see also Section 1.2.2, Project Development Background and History, of this EIS). These alternatives cross BLM-managed lands for 21 miles at and west of the Dalton Highway. Otherwise, these alternatives cross considerably more state land than Alternative C (Appendix F, Table 5). Alternatives A and B are more likely to impact Bettles and Evansville than Alternative C. The Alternative B alignment would impact slightly more land than Alternative A. Alternative A would cross GAAR and the Kobuk WSR near the designated Wilderness boundary, lands managed for wilderness values, high scenic values, and backcountry recreation. Alternative B would cross the same lands at least 7 miles south of the Wilderness boundary. The shared alignment would cross the SRMA near Dalton Highway MP 161 and just south of Chapman Lake, which is listed in BLM public materials as a recreation site for wildlife viewing. See also Section 3.4.3, Recreation and Tourism.

Alternative C Impacts

Alternative C crosses considerably more BLM-managed land than Alternative A and B and would not cross NPS-managed lands, including the Kobuk WSR. Alternative C would be more likely to impact Hughes than Alternatives A and B. The Alternative C alignment would cross the Tozitna River and Indian River existing ACECs (see Appendix F, Table 4). Placing a road across these existing ACECs, established to protect fish spawning and rearing habitat, increases the level of concern regarding impacts to water flows, quantity, and siltation. However, nothing in the *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) or ACEC plans prohibits road construction. BLM's habitat plan for the Indian River ACEC (Kretsinger and Will 1995) provides management guidelines. The Tozitna River ACEC plan (Knapman 1989) does not provide formal management guidelines. See also Section 3.3.2, Fish and Amphibians.

Mining, Access, and other Indirect and Cumulative Impacts

Any of the action alternatives, combined with the mining projects and other developments, would indirectly and cumulatively impact land use and, in some cases, land ownership. The large patterns of land ownership would remain unchanged. General land use intent expressed in area management plans would be satisfied, but the conversion to industrial uses of the road corridor and District would alter existing land uses in the process. The possible development of parallel transportation routes for users that do not have access to the proposed road is generally inconsistent with the management plans. While the alternatives would use differing proportions of land from different owners and different special designation areas, there is no major distinction among the action alternatives regarding overall land ownership or land use, beyond those differences discussed above as direct impacts.

The affected special designation lands would differ, and Alternatives A and B would cross GAAR and Kobuk WSR lands—managed for wilderness values, high scenic values, and backcountry recreation—while Alternative C would not. The Alternative C alignment would cross or is located relatively close to several existing ACECs and RNAs, as shown on Volume 4, Map 3-26. The Spooky Valley RNA and Hogatza River ACEC have greater likelihood of indirect effects than others, because these are areas that have mining claims that would be relatively easy to extend a road into if Alternative C were in place. RNAs are withdrawn from all forms of appropriation and would need to be modified to allow any other entity the land rights necessary to build a road.

3.4.2 Transportation and Access

Affected Environment

The study area for direct effects is limited to where proposed routes cross the existing transportation facilities; however, indirect effects may extend beyond the vicinity of a project alternative because community residents may travel long distances for subsistence purposes (see Appendix L regarding where residents travel for subsistence purposes). The study area for indirect effects extends from the District to its connection to a Southcentral Alaska port (anticipated to be the Port of Alaska) to account for material hauling effects. Volume 4, Map 3-27, shows existing transportation facilities near the project alternatives. Volume 4, Map 3-28, shows the regional transportation system that could be affected. Appendix F, Table 7, summarizes community-based transportation facilities.

Study area communities have limited road networks. Local roads are unpaved, with the longest road segments typically being those that access airports and landfills. Most residents do not use standard vehicles for local transportation needs. Instead, they depend on snowmobiles and other OHVs, together with boats for river travel. As a result of the limited roads, air travel is a primary mode of transportation between communities in the study area. Most communities have DOT&PF-owned airports with scheduled air service, which varies in frequency. In addition, the study area has several backcountry landing strips, which travelers use on an as-needed basis. These landing strips mostly support recreation, hunting, and mining activity.

Inter-community roads in the region are limited. The Dalton Highway is the eastern boundary of the project area and connects Alaska's North Slope to Fairbanks. It is a low-volume public highway with gravel and paved portions. AADT ranges from 300 to 400 vehicles per day, depending on the segment. For the Dalton Highway over 4 years (2013 to 2016), DOT&PF recorded 24 crashes (average 6 per year), 2 of them fatal crashes, and 6 of them serious-injury crashes (DOT&PF 2019). Several communities have year-round or seasonal access to the Dalton Highway, which connects to the Elliott Highway and the state road system. Tanana Road/Tofty Road connects Tanana, Manley Hot Springs, and Minto to the Dalton Highway. For 1 or 2 months per year, a winter road connects Bettles and Evansville to the Dalton Highway, which connects to Fairbanks. However, winter road construction depends on specific conditions, such as sufficiently cold temperatures, adequate snow cover, thick river ice, and low wind (Spindler 2016). Residents also use winter only inter-community trails such as the Shungnak-Kobuk trail, which NAB maintains (NAB 2010).

During summer and fall, residents use boats on rivers and lakes and OHVs over land in the study area. See also Section 3.2.5, Water Resources, for discussion of navigable waters. In winter and spring, residents travel via snowmobile as snow conditions allow. Residents primarily use snowmobiles, OHVs, and boats for subsistence, local travel, and recreation purposes. During summer, commercial barge service on the Kobuk River brings fuel and freight from Kotzebue to Ambler, Shungnak, and Kobuk. Hughes does not have consistent barge service due to shallow river waters (Hughes Traditional Council 2013).

Environmental Consequences

<u>Road Impacts</u>

No Action Alternative Impacts

The No Action Alternative would not result in any impacts to the existing transportation system. Continuation of small-scale mining development and ore exportation would likely generate similar air traffic and Dalton Highway traffic levels as today. Improved access to currently stranded mineral resources would not occur.

Impacts Common to All Action Alternatives

Under all action alternatives, the proposed project would result in the development of an access road to currently stranded mineral resources and would include associated support facilities including: airstrips, maintenance stations with fueling for maintenance equipment and communications towers, and other facilities to support the construction, operation, and maintenance of the road, although the number of each component would vary by alternative. Alternative C has more facilities (except material sites) than the other two alternatives. See Appendix C, Table 1, for a summary of project components by alternative.

Transportation currently occurs in the area for subsistence, recreation, and inter-village travel. Road construction would increase vehicle, rail, and aviation traffic in the region. Construction would involve using heavy equipment and vehicles to transport personnel, fuel, and supplies during construction activities.

Development of the road and mines would lead to increased traffic on the existing surface transportation network, especially on the Dalton Highway; see Appendix H, Table 2-7, for traffic projections during all 3 phases of proposed road development. All action alternatives are expected to have the same traffic volume. Phase 1 and 2 would have less impact because they have lower traffic volumes. The highest traffic volumes occur in Phase 3, so much of the analysis in this section focuses on Phase 3. Traffic would be a mix of ore concentrate trucks and other vehicles, such as those supporting road maintenance or supply/fuel delivery. Fuel and other hazardous materials transported on the road would create a potential for hazardous material spills (see Section 3.2.3, Hazardous Waste, for more information). Additional traffic may occur on the road to support emergency response efforts. See Section 3.3.1, Vegetation and Wetlands, for information about the potential for wildfires in the area.

The BLM is not considering issuance of ROW for a public road. While the proposed road is primarily for industrial access, AIDEA has proposed communities be allowed to use the road for certain uses, such as delivery of commercial goods. Public use could be allowed at designated crossings, which may restrict or cause out-of-direction travel for local travelers compared to current conditions. General public access would be restricted by means of a staffed, gated facility at each end of the proposed road. Preventing unauthorized traffic and implementing access control could minimize vehicle conflicts and crashes. AIDEA would develop a communications plan and safety protocols to reduce vehicle crashes. AIDEA has also proposed creating a subsistence working group, which would be charged with identifying crossing locations that could include winter trails or designated RS2477 routes (or potentially other locations) used for subsistence travel. AIDEA has proposed several design features to reduce trespass on the road, including installing a staffed gate near the Dalton Highway intersection. Appendix N summarizes these measures, which are expected to be highly effective at the road entry point; however, some trespass may occur, particularly by those intersecting the road in the backcountry.

All action alternatives involve bridge and culvert construction for river crossings. These structures may limit a river's ability to be used for water-borne transportation. However, U.S. Coast Guard permits for navigable waterways would be required, and land managers are likely to require designs to allow navigation, whether by canoe and raft or tug and barge, depending on the location. While the types of impacts are similar among alternatives, Alternative C would cross the Kobuk and Koyukuk rivers in areas that could be used by barges or other large boats while Alternatives A and B would cross rivers used primarily by small craft. Phase 1 would have a greater impact as the initial culverts would be installed during this phase. Potential mitigation includes adequate clearance on bridges where barge service and boat use occur to reduce impacts in accordance with bridge permitting that would be effective in maintaining access (see Appendix N).

The proposed airstrips are not intended for public use and are unlikely to have a major impact on aviation activity in the area. AIDEA estimates an additional 1 to 2 flights per week to each maintenance station (Davis 2019). Alternative C would be associated with more flights because it has more maintenance stations. Construction of the road would result in a temporary increase in regional air traffic during construction to support crew changes and transportation of supplies. Construction related air traffic would likely originate in Fairbanks or Anchorage. After closure, aviation activities would consist of an occasional flight for monitoring activities. See Appendix H for air traffic estimates.

Alternatives A and B Impacts

The impacts under Alternatives A and B would be similar to those impacts common to all action alternatives. The intersection of Alternatives A and B with the Dalton Highway would occur at MP 161.

Alternative C Impacts

Alternative C would connect to the Dalton Highway at MP 59.5. Alternative C would have more potential for fuel spills, traffic crashes, and similar impacts because it is the longest of the action alternatives and traverses mountainous terrain. Traffic would spend more time on Alternative C than on the other alignments. However, if the routes are evaluated as the distance between the District and Fairbanks, Alternative C would be similar to other alternatives—17 miles longer than Alternative A and 3 miles longer than Alternative B. Alternative C would cross the Koyukuk and Kobuk rivers. The Kobuk River crossing is a concern as it could affect barge service to Kobuk, so adequate bridge clearance would need to be provided to avoid impacts to that service.

Mining, Access, and other Indirect and Cumulative Impacts

Mine development would change transportation use in the region, increasing road, rail, aviation, and port activity due to the need to transport ore concentrate to market and people and supplies to and from the mines (See Appendix H, Section 2.1.5, Reasonably Foreseeable Action Scenario). Traffic on the Dalton Highway (and other roads) between the Ambler Road turn off and the Fairbanks rail yard would increase. This traffic increase would occur for 161 miles of the Dalton Highway under Alternatives A and B and 59.5 miles under Alternative C, and would likely result in more crashes and maintenance needs. The existing transportation systems are anticipated to be able to accommodate this additional demand without causing traffic congestion.

The proposed project may result in spur roads being built to local villages. Development of these spur roads would depend on the community's proximity to the proposed road and ability to find construction funding.

The proposed project is also likely to worsen the shortage of drivers with Commercial Driver's Licenses. This may result in other industries being unable to hire drivers or the need to hire drivers from outside Alaska (Friedman 2018).

Subsidence from melting permafrost could damage trails, roads, and airstrips. Increased temperatures and lack of snow cover could also affect winter travel.

3.4.3 Recreation and Tourism

Affected Environment

Recreation and tourism in the project area includes road-based activity along the Dalton Highway, fly-in backcountry trips along the southern Brooks Range, and fishing and hunting along the broad lowland river corridors. Volume 4, Map 3-29, illustrates common float trips, lodge areas, and Dalton Highway recreation features.

The BLM manages land covered by the Utility Corridor RMP (BLM 1991a) primarily as a transportation and utility corridor for TAPS and the Dalton Highway. However, many people drive the highway for recreation, and the BLM also manages for this use. The *Recreation Area Management Plan: Dalton Highway* (BLM 1991b) designates the "inner corridor" as an SRMA (see Volume 4, Map 3-26), where recreation is a top management concern. Primary activities in the inner corridor are sightseeing, overnight lodging and camping at developed sites, interpretive services, and fishing. Developed recreation facilities such as campgrounds and visitor contact stations occur at designated development nodes. The BLM manages the "outer corridor" for primitive/traditional recreation opportunities, where primary activities are hunting, fishing, backpacking, and snowmobiling. The BLM prohibits recreational OHVs or snowmobiles within 5 miles of the highway ROW, in deference to state law. West of the corridor, recreation occurs, but the *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) does not emphasize its management. Similarly, the state and NWRs have land management plans that allow, but do not strongly emphasize, management for recreation (see Section 3.4.1, Land Ownership, Use, Management, and Special Designations).

The BLM operates 2 seasonal visitor contact stations on the Dalton Highway. The Yukon River Crossing station has recorded an average of 7,481 visitors per summer season (2004 to 2018; Egger 2019). The Arctic Interagency Visitor Center at Coldfoot has averaged 8,467 visitors per summer season (2004 to 2018; Egger 2019). Winter activity has been growing, particularly tours for aurora viewing. Recreation and tourism traffic is an important component of Dalton Highway traffic. AADT near the Yukon River approaches 300 vehicles per day (vpd; HDR 2018), which is low by 2-lane highway standards. Monthly AADT in summer is 400 to 450 vpd. Truck traffic accounts for approximately two-thirds of the total, with the percentage of trucks increasing with latitude as recreation and tourism traffic turns back and trucks continue to Deadhorse. Using this two-thirds estimate, approximately 150 vpd in summer are standard vehicles, including local resident traffic, oil industry traffic in light vehicles, tour vans, and independent recreational visitors. Traffic counts group recreational motorhomes with trucks. For some independent drivers, contending with trucks on a narrow, and often gravel, road adds challenges to the drive and could detract from the recreational experience.

In 2019, the BLM will permit 13 tour businesses to use facilities in the highway corridor. These typically are van tours from Fairbanks to the Arctic Circle and other destinations. The tour companies annually report numbers of clients at various stops. BLM records show strongly increasing numbers overall from 2010 to 2017. The Arctic Circle Wayside, which represents setting foot in the Arctic for tourists, is the most popular site, with 13,544 visitors in 2017.

A backcountry area not accessible by road and without permanent recreational trails is located west of the highway corridor. GAAR and the southern Brooks Range are primary attractions for people seeking backpacking, river floating, and fishing experiences. A typical trip uses scheduled flights to Bettles and charter aircraft on "tundra tires" or floats to land on gravel bars, lakes, or flat rivers. Recreationists backpack and/or paddle for multi-day trips on their own or with guides. Such trips are in keeping with "solitude" and "primitive and unconfined recreation" values, highlighted in GAAR management. The undeveloped state- and BLM-managed land south of GAAR also provides for these values, and many float trips traverse these lands; however, the BLM does not manage land outside the park to retain wilderness values. Appendix F, Table 8, summarizes common river floating routes. Recreationists can also take floating/fishing trips from the Dalton Highway, where it crosses rivers that flow west through Kanuti NWR. Many other streams in the project area may also be used for floating or powerboat access. See also Section 3.2.5, Water Resources, and Section 3.4.2, Transportation and Access, for other discussion of navigable waters. Among the fly-in options are trips to remote lodges such as Iniakuk Lake Wilderness Lodge and Peace of Selby Wilderness Lodge at Narvak Lake. Each lodge has several outlying cabins on private lands in the Alatna and upper Kobuk drainages, some within GAAR. The lodges offer high-end, customized trips with airplane support for sightseeing, hiking, boating, fishing, hunting, aurora viewing, and dog mushing. The lodges' websites market the wilderness and park surroundings (Peace of Selby Wilderness Lodge 2019; Iniakuk Lake Wilderness Lodge 2019).

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not change existing recreation activity or trends.

Impacts Common to All Action Alternatives

Impacts would occur where people enjoying a remote, natural experience in the backcountry would see the proposed road or hear its traffic or other associated sounds. This is most likely to occur in river corridors popular for boating when boaters approach a bridge or fish, hike, hunt, or camp near a bridge. It is likely the road and any associated facilities located near these rivers would effectively create a zone people would not use for these activities. For people intending a recreational trip away from the routines of home, whether home is in a city or village in the project area, the road would be an engineered structure in a natural environment, and traffic, dust, and new aircraft overflights would intrude visually and audibly on the experience. For people who have been in the backcountry for multiple days, potentially with several more days ahead of them, a road in the middle of the trip would be a disruption and a considerable change in the recreation and tourism environment. These impacts would occur both for fly-in paddlers floating out of GAAR and for residents and visitors using motorized boats and travelling the rivers. Bridge piers are expected to be designed to minimize hazards to navigation. See potential mitigation measures and design features proposed by AIDEA in Appendix N. See also discussion of navigable waters in Section 3.2.5, Water Resources. Physical passage would likely not be a substantial issue, but the structures and road traffic would materially change the experience. Most people in powerboats likely would be less sensitive to the presence of the road, particularly to the sounds of the road, but would be affected by seeing the road. Although recreational use of the road would not be allowed (see Appendix N, Section 3.4.3, Recreation and Tourism), some people are anticipated to try to hike or hitch a ride out to the Dalton Highway from a bridge crossing. Recreational hunters or anglers, including local residents and visitors, similarly may try to use (i.e., trespass on) portions of the road to access fish and game.

Similar impacts could occur for anybody traveling cross country and coming across the road. Cross-country travel would be relatively rare in summer and more likely during winter. Lodge owners; lodge guests; and other landowners visiting their lands, cabins, or fish camps located near the road likely would feel a change in their customary environment. Also, because shooting from or across a road is against State of Alaska law, the road would create a narrow corridor off-limits to taking game. In all cases, it is likely that people would continue to use the rivers, public and private lands, and lodges for recreation and tourism, hunting and fishing, with shifts to other, more remote streams (e.g., rivers in the Arctic NWR) and areas likely to be difficult to separate from normal variations in use.

Alternatives A and B Impacts

Alternatives A and B would cross 5 of the 6 common float trips listed in Appendix F, Table 8 (the Selawik River excepted), and several others such as the Reed and Ambler rivers. Of the 5 crossed, 1 (the Kobuk) is crossed where it is designated a WSR. The other 4 are designated WSR where they occur within GAAR but are not designated WSR where these alternatives would cross. However, virtually all parties that float these rivers float several days beyond GAAR to a community or backcountry area suitable for pickup by small plane. The scenery changes as the rivers leave the mountains and become flatter, wider, and more winding, but the remote characteristics remain. Crossings by road would affect the sense of solitude and remoteness currently experienced.

Alternatives A and B would terminate at a material site adjacent to the Ambler River. Alternative A would cross the designated Kobuk WSR 3.8 river miles south of Walker Lake (2.7 straight-line miles), while Alternative B would cross the Kobuk WSR 26 river miles southwest of Walker Lake (14.6 straight miles). Under Alternative A, the road and dust plumes from traffic on the road would be visible and traffic likely would be heard under some conditions near Walker Lake, a primary access point for visitors to this part of GAAR. The alternatives would be identical near Iniakuk and Narvak lakes, where lodges are located.

Approximately 1 mile of the shared Alternative A and B alignment, roughly centered on MP 1, would be approximately 0.75 mile upstream of and at a similar elevation as the existing access road for Chapman Lake. Chapman Lake is located west of the Dalton Highway, which is listed in BLM recreation documents as a wildlife viewing site for highway travelers. In addition, a material site and Ambler Road maintenance station are proposed near Ambler Road MP 0.6 and overlapping the road to Chapman Lake. The material site would be easily visible from a lake overlook at a distance of 0.5 mile. The AIDEA gatehouse also is likely to be in this area. Traffic on the new road is likely to be audible from the lake, and dust likely would be visible. Vehicles on the Ambler Road may be visible from some vantage points depending on tree cover, which is variable but sparse in this area. The gatehouse would be expected to have continual traffic sounds audible and overhead lights and buildings visible from the lake area, decreasing the attractiveness of the location for wildlife viewing. The material site could temporarily or permanently eliminate public road access to the lake overlook.

Alternative C Impacts

Alternative C would avoid any recreational impact associated with GAAR. It would terminate adjacent to the Ambler River. It would cross the Kobuk River downstream of Kobuk, where most river floaters end their trips, so would avoid most impact to recreationists floating out of GAAR. Alternative C would not cross the other common river float trips (Appendix F, Table 8) and would therefore avoid those impacts. Alternative C would cross the Kobuk River (outside its WSR designation) and cross and parallel the Hogatza and Koyukuk rivers, all used by boaters for sport fishing, hunting, and access to fish camps and other private property used in part for recreation. Impacts as described for all action alternatives would occur and likely would affect more river users overall, although some would be passing under the road solely for transportation rather than recreation. Alternative C impacts on recreational experiences would occur in less sensitive areas than those impacted by Alternatives A and B.

Mining, Access, and other Indirect and Cumulative Impacts

Mine development, like road development, would alter current backcountry recreational use patterns. Much of the District would be relatively unattractive for recreation. A busy, lit, and noisy ore-trailer assembly area near the Dalton Highway could conflict with recreational use of the Chapman Lake under Alternatives A and B, depending on its ultimate location. Increased traffic on the Dalton Highway would likely diminish the existing recreational experience, and existing facilities such as roadside privy toilets likely would be inadequate. The traffic impacts would occur for 161 miles of the Dalton Highway under Alternatives A and B and 59.5 miles under Alternative C. Cumulative impacts of the road project would occur principally because the road would induce development of the mines. The road and the mines together would substantially alter the recreation environment along the southern Brooks Range, with greater effects under Alternatives A and B than under Alternative C.

3.4.4 Visual Resources

Affected Environment

The proposed road corridors are mostly undeveloped lands with a natural appearance and a visual variety of planar, rounded, and blocky topographic forms; vegetation textures; water; and colors. All public lands have scenic value, but areas with the most variety and harmonious composition have the greatest value (BLM 2018c). In some locations, there is evidence of human activity (e.g., cabins, communities). The most prominent feature of the built environment is the TAPS, which includes swaths cut through the forest for the Dalton Highway and the pipeline, and the highway and reflective pipe themselves.

Key viewing locations typically are points or corridors where people are likely to be, particularly in areas where there is an expectation for a pleasant or natural view, including:

- River corridors and lakes used for recreational float trips, particularly the Alatna, John, North Fork/Middle Fork Koyukuk, and Kobuk rivers and Walker and Nutuvukti lakes;
- Dalton Highway Scenic Byway, particularly pullouts and overlooks along the highway;
- Communities, where people are present most often; and
- Lodges, cabins, and seasonal hunting/fishing camps, where the same people may visit repeatedly.

The BLM manages visual resources under a Visual Resources Management (VRM) system. The BLM manages the Dalton Highway “inner corridor” per Class IV VRM objectives, where a high level of change in landscape character is allowed and results of management activities may dominate the view (BLM 1989, 1991a, 1991b). The BLM manages lands associated with the “outer corridor” as Class III, where management activities may attract attention but should not dominate the view (BLM 1989, 1991a). The BLM addresses lands farther west in the existing Central Yukon management area as follows: “Areas of outstanding scenic value in the Ray Mountains would be managed where possible to retain existing character of the landscape. Other areas would be managed to lessen impacts from other activities” (BLM 1986).

In the project area, the BLM (2018c) has prepared a Visual Resource Inventory (VRI) for lands in the Central Yukon management area. The BLM categorizes lands into 4 VRI classes, which are separate from VRM classes. VRI classes represent the relative value of the visual resource: Classes I and II are most valued, Class III is of moderate value, and Class IV is the least valued. The VRI process involves a scenic quality evaluation (visual appeal); a sensitivity level analysis based on the number of people expected to be in an area, their purposes, and the nearby land management; and a delineation of distance zones from a travel corridor or viewpoint. The final VRI class (I–IV) summarizes these elements in a single classification. Volume 4, Map 3-30, shows BLM VRI classes for the study area. See the VRI (BLM 2018c), incorporated here by reference, for detail.

The NPS completed a VRI for GAAR related to the proposed project (Meyer and Sullivan 2016). Visual values of NWR lands are similar to the NPS- and BLM-managed lands, but this analysis does not address them because no alternative would cross NWR lands. The State of Alaska does not specifically manage its lands for scenic values.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any changes to the visual environment.

Impacts Common to All Action Alternatives

All action alternatives would affect the visual environment. Appendix F, Tables 7 and 8, illustrate how much of each alternative would lie within VRI and VRM areas shown on Volume 4, Map 3-30. Impacts occur when a harmonious composition of visual elements and visual variety is disrupted. The proposed project would introduce a linear engineered element with a contrasting light-colored gravel surface into a primarily natural environment of darker colored trees and tundra. The visual texture of the road would appear harder and smoother than most surrounding land cover. Consequently, the road would be immediately visible when trees or terrain were not blocking it, and from the air or high vantage points. The line of the road, as well as motion, dust plumes, reflection, and lights from traffic on the road, would draw the eye of people scanning the landscape. As a curving line following the contours of the land, the road would not necessarily be visually unpleasant, but it would be distinct, and different from everything around it. Major project bridges would be large engineered structures that would coincide in many cases with river travel corridors where people concentrate, but in most cases river travelers would quickly pass the structures. Boaters likely would not see other parts of the road, although material sites or water access points are near some bridges and may be visible.

Other project elements, such as the dozens of material sites, several permanent maintenance camps with 3,000-foot runways, and multiple communications sites with buildings and communications towers, also would place contrasting forms, lines, and colors into the mostly natural setting. Communications towers likely would be gray galvanized metal structures 100 to 150 feet tall, much taller than any local trees. Buildings are likely to be boxy, metal-sided structures built for utility over aesthetics, creating contrasting forms. Potential mitigation measures outlined in Appendix N (Section 3.4.4, Visual Resources) include stipulations that specify use of earthy brown, gray, and green colors for siding and roofing to reduce the contrast of structures, but it is likely the surfaces would remain reflective and therefore highly visible over distance when the view angle and sun angle converged. For users of the road, who would be looking out on the landscape, the driving experience is likely to be perceived as highly scenic and pleasing.

NPS completed a viewshed analysis for the portions of Alternatives A and B that would cross GAAR (Meyer and Sullivan 2016; see in particular Summary of Findings and Conclusions), basing some of the work on a visual analysis NPS performed in conjunction with AIDEA (DOWL 2014b), both incorporated here by reference. The AIDEA effort included figures with simulation of the road appearance from 12 key observation points within GAAR. These simulations may be considered reasonable representations of the type of visual change that would occur under any alternative, including at locations outside GAAR, at similar distances and vantage points. Appendix A, Figures 3-6 and 3-7, provides example simulations. The impacts of the road would be of long duration, likely permanent despite closure and reclamation measures, and would include strong contrasts when seen from relatively close range, higher vantage points, or from the air.

Alternative A Impacts

Alternative A, like Alternative B, would traverse the southern foothills of the Brooks Range, an area generally of high visual variety. Alternative A would cross the National Preserve for 26 miles, roughly paralleling the Wilderness boundary within approximately 1 mile for 16 miles, and it would cross the Kobuk WSR. While ANILCA provided for passage through GAAR, management of these lands is the most sensitive to visual changes of any in the project area, particularly the designated Wilderness. While Alternative A would not pass through Wilderness, it would run close to it. People floating the Kobuk WSR and other rivers downstream of their “wild and scenic” designations would encounter visually contrasting bridges (see Section 3.4.3, Recreation and Tourism; see Appendix A, Figure 3-6). The area of Alternative A around MP 1 would be in an area visually connected with Chapman Lake (see Section 3.4.3, Recreation and Tourism).

Alternative B Impacts

Alternative B, like Alternative A, would traverse the southern foothills of the Brooks Range, an area generally of high visual variety. Alternative B would cross the National Preserve for 18 miles at a distance of 8 miles or more from the Wilderness boundary, effectively out of sight, which would create less impact than Alternative A. While ANILCA provided for passage through GAAR, management of these lands is more sensitive to visual changes than most other lands in the project area. People floating the Kobuk WSR and other rivers downstream of their “wild and scenic” designations would encounter visually contrasting bridges (see Section 3.4.3, Recreation and Tourism; see Appendix A, Figure 3-6). The area around MP 1 of Alternative B would be in an area visually connected with Chapman Lake (see Section 3.4.3, Recreation and Tourism).

Alternative C Impacts

Alternative C would traverse mountains, rolling hills, and broad river flats, not unlike that shown in Appendix A, Figure 3-7. Overall, the visual variety of these areas is high, but certain flat areas (e.g., 50 miles of road north and east of Hogatza) may provide less visual interest. Land management along this alignment is not highly sensitive to visual changes. The road would pass approximately 1.3 miles west of Kobuk. Dust plumes likely would be visible west of town. Traffic, including reflections and headlights coming off the hills to the north, would increase and would occur 24 hours per day. The Kobuk River bridge and road would be readily visible by anybody traveling downriver by boat or snowmobile, a common route. At Hughes, the road and Koyukuk River bridge would be similarly visible by anybody traveling upriver or to the northwest (e.g., up Hughes Creek). Overall, Alternative C visual impacts are larger in area due to its longer length, but of less severity due to lower sensitivity of users and less land management sensitivity.

Mining, Access, and other Indirect and Cumulative Impacts

Past actions have resulted in the visual environment described in the Affected Environment, with gradual incursion over more than 100 years of visible cut trails and expanded communities. Construction of TAPS and the Dalton Highway resulted in major visual changes in the 1970s. In 1980, creation of conservation system units protected and to a certain extent promoted the natural visual environment. The impacts of the proposed road would continue a trend of lines across the project area.

The mining scenario described in Appendix H would result in 4 new mines with associated roads and airstrips in the mountains north of Kobuk and south of GAAR. Several open pits mines that each could be 0.75 mile across and with tailings areas up to 1.5 miles long and 0.75 mile wide, along with traffic dust, lights, and buildings to house several hundred to more than 1,000 workers would change the visual environment of the area, introducing the engineered, stair-stepped mining pits and unnatural and contrasting forms (buildings, embankments), lines (roads, vertical mill towers, communications towers), and colors. This area is used primarily by local residents and some river floaters (e.g., Ambler River) and is seen by people traveling by aircraft for transportation or tourism. The numbers of travelers who would see the mine-related development is not high, but many of those who would see them likely would be sensitive to the changes.

The visual impacts of the proposed road would be important by themselves, regardless of alternative. Combined with past impacts (particularly the Dalton Highway/TAPS corridor) and the reasonably foreseeable mining development, impacts in the project area would be greater. The impacts would be similar among the alternatives except that Alternative A would affect more sensitive GAAR and WSR lands along the proposed road. Alternatives B and C, and particularly C, would affect less sensitive areas. However, Alternative C, because of its length, would affect a larger area overall.

3.4.5 Socioeconomics and Communities

Affected Environment

The socioeconomics study area focuses primarily on the Yukon-Koyukuk Census Area (YKCA) and the NAB. Particular emphasis is placed on describing socioeconomic conditions in the communities within 50 miles of the proposed road that are not connected to the statewide road system year-round. The proposed project could potentially result in changes to resident and commodity transportation patterns and costs in these communities. The YKCA communities affected include Bettles, Evansville, Allakaket, Alatna, Huslia, Hughes, and Rampart, while the NAB communities affected include Kobuk, Shungnak, and Ambler. Residents in the Nome and Kusilvak Census Areas and North Slope Borough could also experience effects to subsistence resulting from impacts to caribou (see Section 3.4.7, Subsistence Uses and Resources). Volume 4, Map 3-31, depicts these geographic areas and the locations of the potentially affected communities. Appendix F, Table 13, lists the communities that could be affected and provides population and demographic data.

Economic Conditions

This analysis focuses on NAB and YKCA economies because that is where the primary socioeconomic impacts are anticipated. Many of the communities in these locales have "mixed" economies in which households rely on cash income and the harvest of subsistence resources. Cash-paying jobs tend to be temporary or seasonal in rural Alaska, so cash incomes tend to be small and insecure (ADF&G n.d.). Transfer payments, including the Permanent Fund Dividend, unemployment benefits, retirement benefits, and Medicaid payments, account for a much larger share of household income (Goldsmith 2010). Due to the low availability of jobs, together with the high cost of food in local grocery stores, subsistence is essential to many of these residents' diets. Rural households use cash to purchase fuel oil, electricity, and family goods, such as clothing. They also use cash to purchase equipment used in subsistence hunting, fishing, and gathering, such as guns and ammunition, fishing nets, boats, OHVs and snowmobiles (including gas and oil), and rain gear. This use of cash to invest in subsistence food production is an essential component of many household economies (Wolfe and Walker 1987; ADF&G n.d.).

Employment. Appendix F, Table 11, presents a snapshot of the resident workforce of the NAB and YKCA by industry over the 2014–2016 period, based on data provided by the Alaska Department of Labor and Workforce Development (ADOLWD 2019). Resident employment in the NAB totaled 3,004 jobs in 2016 (Appendix F, Table 11). Private industries employed approximately 60 percent of the total resident workforce, and the public sector employed 40 percent. The largest private sector employers included Maniilaq Association, a non-profit corporation that provides health and social services, and Teck Alaska, the operator of the Red Dog Mine. Mineral exploration activities in the District also created some mining-related jobs (DOWL 2016a). The largest public sector employer of residents was local government, which included tribal government employment.

Employment in the YKCA totaled 2,567 jobs in 2016 (Appendix F, Table 11). State and local governments provided approximately 60 percent of the jobs. The Tanana Chiefs Conference, a non-profit corporation that provides social and health services to Alaska Natives, was the largest private employer. Work associated with the TAPS accounted for many of the highest paying private-sector jobs. The TAPS passes through the center of the census area, with 3 pump stations between Livengood and Evansville (Shanks 2013).

Unemployment is generally high in the study area, with typical unemployment rates in the double digits. Unemployment data likely underestimate the number of people who would like to work, particularly in more remote communities, because the unemployment rate includes only people who are actively seeking work. Several of the study area communities are off the road system, making commuting to a job in another town or city impractical. Consequently, some people may cease to actively search for work (Robinson 2009).

Appendix F, Table 13, shows the unemployment rates in the NAB and YKCA, which are substantially higher than the state rate, while median household incomes are lower.

Cost of Living. Reliance on air travel is costly for the communities not connected to the statewide road system, which the high prices for goods and services reflect. A recent study of grocery costs in 16 Alaska communities conducted by the University of Alaska Fairbanks' Cooperative Extension Service reports that the highest costs are in areas where most food is flown in. For example, in Kotzebue, groceries are more than double the cost for the same items in Fairbanks and Anchorage (Fried 2018). The provision of public infrastructure and services in rural Alaska is expensive. For example, the cost to construct public buildings in rural Alaska is approximately twice as much per square foot as in Anchorage (Foster and Goldsmith 2008). The higher construction cost is due to higher freight costs (barge and air), limited supply of specialty labor (mechanical, electrical), permafrost and other challenging foundation conditions, weather delays, remote logistics, and high fuel costs.

Cost of Energy. Heating fuel is a major expenditure in the study area communities, as shown in Appendix F, Table 12. In 2018, the price per gallon for number 1 fuel oil was higher in all communities than in Fairbanks, where it was $3.05. The cost was relatively lower in Bettles and Evansville because they are able to contract large semi-truck tankers to haul in a year's supply of fuel when the winter road is accessible (Spindler 2016). Other study area communities pay among the highest prices in the state, which is a particular economic burden on local households given the relatively high unemployment and poverty rates among YKCA and NAB residents (Shanks 2009, 2013).

Study area communities use diesel fuel to generate all electricity produced and consumed in each community. The cost of generating electricity in rural areas is considerably higher than in urban areas of the state, as stand-alone diesel generators not tied into the regional grid generate the electricity. Delivery of fuel for power generation, heating, and transportation is seasonal and limited by sea or river ice, water levels, or ice road availability. This means that communities must store large volumes of fuel oil in bulk fuel storage tank farms to meet their annual energy needs. Fuel storage requires a substantial capital infrastructure investment (Wilson et al. 2008). Additionally, the lack of economies of scale leads to costly electricity per unit produced (Fay et al. 2012). The state subsidizes rural electric utilities customers through the Power Cost Equalization (PCE) program, which lowers residential electricity rates in participating communities. Appendix F, Table 12, shows the PCE subsidy rates for 2017.

Community Services

Health Care. Health clinics offering primary care are located in all study area communities. However, the staff, equipment, and other resources of many of these clinics are limited, meaning that trauma and serious illness cases must be sent to an outside hospital, usually by airplane or helicopter. Helicopter medevacs can cost $100,000 or more, and fixed-wing aircraft medevacs exceed $22,000 (Schoenfeld 2013; Alaska Federal Health Care Partnership 2016).

Law Enforcement. Law enforcement in the study area is primarily the responsibility of Alaska State Troopers, provided by a central headquarters with area posts in Fairbanks, Coldfoot, and Kotzebue. The logistical issues created by distance between posts and communities, together with erratic weather conditions and limited weather stations, create challenges for troopers largely dependent on aircraft to conduct their work. Some communities, including Allakaket and Alatna, have no local law enforcement officer; therefore, there is little ability for officers to provide a prompt response in the event of an emergency.

Solid Waste Disposal. ADEC must approve solid waste plans for any construction; typically, combustible solid waste is incinerated. Non-combustible solid waste must be disposed of in approved facilities using appropriate procedures. In most of the study area, solid waste is disposed of in local landfills operated by local governments. The exception is Bettles, which uses the landfill at Evansville. All landfills in the study area are categorized as Class III (i.e., a municipal landfill that accepts less than 5 tons of solid waste per day and is not connected by road to a larger landfill or is 50 miles by road from a larger landfill; 18 AAC 60.300(c)(3)). Landfills at Evansville, Huslia, Rampart, Ambler, Kobuk, and Shungnak backhaul some household hazardous materials and recyclables by barge, small boat, airplane, or truck to a larger community for final disposal (ADEC 2019). However, the feasibility of most backhaul programs varies annually, seasonally, and daily depending on transportation costs, local government revenue, river depths, and staff experience (Zender Environmental Health and Research Group 2015). Landfills at Alatna, Allakaket, and Hughes currently have no backhaul capability (ADEC 2019). The Bornite Mine Camp, located 12 miles north of Kobuk, has a permitted landfill. The BLM does not permit the burial of garbage within the lands it manages in the project area.

Public Health

A health impact assessment has been completed (NewFields 2019) that describes current human health conditions for communities within 50 miles of the proposed road and project alternatives. Potentially affected communities are located in the Interior Public Health Region (YKCA) and Northern Public Health Region (NAB). The overall illness and mortality indicators for the area are generally consistent with the overall trends observed for all Alaska Natives. Illness is dominated by communicable diseases, dental disease, injury, and poisoning. Musculoskeletal diseases are a leading cause of outpatient visits. Cancer incidence rates have increased substantially over the last 50 years and are associated with underlying rates of smoking, alcohol usage, and obesity.

The 3 leading causes of mortality for all Alaska Natives are cancer, heart disease, and unintentional injury. The Northern Public Health Region has higher cardiovascular and unintentional injury mortality rates than the Interior Public Health Region. Chronic obstructive pulmonary disease (COPD) mortality rates have increased considerably and are consistent with high smoking rates. Alaska Native males had substantially higher mortality rates for cancer, heart disease, unintentional injury, suicide, COPD, and alcohol abuse than Alaska Native females. Alaska Native females had substantially higher rates of mortality due to cerebrovascular disease and chronic liver disease than Alaska Native males. Alaska Native infant mortality rates have decreased substantially since the 1980s. Life expectancy for Alaska Natives has been increasing since the 1980s and is now 70.7 years.

NOA is present in multiple geographic areas within the Interior Public Health Region.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any changes to socioeconomic conditions in the study area communities. The No Action Alternative would likely maintain the current baseline health trends in regional mortality and morbidity.

Impacts Common to All Action Alternatives

Employment and Income. While employment and income opportunities would vary under each action alternative and would be different during road construction or operations, all action alternatives could provide some increased job opportunities for residents; although, jobs may be temporary and residents may lack the desired qualifications for such jobs. A majority of the study area communities have high levels of unemployment and low-income with high costs of living. AIDEA has stated the proposed access road could alleviate through potential commercial access for affected communities (see Appendix H, Section 2.2.2, Commercial Access Scenario).

Under all action alternatives, most of the direct, on-site construction jobs would be in the heavy civil construction trade, including heavy equipment operators, site engineers, construction managers, and construction laborers. State-level data from the ADOLWD indicates that approximately 81 percent of construction laborers in Alaska are state residents (Kreiger et al. 2019). While firms based in Anchorage would likely receive most of the Alaska-based construction contracts, it is expected that workers employed by these firms would come from all regions of the state. As a state agency, AIDEA cannot offer a hiring preference to residents of the NAB/YKCA. However, a large number of working-age adults residing in the region are currently qualified to fill project construction jobs. In 2016, for example, 153 NAB residents and 152 YKCA residents worked as construction laborers (ADOLWD 2019). Also, many residents are available for immediate employment, as there were approximately 737 unemployment insurance claimants in the NAB and 614 in the YKCA in 2016 (ADOLWD 2019). Many of these unemployed individuals likely have the requisite skills for construction jobs or could be trained for construction jobs at project worksites. An estimated 20 percent of construction jobs would go to residents of this region (UA 2019).

Construction of the proposed road would initiate subsequent rounds of income creation, spending, and re-spending. Third-party contractors, vendors, and manufacturers receiving payment for goods or services required by the project would, in turn, be able to pay others who support their businesses. Also, people directly and indirectly employed to construct or maintain the road would generate jobs and income as they purchase consumer goods and services to meet household needs (also termed "multiplier effects"). Impact Analysis for Planning (IMPLAN), an input-output model, was used to estimate the multiplier effects of the project's construction and operation on the statewide economy. These multiplier effects take into account both the sector-based interactions that exist in the economy and the leakages in the form of purchases of goods and services from outside Alaska. It is estimated that approximately 10 percent of the total jobs created during road construction, including jobs created as a result of multiplier effects, would be filled by NAB/YKCA residents (UA 2019).

Annual operations and maintenance expenditures would provide ongoing employment once construction was completed. An estimated 20 percent of the jobs directly supported by operation of the proposed road would be filled by NAB/YKCA residents (UA 2019). Overall, it is estimated that approximately 12 percent of the total number of jobs created annually during road operation, including jobs created as a result of multiplier effects, would be filled by NAB/YKCA residents (UA 2019).

Road construction could also potentially generate economic benefits for ANCSA corporations, such as Doyon Limited. Portions of the road alignments cross 10 to 12 miles of land for which Doyon Limited owns the subsurface rights. Furthermore, there are 4 project material sites located on land for which Doyon Limited owns the subsurface estate. Doyon Limited manages 40 sand, gravel, and rock sources in 34 villages within the Doyon region to generate revenue (Doyon Limited 2019). Road construction would require approximately 23.6 million cubic yards of material for a total estimated cost of $160.2 million, which includes labor and the material expense. Of this total amount, approximately $28.6 million is expected to go to Doyon Limited (Cardno 2015).

State and Local Government Revenues. With the proposed project occurring in a census area rather than an organized borough, unless the Koyukuk River villages form a borough, no local government revenues are expected to be generated during road construction or operation. The State of Alaska would receive royalty payments from excavation of embankment materials and aggregate on state lands during road construction; however, there is insufficient information to estimate these payments.

Community Services. During construction, it is anticipated that project construction workers for the proposed road would be housed in work camps, so no increase in demand for community services and other public infrastructure is anticipated in study area communities. During road operations, people employed during the operation and maintenance of the proposed road would likely commute from their homes and live in accommodations at the maintenance stations; therefore, they are not projected to create additional demand for public infrastructure and services in study area communities.

Public Health. Impacts to human health are somewhat similar across all action alternatives, with differences based primarily on each community's location and distance from the road (see NewFields2019 for further information). Potential effects are related to socioeconomic improvements in household income and employment during active road construction and operation. Increased economic benefits may decrease the number of food-insecure households but would also change the use of traditional foods. Increases in accidental releases (e.g., fuels, hazardous materials) could affect terrestrial and aquatic resources, which would affect access to traditional foods. Potential subsistence impacts to access, quantity, and quality (real or perceived) related to road construction and operation (e.g., NOA and other dusts, noise, physical barriers, habitat fragmentation, competition for resources) could occur with resulting effects on local diets as discussed in Section 3.4.7, Subsistence Uses and Resources. Changes in diet are associated with long-term increases in non-communicable disease rates. Road construction and operations could increase distribution and consequent exposure to NOA materials, with resultant health effects. Increased interaction between community members and industrial road traffic could result in serious accidents and injuries. Potential measures to decrease impacts, including participatory monitoring and health education and promotion, are further discussed in the Health Impact Assessment (NewFields2019, Chapter 5, Table 64).

Alternative A Impacts

An estimated total of 2,730 jobs would be directly supported by the construction of the proposed road over the entire construction phase. If Phase 1 and 2 construction lasts 4 years, the average direct construction employment is projected to be 680 jobs annually. Assuming 81 percent of the construction laborers are state residents, Alaskans would hold 550 of the direct jobs per year. An estimated 110 of these direct jobs would be filled by NAB/YKCA residents, assuming 20 percent of the construction jobs would be filled by residents of this region.

Construction-related spending for materials and services would support an additional estimated 180 jobs throughout Alaska annually, while construction employee spending would support an additional 310 jobs annually. Overall, it is estimated that 1,170 jobs would be supported annually during project construction, of which approximately 117 would be filled by NAB/YKCA residents, assuming 10 percent of the total jobs created during road construction would be filled by residents of this region.

An estimated 50 jobs would be directly supported by operation of the proposed road. Of these direct jobs, 10 would be filled by NAB/YKCA residents, assuming 20 percent would be filled by residents of this region. Operations-related spending for materials and services would support an additional 20 jobs throughout Alaska annually, while operations employee spending would support an additional 20 jobs annually. Overall, an estimated 90 jobs would occur annually during road operations, of which approximately 9 would be filled by NAB/YKCA residents, assuming 11 percent of the total jobs created during road operations would be filled by residents of this region.

Potential health impacts from Alternative A are essentially the same as those discussed above for all alternatives. Alternative A and B alignments are quite similar; therefore, the health consequences are nearly identical. Kobuk, and possibly Shungnak and Ambler, would see similar potential for these health-related effects because they would be similarly situated geographically from the road under any alternative. Bettles and Evansville would be more likely to experience health-related impacts under Alternatives A and B as compared to Alternative C due to their proximity to the road alignment under those alternatives.

Alternative B Impacts

An estimated total of 2,930 jobs would be directly supported by the construction of the proposed road over the entire construction phase. If Phase 1 and 2 construction lasts 4 years, the average direct construction employment is projected to be 730 jobs annually. Assuming 81 percent of the construction laborers are state residents, Alaskans would hold 590 of the direct jobs per year. Approximately 120 of these direct jobs would be filled by NAB/YKCA residents, assuming 20 percent of the construction jobs would be filled by residents of this region.

Construction-related spending for materials and services would support an additional estimated 190 jobs throughout Alaska annually, while construction employee spending would support an additional 330 jobs annually. Overall, it is estimated that 1,250 jobs would be supported annually during project construction, of which approximately 125 would be filled by NAB/YKCA residents, assuming 10 percent of the total jobs created during road construction would be filled by residents of this region.

An estimated 60 jobs would be directly supported by operation of the proposed road. Of these direct jobs, 12 would be filled by NAB/YKCA residents, assuming 20 percent would be filled by residents of this region. Operations-related spending for materials and services would support an additional 20 jobs throughout Alaska annually, while operations employee spending would support an additional 30 jobs annually. Overall, an estimated 110 jobs would occur annually during road operations, of which approximately 12 would be filled by NAB/YKCA residents, assuming 11 percent of the total jobs created during road operations would be filled by residents of this region.

Potential health impacts from Alternative B are essentially the same as those discussed above for all alternatives. Alternative A and B alignments are similar; therefore, the health consequences are nearly identical. Kobuk, and possibly Shungnak and Ambler, would have similar potential for health-related effects because they would be similarly situated geographically from the road under the action alternatives. Bettles and Evansville would be more likely to experience health-related impacts under Alternatives A and B as compared to Alternative C due to their proximity to the road alignment under those alternatives.

Alternative C Impacts

Because it is much longer, Alternative C would provide more road construction and operations jobs than Alternatives A or B. An estimated total of 5,240 jobs would be directly supported by the construction of the proposed road over the entire construction phase. If Phase 1 and 2 construction lasts 4 years, the average direct construction employment is projected to be 1,310 jobs annually. Assuming 81 percent of the construction laborers are state residents, Alaskans would hold 1,060 of the direct jobs per year. Approximately 210 of these direct jobs would be filled by NAB/YKCA residents, assuming 20 percent of the construction jobs would be filled by residents of this region.

Construction-related spending for materials and services would support an additional estimated 350 jobs throughout Alaska annually, while construction employee spending would support an additional 590 jobs annually. Overall, it is estimated that 2,250 jobs would be supported annually during project construction, of which approximately 225 would be filled by NAB/YKCA residents, assuming 10 percent of the total jobs created during road construction would be filled by residents of this region.

An estimated 80 jobs would be directly supported by operation of the proposed road. Of these direct jobs, 16 would be filled by NAB/YKCA residents, assuming 20 percent would be filled by residents of this region. Operations-related spending for materials and services would support an additional 20 jobs throughout Alaska annually, while operations employee spending would support an additional 40 jobs annually. Overall, an estimated 140 jobs would occur annually during road operations, of which approximately 15 would be filled by NAB/YKCA residents, assuming 11 percent of the total jobs created during road operations would be filled by residents of this region.

Impacts from Alternative C are identical to Alternatives A and B with the following exceptions: (1) exposure to NOA materials is likely to be less of an issue because Alternative C traverses areas identified as having less "high to known asbestos potential" (see Volume 4, Map 3-2), and (2) the community of Kobuk, and possibly Shungnak and Ambler, would see similar potentials for these health-related effects because they would be similarly situated geographically from the road under any alternative. Hughes would have closer proximity to the road and would be more likely to experience the impacts described above, while Bettles and Evansville likely would not.

Mining, Access, and other Indirect and Cumulative Impacts

Past and present actions that have affected NAB/YKCA communities, including those communities closest to the proposed road, include mining development (e.g., Red Dog Mine), infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, and state and federal hunting and harvesting regulations.

The socioeconomic baseline of the study area is characterized by communities having high levels of unemployment, low incomes, and high costs of living. Construction of the access road and further development of the mines in the District would result in increased employment opportunities and income for some of the residents in this region. While the future closure of Red Dog Mine may result in some job loss for area communities, other oil and gas projects in northern Alaska provide potential employment opportunities.

While the access road is in operation, communities could benefit from secondary uses beyond providing industrial access to the District. AIDEA's application indicates that a secondary benefit of the proposed road would come from commercial access for communities closest to the road, creating opportunities for less expensive transportation of goods to and from some NAB/YKCA communities. See Appendix H, Section 2.2.2 (Commercial Access Scenario), for assumptions and details about commercial access for local communities. AIDEA's inclusion of a fiber optic communications line for internet and telephone service along the access road (see Appendix H, Section 2.2.3, Fiber Optics Communications and Related Issues) would likely result in communities desiring connection to the fiber optic line. These opportunities could result in beneficial socioeconomic effects to these communities.

Increased access to communities may increase the potential for bringing drugs, alcohol, and other prohibited substances into the communities. Adverse social or cultural impacts could occur without additional government or community plans to increase police or safety officer presence (see Appendix L, Section 6.4 [Road Impacts], for discussion). AIDEA has proposed design features such as a staffed gate at the Dalton Highway end of the road, which is intended to prevent public access along the road (see Appendix N). This would help to curb the potential for bringing these items into these communities, but is unlikely to be completely effective. In addition, AIDEA's proposed reclamation of the road at the end of its useful lifespan could have great impact on communities that have become dependent on commercial access and fiber optic service. Cumulative actions could also further disrupt subsistence resources and users in the communities that rely on subsistence to support their lifestyle and economy. See also Sections 3.4.5, Socioeconomics and Communities, and 3.4.7, Subsistence Uses and Resources.

The construction and operation of the proposed road, together with the mining development that the road would support, would provide opportunities for workforce training and development and employment for Alaska residents, including residents of NAB/YKCA communities in the project area. In addition, mining development would generate revenues for the State of Alaska through royalties, income taxes, toll payments, and other taxes and fees. The NAB and NANA would also experience substantial increases in revenue as a result of mining development. This revenue could be used to support education, health facilities, and other public infrastructure and services in communities in the region.

The combined effects of project employment opportunities, enhanced ability of the NAB and NANA to support public infrastructure and services in the region, and reductions in the cost of living due to changes in the logistics of transporting fuel, freight and people are expected to have an overall beneficial impact on the economic well-being of individuals and families in NAB/YKCA communities. However, should employment opportunities in mining projects lead to depopulation of some NAB/YKCA communities due to migration to urban centers, the effect on the range and level of local public services and facilities could be negative. Increased economic activity could enhance the ability for communities to support local infrastructure investments, such as water and sewer improvements, with related health benefits.

Potential commercial access could improve goods and service distribution, resulting in a mixture of positive and negative impacts. For example, access to cheaper building materials could make constructing or maintaining water, sewer, or other health-related infrastructure less expensive. Improved commercial access could lower distribution costs for clinic supplies. However, it would also facilitate increases in substance abuse due to easier importation of alcohol and tobacco products. Improvements in road and air infrastructure (i.e., new landing strips associated with road construction and maintenance) would facilitate redundancy for emergency evacuation for health related emergencies or during disasters for communities (See Appendix H Section 2.2). There would be potential health improvements due to access to fiber optic cable infrastructure because faster and more stable internet/telecommunications would facilitate telemedicine.

Increased economic benefits of job access at potential mines may decrease the number of food-insecure households. For example, improved incomes may allow for purchase of better snowmobiles and hunting/fishing supplies, which would facilitate subsistence activities. Potential indirect and cumulative impacts to access, quantity, and quality (real or perceived) of subsistence foods could occur, related to: (1) increased competition for resources (induced access), (2) impacts to fish and game populations or locations, and (3) difficulties with scheduling time off work for subsistence activities. Impacts to subsistence harvesting could have cascading effects on long-term non-communicable disease rates (e.g., diabetes). See Section 3.4.7 (Subsistence Uses and Resources) for information on which communities are likely to experience subsistence impacts.

A fly-in-fly-out workforce at the mines could have mixed effects on community cohesion (e.g., employed adults may relocate to urban areas but send remittances back to the villages) with health related effects from psychological stress. Increases in communicable diseases related to in-migration and increased incomes are a concern and often associated with the “boom and bust” cycle. Increases in vaccine preventable diseases are possible in association with large construction work camps. Kobuk, and possibly Shungnak and Ambler, would see the most potential for indirect and cumulative health effects from the proposed road and mining in the District because of their proximity to the mines and likely access of mine workers to and from the mines via the Dahl Creek airstrip.

3.4.6 Environmental Justice

Affected Environment

Executive Order 12898 directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law (see Appendix F, Section 1.6, Environmental Justice), for details about this Executive Order). Appendix F, Table 13, identifies environmental justice study area communities; nearly all communities listed are environmental justice communities based on minority and/or low-income metrics. The communities that did not meet the criteria are Fairbanks, Wiseman, and Bettles. Communities in the study area with proportionally larger Alaska Native populations often have the highest poverty rates. Statewide, the average percentage of Alaska Natives living in poverty during the 2013 to 2017 period was higher than any other racial or ethnic group and more than 3 times that of whites (U.S. Census Bureau 2019). Generally, unemployment within the study area communities is high, with typical unemployment rates in the double digits.

Environmental Consequences

<u>Road Impacts</u>

No Action Alternative Impacts

The No Action Alternative would not result in any impacts to areas of potential environmental justice concern listed in Appendix F, Table 13, and therefore would have no disproportionately high and adverse effects on minority and low-income populations. The economic conditions at the local, regional, and state level would be expected to continue along current trends (e.g., high levels of unemployment, low incomes, high costs of living).

Impacts Common to All Action Alternatives

The impacts to minority and low-income populations would be similar for all action alternatives regardless of project phase. The notable difference in impacts is that Alternative C would be more likely to affect Hughes and less likely to affect Bettles and Evansville than would Alternatives A and B. All alternatives would affect Kobuk by direct road connection, and Shungnak and Ambler because they are relatively close to Kobuk and the project. Implementation of any action alternative could result in adverse effects to the areas of potential environmental justice concern listed in Appendix F, Table 13, and these effects would likely be predominantly borne by minority and low-income populations and would be appreciably more severe than those experienced by non-minority or non-low-income populations. Primary factors that may result in disproportionately high and adverse effects on minority and low-income populations include potential reductions in subsistence resource abundance and availability and increased exposure to public health risks.

Subsistence resources (see Section 3.4.7, Subsistence Uses and Resources) are of high importance to the areas of potential environmental justice concern listed in Appendix F, Table 13. Due to their economic, cultural and social dependence on subsistence resources, the minority and low-income populations in these communities would be most vulnerable to the potential reductions in subsistence resource abundance and availability resulting from the project.

In addition, some potential adverse public health impacts (see Section 3.4.5, Socioeconomics and Communities) may be concentrated in areas of potential environmental justice concern. A number of these effects, such as a possible increase in the number of food-insecure households and increases in psychosocial stress at either a household or individual level, may be related to decreased access to subsistence resources. Other potential adverse public health effects that may disproportionately affect minority and low-income populations due to their proximity to the proposed road include increased exposure to NOA materials.

The construction and operation of the proposed road is expected to provide opportunities for workforce training and development and employment for residents of NAB/YKCA communities (see Section 3.4.5, Socioeconomics and Communities), most of which have majority minority populations and large low-income populations. However, the minority and low-income populations in these communities are not expected to receive project-related employment benefits in greater proportion or degree than other populations in the region or the general state population.

Mining, Access, and other Indirect and Cumulative Impacts

Past and present actions that have affected the areas of potential environmental justice concern listed in Appendix F, Table 13, include mining development (e.g., Red Dog Mine), infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, and state and federal hunting and harvesting regulations.

The construction and operation of the proposed road, together with the mining development that the road would support, is expected to result in a reduction in subsistence resource abundance and availability (see Section 3.4.7, Subsistence Uses and Resources, and Appendix H, Section 3.5.7, Subsistence Uses and Resources). This reduction would have a disproportionately high and adverse impact on minority and low-income populations because of their economic, cultural, and social dependence on subsistence resources. Changes in subsistence resource abundance resulting from climate change could contribute to changes in resource availability caused by road construction and mining development, further reducing their availability to minority and low-income populations.

In addition, some potential adverse public health impacts of road construction and mining development may be concentrated in areas of potential environmental justice concern (see Section 3.4.5, Socioeconomics and Communities). A number of these effects, such as a possible increase in the number of food-insecure households and increases in psychosocial stress at either a household or individual level, may be related to decreased access to subsistence resources. Other potential adverse public health effects that may disproportionately affect minority and low-income populations due to their proximity to the proposed road and mining development include increased exposure to NOA materials.

These impacts to minority and low-income populations would be partially offset by increased employment opportunities, expanded public services, and reductions in the cost of living due to changes in the logistics of delivering fuel and freight in some communities. Road and mine construction and operation would provide opportunities for workforce training and development and employment for NAB/YKCA communities, most of which have high minority and low-income populations. Proposed mines located on land owned by NANA (e.g., Bornite Mine) may be developed under an operating agreement specifying that NANA shareholders receive direct and meaningful benefits from development at the mine. In addition, the revenue the NAB and NANA would receive from mining development could be used to support public infrastructure and services in the region. Construction of the proposed road could also reduce the costs of transporting goods to some NAB/YKCA communities and provide increased access to emergency and health care services.

3.4.7 Subsistence Uses and Resources

Affected Environment

Subsistence is a central aspect of rural Alaskan life and culture and is the cornerstone of the traditional relationship of Alaska Native people with their environment. Residents of the study communities rely on subsistence harvests of plant and animal resources both for nutrition and for their cultural, economic, and social well-being. Activities associated with subsistence—processing, sharing, redistribution networks, cooperative and individual hunting, fishing, gathering, and ceremonial activities—strengthen community and family social ties, reinforce community and individual cultural identity, and provide a link between contemporary Alaska Natives and their ancestors. Traditional knowledge, based on a long-standing relationship with the environment, guide these activities. More than just food, subsistence includes economic, social, cultural/traditional, and nutritional elements. In Alaska, a dual management system by the State of Alaska and federal government regulates subsistence hunting and fishing. Subsistence activities on all lands in Alaska, including private lands, are subject to state or federal subsistence regulations, with the state managing harvest of fish and wildlife on privately owned land.

Primary subsistence study communities for this EIS are those located within 50 miles of the project alternatives, or with subsistence use areas documented within 30 miles of the project alternatives. There are 27 primary subsistence study communities (see Appendix F, Table 14, and Volume 4, Map 3-32). In addition, the project is within the range of the WAH, a highly migratory and important subsistence resource to communities in western and northwestern Alaska. While the action alternatives may affect the RMH and HHH, subsistence harvest of these herds is highly limited due to limited access (Pamperin 2015). The EIS analyzes a separate subset of the 42 member communities of the Western Arctic Caribou Herd Working Group (WAH WG; Volume 4, Map 3-32). These caribou subsistence study communities are referred to as the WAH study communities and include overlap with 16 of the primary subsistence study communities listed in Appendix F, Table 14. Inclusion of the WAH study communities captures potential indirect or cumulative impacts to communities who use caribou that migrate through the project area and are harvested elsewhere. The Subsistence Technical Report (Appendix L) provides more detailed resource- and community-specific subsistence use data.

Subsistence Use Areas

Appendix L, Maps 2 through 27, depict subsistence use areas for all resources for individual subsistence study communities. Sixteen of the 27 study communities have use areas overlapping with 1 or more of the project alternatives (see Appendix F, Table 14). The remaining 11 study communities have subsistence use areas within 30 miles of 1 or more of the project alternatives or are within 50 miles of a project alternative.

Communities closest to the project alternatives (i.e., within 30 miles) include those surrounding the Koyukuk River (Alatna, Allakaket, Bettles, Coldfoot, Evansville, Hughes, Wiseman), Kobuk River (Ambler, Shungnak, Kobuk), and Yukon River (Rampart, Stevens Village, Tanana). Additional study communities in the Kotzebue Sound and Kobuk River regions (Kiana, Noorvik, Buckland, Selawik, Noatak, Kotzebue) harvest resources to the west and downstream from the project alternatives. Communities in the Koyukuk, Tanana, and Yukon River regions (Huslia, Galena, Beaver, Nenana, Minto, Manley Hot Springs) harvest resources to the south and east of the project alternatives. Anaktuvuk Pass (on the North Slope but included in the Koyukuk River region study communities) harvests resources to the north of the project alternatives.

Subsistence use areas for the Kobuk River region study communities (Ambler, Kobuk, Shungnak, Kiana, Noorvik) are focused around the Kobuk River, but extend south toward the Koyukuk River drainage and north into the Brooks Range and as far as the North Slope of Alaska (Appendix L, Maps 2 through 6). Residents' subsistence uses also extend downriver and into the marine waters of Kotzebue Sound and the Chukchi Sea. More recently documented subsistence use areas (Watson 2018; Satterthwaite-Phillips et al. 2016) indicate a smaller extent of overland travel. In particular, recent studies show less extensive travel to the north of the study communities into the Brooks Range and onto the North Slope. Watson (2018) suggests that some of the shifts in use areas may reflect changes in WAH migratory routes; changes in traditional hunting methods to avoid diverting caribou during their fall migration (i.e., hunting them farther south); decreased need for extensive overland travel (e.g., less reliance on furbearer trapping); and increased reliance on fish resources (i.e., greater focus on riverine use areas). Except for Noorvik, subsistence use areas for Kobuk River region study communities overlap with the western portion of the project alternatives.

Subsistence use areas for the Kotzebue Sound region study communities (Kotzebue, Buckland, Selawik, Noatak) are focused around Kotzebue Sound; the Chukchi Sea coast; and lands and rivers surrounding Kotzebue Sound, including the Brooks Range and the Noatak, Kobuk, Selawik, and Buckland rivers (Appendix L, Maps 7 through 10). More recently documented subsistence use areas for these study communities (Satterthwaite-Phillips et al. 2016) indicate a smaller extent of overland travel. Subsistence use areas for Kotzebue Sound region study communities do not overlap with the project alternatives but occur downriver from the alternatives or approach the project alternatives in overland areas from the west and north.

Subsistence use areas for the Koyukuk River region study communities for this project (Alatna, Allakaket, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Huslia, Wiseman), are focused around the upper and lower Koyukuk River drainages and various tributaries of the Koyukuk River, the upper Kobuk River, and overland areas surrounding the Koyukuk River and into the Brooks Range (Appendix L, Maps 11 through 19). Use areas for the northernmost Koyukuk River region study community of Anaktuvuk Pass extend onto the North Slope of Alaska and as far north as Nuiqsut, while use areas for the southernmost community of Huslia extend west to Kotzebue Sound and south to the Yukon River. More recently documented subsistence use areas for the study communities indicate various changes to contemporary subsistence use areas compared to historic use areas, including certain changes brought about by establishment of GAAR (Watson 2018; SRB&A n.d.). Koyukuk River region use areas for all communities overlap with various portions of the project alternatives.

Subsistence use areas for the Tanana River region study communities (Tanana, Manley Hot Springs, Minto, Nenana) are focused around the Tanana River, Yukon River, Nenana River, and Minto Flats (Appendix L, Maps 20 through 23). For road-connected communities (e.g., Manley Hot Springs, Minto, Nenana) use areas also occur along the Parks, Elliott, Steese, and/or Dalton highways. In the case of Nenana, documented use areas occur as far west as the Koyukuk River. Tanana use areas overlap with the southern portion of the project area.

Subsistence use areas for the Yukon River region study communities (Stevens Village, Rampart, Galena, Beaver) are focused around the Yukon River system, extending from the Chalkyitsik area to the mouth of the Koyukuk River, in addition to along the Koyukuk River toward Alternative C near Hughes (Appendix L, Maps 24 through 27). A majority of use areas for the Yukon River region study communities are located to the east and south of the proposed project alternatives.

Timing of Subsistence Activities

Data on the timing of subsistence activities are available for all 27 subsistence study communities. The seasonal round of subsistence activities is similar with some variation by community and region. Across all regions, spring was traditionally centered around muskrat and waterfowl hunting at spring camps and preparation for the busy salmon harvesting season (YRDFA 2008). While residents no longer use spring muskrat camps regularly, some hunting of muskrats and beaver continues to occur, and waterfowl hunting remains an important spring activity (Braem et al. 2015). When available, residents may hunt WAH during their spring migration north. Spring carnivals are important regional events, particularly for Kobuk and Koyukuk river communities, which center on the harvest and sharing of subsistence foods (Watson 2018). In summer, residents set nets for salmon, sometimes while staying at traditional fish camps, with vegetation harvesting and large land mammal hunting also occurring during this time. Harvesting of sheefish during their summer runs is a key summer activity for Kobuk River communities. Large land mammal hunting begins in summer but peaks during fall, when residents hunt for caribou, moose, bear, and Dall sheep. Residents also hunt waterfowl in fall as they migrate south (Betts 1997). In fall, non-salmon fish (e.g., grayling, whitefish) replace salmon as the primary fish resource, with target species varying by community and region (Betts 1997; YRDFA 2008; Marcotte and Haynes 1985). Fall is also an important time for berry picking. Hunting and fishing (through the ice) continues at somewhat lower levels into winter. Residents may harvest moose for potlatches during winter, and some individuals also trap and hunt for beaver and other furbearers (e.g., wolf, wolverine, lynx, marten, fox) in winter. When caribou migrate into the region during winter, hunters from the Kobuk and Koyukuk river regions may travel by snowmobile—sometimes great distances—to harvest them (Watson 2018). Residents also harvest ptarmigan during winter when available.

Harvest Data

Appendix F, Table 15, provides average harvest and participation data for all resources for the 27 subsistence study communities, Appendix F, Table 16, provides average moose harvest and participation data for the 27 subsistence study communities, and Appendix F, Table 17, provides average caribou use and harvest data for the 42 caribou study communities. Use of subsistence resources among the study communities is high. On average, between 96 and 100 percent of households in the study communities report using subsistence resources on an annual basis, and between 75 and 100 percent of households report participating in subsistence activities. On average, subsistence study communities harvest 576 pounds of subsistence resources (in terms of edible pounds) per capita annually. The highest average harvest is in Tanana (2,157 pounds), followed by Huslia (1,082 pounds), Fort Yukon (999 pounds), and Hughes (926 pounds). Regarding percentage of overall harvest, large land mammals and salmon are the top resource harvested in 12 study communities. Non-salmon fish is the top harvested resource in 2 study communities (Selawik and Noorvik). In general, large land mammals, salmon, and non-salmon fish comprise the top 3 resource categories harvested by most of the study communities, although marine mammals, migratory birds, vegetation, and upland game birds also appear among the top resources for some study communities.

Moose is a key large land mammal resource among many of the study communities and therefore species-specific data are provided in Appendix F, Table 16. On average, between 25 and 100 percent of the subsistence study communities report using moose (64 percent of households across all communities). Nearly half of households report attempting harvests of moose. Moose harvests account for up to 51.5 percent of subsistence harvests in the study communities and provide between 7 and 198 pounds per capita, on average. Communities harvesting the most moose per capita (over 100 pounds annually) include Rampart, Tanana, Galena, Alatna, Hughes, Wiseman, and Huslia. Data on use and harvests of caribou are provided in the following section.

Subsistence Uses of the Western Arctic Herd

Appendix F, Table 17, provides caribou use and harvest averages across all available study years for the 42 caribou study communities listed in Appendix F, Table 14, and depicted on Volume 4, Map 3-32. The 42 caribou study communities are members of the WAH WG and are subsistence users of the WAH. Caribou is a key subsistence resource for many of the WAH WG study communities. With few exceptions, use of caribou among the 42 study communities is high, with more than 50 percent of households in 30 of the 42 study communities using caribou. The contribution of caribou toward the total subsistence harvest is highest in the communities of Anaktuvuk Pass, White Mountain, Ambler, Shungnak, Deering, Koyuk, Noatak, and Buckland. Caribou contributes an average of at least one-third of the total harvest in those communities. Caribou sharing ranges widely, with between 2 and 71 percent of

WAH WG households giving caribou, and between 3 and 84 percent receiving caribou. On average, caribou contribute approximately 25 percent toward the total harvest for the study communities. Nearly half of households (48 percent) participate in caribou hunting, and residents harvest an average of 101 pounds of caribou annually (Appendix F, Table 17).

Environmental Consequences

Road Impacts

The following sections describe the potential impacts of the proposed road to subsistence uses and resources. Further discussion of potential impacts resulting from the project is provided in the Subsistence Technical Report (Appendix L) and the ANILCA Section 810 Preliminary Evaluation (Appendix M). A summary of community use areas crossing each alternative is provided in Appendix F, Table 18, while resource-specific data are provided in Appendix L. Based on these data, the project crosses subsistence use areas for 16 of the 27 subsistence study communities (Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village, Tanana, Wiseman). Subsistence use areas are most commonly crossed for small land mammals (15 communities), caribou and moose (12 communities each), and non-salmon fish and vegetation (10 communities each). Most of these resources (moose, caribou, vegetation, non-salmon fish) are of high importance to a majority of the potentially affected communities. In the case of small land mammals, these resources are generally of low to moderate resource importance to the study communities (see Appendix L). While trapping and hunting of furbearers and small land mammals occur among a smaller subset of community harvesters and provide a minimal amount in terms of subsistence foods, these activities are an important component of the local economy and culture, and furbearer harvesters often expend considerable time, money, and effort in their pursuits. The study communities with the highest numbers of resource uses crossed by the proposed project alternatives are Hughes, Kobuk, Shungnak, Allakaket, Ambler, Bettles, and Evansville (8 or more resources out of 14 resource categories).

No Action Alternative Impacts

The No Action Alternative would not result in any changes to subsistence activities among the subsistence study communities.

Impacts Common to All Action Alternatives

All action alternatives could impact subsistence resource abundance and availability as well as user access in the project study area. These impacts are discussed below. See also Appendices L and M for additional discussion of project impacts to subsistence.

Resource Abundance

Construction activities that could affect resource abundance through removal or disturbance of spawning, foraging, and nesting habitat include blasting/mining, operation of construction equipment, excavation, placement of gravel, construction noise, human presence, water withdrawal, installation of bridges and culverts, and air and ground traffic. Construction activities may also cause direct mortality to individual animals (e.g., caribou, fish, moose, waterfowl) through vehicle and aircraft collisions, pile driving, and blasting.

Operation activities that could affect resource abundance include the presence of roads and bridges (e.g., habitat fragmentation), the presence of other infrastructure (e.g., communications towers, culverts), fuel or other contaminant spills, dust deposition, road and air traffic, and human activity. The presence of the road in addition to related culverts, bridges, and gravel infrastructure would alter and impact fish habitat upstream and downstream from the road, which could affect fish abundance for subsistence users in certain waterways crossed by the road. It is not possible to predict the location and magnitude of such changes, although key sheefish spawning areas in the Kobuk River drainage and whitefish spawning in the Alatna River may be particularly vulnerable to population-level impacts (Section 3.3.2, Fish and Amphibians).

Habitat fragmentation resulting from sustained disturbances to caribou and other mammal and bird resources along the proposed road could result in decreased abundance of these resources over time. In the case of caribou, other Alaska herds such as the Central Arctic Herd have maintained habitat connectivity and general migration patterns despite being intersected by highways and roads. While the project represents a small proportion of the total WAH and RMH ranges, fragmentation of the ranges resulting from a road may be more pronounced because the WAH and RMH ranges have had less exposure to development infrastructure and activities than other herds such as the Teshekpuk and Central Arctic herds (see Section 3.3.4, Mammals). The likelihood of longer term impacts on resource abundance vary by resource and are discussed below under the individual alternatives, Indirect and Cumulative Impacts, and individual biological resources subsections in Section 3.3, Biological Resources. Appendix L includes additional information on longer term impacts.

As with construction, some direct mortalities may occur as a result of collisions with vehicles, aircraft, or infrastructure during operations. Individual mortalities of terrestrial mammals and birds would be most common under Phase 3 when traffic levels are highest. Collisions with caribou are most likely to occur within the western portion of the road corridors where caribou density is higher.

Ingestion of contaminated water or vegetation as a result of spills could also cause illness in individual animals. Larger hazardous materials spills into waterways would have larger effects on fish habitat and abundance, particularly if spills occur in sheefish, whitefish, or salmon spawning streams, and could have population-level effects. For additional discussion of potential impacts to resource abundance resulting from operation, see Appendix L and Section 3.3, Biological Resources. See Section 3.2.3, Hazardous Waste, for a discussion of spills.

Resource Availability

Many of the subsistence study communities have high unemployment rates, incomes below the poverty line, and high food insecurity (Guettabi et al. 2016). Despite these factors, community populations are stable. Subsistence activities and harvests are a key component in maintaining residents' ability to remain in their communities (Guettabi et al. 2016). Because of the importance of subsistence to maintaining the stability of the mixed economy and resilience of the study communities, these communities are also particularly vulnerable to impacts on subsistence harvests and subsistence resource availability. Furthermore, many of the subsistence study communities do not currently have road access and most Alaska Native populations have specific cultural, social, and spiritual identities and needs that are inextricably linked to subsistence, which adds to vulnerability associated with change introduced through an industrial road. These communities would be most vulnerable to potential impacts to subsistence resource availability resulting from the project.

Construction activities that may affect resource availability for subsistence users include excavation, blasting, mining, ROW clearing, gravel placement, operation of construction equipment, general construction noise, human activity, vehicle and air traffic, sedimentation, and fuel or other contaminant spills. Infrastructure such as the pioneer road, material sites, culverts, and bridge piles may also pose physical obstructions for terrestrial mammals and fish. Impacts of infrastructure on resource availability are further discussed in Appendix L and below, under Operation. The 16 communities that have use areas overlapped by project alternatives would experience direct impacts to resource availability. Larger impacts to resource behavior, migration, or distribution could result in indirect impacts to resource availability for all 27 subsistence study communities, and in the case of caribou, the 42 caribou study communities. Impacts to individual study communities are discussed in more detail in Appendix L.

In the short term, blasting and ROW clearing may displace or divert subsistence resources such as large and small land mammals and waterfowl due to the noise associated with such activities. These activities would also impact vegetation and surrounding habitat for subsistence resources such as caribou, moose, and waterfowl, and would remove berry, wild plant, and wood harvesting areas for study communities along the road corridor. Noise from construction equipment, gravel placement, blasting, mining, vehicle traffic, aircraft and helicopters, and human activity would likely displace or divert subsistence resources such as caribou, moose, bear, small land mammals, and waterfowl. Traffic itself causes a physical barrier for migratory animals, particularly caribou, and could also displace or divert resources when herds are separated (Vistnes and Nellemann 2007). Some animals, such as certain species of small land mammals and caribou, can become habituated to development activities over time; however, this habituation could result in changes to resource distribution and may also cause increased mortalities due to vehicle strikes (see Section 3.3.4, Mammals).

Potential effects of construction activities on resource availability also include contamination resulting from fuel and other chemical spills, dust deposition, sedimentation due to erosion along river and stream banks, and increased emissions. Construction activity may lead to concerns by local residents about contamination of subsistence resources, particularly plants and berries, which are of high importance to nearly all potentially affected communities and which could be directly affected by fugitive dust along the road corridors. This concern would be especially elevated in areas where NOA is exposed during construction or contained in the gravel fills used for the project. Fuel spills and erosion may also result in contamination of waterways, affecting fish and other animals who ingest contaminated water. Contamination or perceived contamination can have indirect effects on subsistence, as subsistence users may reduce their consumption of a resource if they fear contamination; therefore, resources perceived as unhealthy or contaminated are considered unavailable to local residents.

The potential for impacts to resource availability resulting from hunting or fishing by construction workers is a key concern that has been raised by the study communities. This analysis assumes no road users authorized by AIDEA (e.g., construction workers, vehicle operators) would be allowed to hunt or fish from project facilities. Potential mitigation measures presented in Appendix N (Section 3.4.7, Subsistence Uses and Resources) include a measure to this effect; the BLM would have the authority to enforce such restrictions on BLM-managed lands only, however. AIDEA could adopt this measure as an overall design feature of its own, and it would then apply throughout the length of the project. Public access to the area by the general public and project workers for hunting or fishing via the proposed road would not be allowed. It is possible that once the area is known to more people, they may visit the area (via airplane, OHV, or snowmobile) and access public lands to engage in harvesting activities, which could increase the number of hunters in the area over time and reduce resource availability for local residents. However, potential mitigation measures in Appendix N include design features proposed by AIDEA to monitor road activity and staff gates around the clock to minimize such use.

See Appendix L for more detailed discussions of potential impacts to the availability of caribou, moose, fish, and vegetation to the study communities.

Disturbance, displacement, or contamination of subsistence resources during operations could result in those resources being unavailable at the time and place that local harvesters are accustomed to finding them. In general, impacts would be similar to the construction impacts (discussed above) pertaining to traffic, dust deposition, human activity, contamination, and infrastructure. However, the impacts would occur over a longer period and would occur with either greater or lesser frequency or intensity depending on the impact source. Under Phase 3, the final road would be larger and access roads and maintenance stations would be in place; therefore, infrastructure-related impacts on resource availability during operations would be more likely than during construction. Overall, decreased availability of resources resulting from project operations may result in residents having to travel farther to access subsistence resources, with greater risks to safety and greater expenditures of time, effort, and money.

Sources of noise from maintenance and operation of the road would include vehicle traffic, small fixed-wing aircraft, helicopters, maintenance equipment and activities (e.g., grading, sanding, plowing, gravel placement), and human activity. The frequency of truck traffic would increase over the 3 project phases, and would be higher once mine exploration and development began, with 104 to 168 trips per day during peak mine production (see Appendix H, Table 2-7). Increased traffic along the Dalton Highway may also displace caribou from the HHH, affecting resource availability to users of that herd, although documented use of the herd by local residents is limited. Air traffic levels would be slightly lower under operation. While overall ground traffic would be higher during mine production, human activity would be lower once construction is complete. During road operations, the final 2-lane road combined with an increase in traffic would likely increase the potential for deflection or delay of caribou movements, particularly during the fall migration south (see above under Construction), a peak hunting time for the study communities. In other rural communities where roads have been built, access to private roads has in some way offset some of the impacts to resource availability; however, AIDEA's proposal would prohibit local public access along the road and this lack of access to local hunters would introduce subsistence impacts with no offsetting subsistence benefit.

Stream and riverbeds may experience increased sedimentation or alteration over time due to the presence of culverts and bridge piers. If culverts and bridges are not properly maintained or if erosion control measures are not taken, fish migrations could be disrupted or blocked, which could reduce fish availability for subsistence users. In addition, many of the proposed culverts as currently proposed by AIDEA would likely not be large enough to allow for adequate fish passage, increasing the likelihood for impacts to resource availability for subsistence users in certain waterways (see Section 3.3.2, Fish and Amphibians). The risk of contamination from dust deposition and fuel would continue through the life of the project, and depending on the magnitude of spills could have far-reaching impacts on upstream and downstream subsistence users. Gravel mining and associated blasting would continue throughout operations for roadway maintenance; therefore, some individual loss or displacement of fish would continue during operations.

User Access

Sixteen of the 27 subsistence study communities have subsistence use areas crossing 1 or more of the proposed road corridor alternatives (see Appendix F, Table 18, and Appendix L). These communities would be the most likely to experience direct impacts to user access resulting from the proposed road. Of these communities, 5 (Bettles, Evansville, Hughes, Kobuk, Shungnak) have use areas that are bisected by the road, meaning that access to a large portion of their hunting, fishing, and gathering areas would require crossing the road (depending on the chosen alternative). Alatna, Allakaket, and Ambler use areas are also crossed but to a lesser degree (i.e., the road intersects a portion rather than through the center of their use areas) than the above 5 communities. The subsistence activities that most commonly occur near the proposed corridors include hunting and trapping of small land mammals and furbearers, hunting of moose and caribou, vegetation harvesting, non-salmon fish harvesting, and migratory bird hunting. Other resource harvesting activities that could be affected include other large land mammal (Dall sheep and bear) hunting, upland game bird hunting, salmon fishing, and to a lesser extent, egg harvesting.

Impacts to harvester access would occur near the road corridor, where harvesters could be faced with physical obstructions to access or be forced to avoid construction work areas. Construction infrastructure (e.g., the pioneer road, construction laydown materials, and heavy equipment) could present physical barriers to subsistence users. For example, hunters may not be able to cross over a high road on their snowmobiles, particularly if they are pulling a heavy load. In addition, individuals traveling overland may have to divert around material sites and other areas that are unsafe for travel. AIDEA has proposed working with subsistence users to provide crossing ramps to provide access to their subsistence resources (see potential measures in Appendix N, Section 3.4.7). Although the road would include crossing ramps for local residents to use when traveling overland, these likely would not be in place until Phase 2 or 3 of the project; therefore, the road is more likely to pose a physical obstruction to overland travel during the construction phase. In addition, hunters may not be permitted to cross construction-phase roads until crossing areas are established, which would obstruct travel altogether for a period of time. It is anticipated that bridges would be designed with adequate clearance. However, it is possible that bridges may also obstruct boat travel along certain smaller waterways; the likelihood of this impact depends on individual bridge height and design.

The degree of impacts from construction would depend on whether the timing of construction activities conflicts with subsistence use areas and activities for a community. Because construction would occur year-round, it is likely that there would be direct conflicts with construction activities for certain subsistence uses. According to data collected for several communities whose use areas are bisected by the project alternatives (Hughes, Bettles, Evansville), in addition to several additional communities whose use areas overlap with portions of the project (Alatna, Allakaket, Wiseman/Coldfoot), residents of the region primarily use boats and snowmobiles to access hunting and gathering areas, although road-connected communities (Wiseman/Coldfoot) also commonly use road vehicles to access harvesting areas (see Appendix L; SRB&A n.d.; Watson 2018). Subsistence activities occur year-round, peaking in fall (August and September) and again in mid-winter and early spring (February through April) for most study communities with available data. The project corridors cross areas used for both riverine and overland travel (see Appendix L), and construction activities would occur year-round; therefore, residents may experience impacts from construction during all subsistence seasons and for all subsistence activities that are overlapped by the project.

In addition to physical barriers to subsistence users during construction, residents may also experience reduced access due to security restrictions around construction work areas or general avoidance of development areas. Regardless of regulatory and physical barriers in the project area, subsistence users may choose not to access nearby subsistence use areas any longer because construction-related sites, smells, lights, noises, and activities could disturb resources, reduce the potential for a successful harvest, and impact the harvester’s experience. In addition, residents may avoid hunting near the road due to concerns about shooting near infrastructure and human activity, lack of knowledge regarding security protocols, contamination concerns, and general discomfort with conducting traditional subsistence activities near non-local workers and industrial activity. In addition, shooting from or across a road is contrary to Alaska law. For additional discussion of potential avoidance related to the project, see Appendix L.

As noted above, 16 of the 27 subsistence study communities have subsistence use areas crossing 1 or more of the proposed road corridor alternatives, and the road and other project related infrastructure would represent a direct reduction of traditional subsistence hunting and harvesting areas for these communities. During road operation, residents would continue to experience physical barriers to access resulting from infrastructure such as roads, although the presence of crossing ramps would help reduce those impacts. Whether crossing ramps would reduce access impacts for local hunters would depend on the location, design, and frequency of the ramps. Because subsistence users do not always use or follow established trails when pursuing resources overland, instead traveling in various directions based on environmental factors (e.g., weather, snow, ice conditions) and traditional knowledge of resource distribution and behavior, the presence of crossing ramps would not completely mitigate impacts to user access. Subsistence users may have to travel additional distances when pursuing resources to locate approved crossing areas, or they may take safety risks by crossing in areas not approved for crossing. In addition, despite the presence of crossing ramps, some individuals may still have difficulty using crossing ramps, especially when hauling sleds. Subsistence users in the North Slope community of Nuiqsut have reported difficulty under certain conditions when using crossing ramps on industrial roads near their community (SRB&A 2018).

While road access for local subsistence users would not be permitted, it is possible that residents from nearby study communities in addition to non-local hunters from other regions would use the cleared ROW alongside the road as a travel corridor for overland (snowmobile or OHV) travel, particularly if resources such as moose concentrate in these corridors. AIDEA indicates that ROW travel would be prohibited and security would patrol the roads to prevent violations. Enforcement measures would reduce, but are not anticipated to stop, all trespass use of the ROW. Restrictions on use of the ROW, particularly by local residents when certain areas of the road would be crossable, may be difficult to enforce. Increased non-local access would be less likely but may affect subsistence uses for residents of the subsistence study communities by increasing human activity and competition in the area. A potential for increased access by outside hunters is a primary concern that has been voiced by a number of subsistence study communities (Watson 2014; BLM 2018a). For additional discussion of potential use of the ROW by local and non-local hunters, see Appendix L.

During operations, harvester avoidance of the project area may be reduced from construction levels due to decreased noise and human activity disturbances, although avoidance responses would likely continue throughout the life of the project for certain individuals. The area of infrastructure-related avoidance by local residents would be larger during operations due to the greater infrastructure footprint. In addition, avoidance may extend to a larger area than the footprint if residents perceive that resources are less available in surrounding areas. Because the road corridor bisects subsistence use areas for 8 communities (Bettles, Evansville, Hughes, Kobuk, Shungnak, and to a lesser extent Alatna, Allakaket, and Ambler), residents from these communities may not have the option to avoid the road altogether to continue accessing traditional subsistence use areas. Therefore, total avoidance of the affected area may be more likely for residents from communities whose use areas are on the periphery of the project area (e.g., Anaktuvuk Pass, Huslia, Kiana, Selawik, Stevens Village, Tanana).

Regardless of alternative, AIDEA has proposed a design feature that would create a subsistence working group, which would be charged in part with identifying road crossing locations used for subsistence and other local travel. For additional details about potential mitigation, see Appendix N, Sections 3.4.2 (Transportation and Access) and 3.4.7 (Subsistence Uses and Resources). Potential mitigation measures also include timing project activities to avoid subsistence activities and, generally, not impeding subsistence. The potential measures are anticipated to be effective in minimizing impacts, but would not completely mitigate them.

Alternative A Impacts

Alternative A crosses subsistence use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman. Therefore, these communities would likely experience direct impacts of Alternative A on their subsistence uses in terms of direct reduction of subsistence use areas, impacts on user access, and direct impacts to resource availability (i.e., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAH WG study communities.

Communities with the highest number of resource uses crossed (5 or more resources) include Bettles, Evansville, Shungnak, Ambler, Coldfoot, Kobuk, and Wiseman. Alternative A bisects community uses (i.e., community residents would need to cross or detour around the road to access a large portion of their subsistence use area) for Bettles, Evansville, Kobuk, and Shungnak; therefore, these communities would be most heavily impacted by Alternative A in terms of access. Bettles, Evansville, and Kobuk would be closest to the road corridor; therefore, they would be more likely to experience benefits of the road regarding lowered costs of subsistence supplies/equipment and other goods if the communities can develop a way to create an access route from their community to the nearby corridor (note: Kobuk is the only community that would have direct access). Appendix H describes communities' anticipated access of the route for commercial deliveries.

Resources for which availability could be directly affected under Alternative A include caribou (9 communities), moose (9 communities), small land mammals (8 communities), migratory birds (6 communities), Dall sheep (6 communities), and vegetation (6 communities) (see Appendix F, Table 18, and Appendix L). Of these resources, moose, caribou, and vegetation are resources of high importance to a majority of the potentially affected study communities. For a smaller number of communities, harvests of salmon, non-salmon fish, bear, and eggs could be directly affected.

Alternative A crosses through key migratory range for the WAH and could therefore affect the availability of WAH to the south (in fall) and north (in spring/summer) of the road. The road runs perpendicular to the primary direction of movement during migration, increasing the likelihood of caribou being diverted and delayed during migration. Caribou would cross the Alternative A corridor during fall and winter (Section 3.3.4, Mammals). Alternative A is to the north of a majority of the study communities whose caribou hunting activities peak in fall (see Appendix L). Large deflections of caribou to the north of these communities during fall could substantially impact resource availability to subsistence harvesters. The likelihood of large deflections would vary annually based on environmental and development-related (e.g., traffic and noise levels) factors. The importance of maintaining the north-south migration is evident in traditional hunting methods that place hunting camps to the south of rivers and allow the first of the caribou herd to pass by before hunting them (WAH WG 2017). Direct impacts to caribou availability along the road corridor resulting from smaller-scale disruptions may occur for the communities of Bettles, Evansville, Shungnak, Ambler, Kobuk, Alatna, Allakaket, Anaktuvuk Pass, and Selawik. For Anaktuvuk Pass, the road corridor is on the periphery of their caribou hunting areas. Larger-scale disruptions may extend to other harvesters of the WAH. Alternative A does not occur within the range of the RMH. Traffic increases on the Dalton Highway may affect the HHH and subsistence activities near the Dalton Highway.

Under Alternative A, fish availability could be directly affected for 4 study communities: Bettles, Evansville, Shungnak (for salmon), and Ambler. Non-salmon fish are a resource of high importance to these communities (see Appendix L). In particular, sheefish spawning grounds, which are particularly sensitive to changes in environmental conditions, occur along the Alatna and Kobuk rivers, which are crossed by the Alternative A corridor. Any impacts from construction or operation of the road corridor that change water quality downstream could affect sheefish spawning grounds, which could impact communities downstream from the corridor on the Koyukuk and Kobuk river drainages (Alatna, Allakaket, Hughes, Huslia, Ambler, Kobuk, Shungnak, Kiana, Noorvik). These communities could experience indirect impacts if larger changes to fish health or availability occur. Alternative A has a greater potential to directly affect sheefish spawning grounds compared to Alternative C. In addition to sheefish spawning grounds, Alternative A also crosses streams in the Upper Koyukuk drainage (Alatna River, Henshaw Creek, North Fork Koyukuk River, Wild River, John River), which support spawning for Chinook, chum salmon, and whitefish. Impacts to these spawning grounds could also have larger impacts to communities that harvest salmon downstream from the road corridor.

Alternative B Impacts

Alternative B is similar to Alternative A regarding the communities that could be directly affected and the nature of the potential impacts. Alternative B crosses use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman (see Appendix F, Table 18, and Appendix L). Therefore, these communities would likely experience direct impacts from Alternative B on their subsistence uses regarding direct reduction of subsistence use areas, impacts on user access, and direct impacts to resource availability (i.e., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). The primary difference between Alternatives A and B regarding direct community impacts is that the route would not overlap with migratory bird hunting areas for Ambler but would overlap with vegetation harvest areas for that community. Alternative B would cross within approximately 7 miles of sheefish spawning habitat on the Reed River, introducing higher potential for degradation and contamination of that habitat from spills (Section 3.3.2, Fish and Amphibians). For caribou, the effects would the same as under Alternative A (Section 3.3.4, Mammals). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAH WG study communities.

Alternative C Impacts

Alternative C crosses use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village, and Tanana. These communities would likely experience direct impacts from Alternative C on their subsistence uses regarding direct reduction of subsistence use areas, impacts on user access, and direct impacts to resource availability (i.e., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAH WG study communities. However, large migratory changes are less likely under Alternative C than Alternatives A and B because Alternative C does not intersect as much of the WAH's migratory range.

Communities with the highest number of resource uses crossed (5 or more resources) include Allakaket, Hughes, Kobuk, Shungnak, Ambler, Stevens Village, and Alatna. Alternative C bisects community uses (i.e., community residents would need to cross or detour around the road in order to access a large portion of their subsistence use area) for Hughes, Kobuk, and Shungnak; therefore, in terms of access these communities would be most heavily impacted by Alternative C. These communities would also be most likely to experience benefits of the road related to lowered costs of subsistence supplies/equipment and other goods if these communities can develop a way to create an access route from their community to the nearby corridor. The community of Kobuk would be located directly along the Alternative C route and Hughes is within 4 miles of the route. Appendix H describes communities' anticipated access of the route for commercial deliveries.

Resources for which availability could be directly affected under Alternative C include small land mammals (11 communities), caribou (10 communities), non-salmon fish (8 communities), moose (8 communities), bear (7 communities), vegetation (6 communities), migratory birds (6 communities), and salmon (5 communities) (see Appendix F, Table 18, and Appendix L). For a smaller portion of communities, harvests of Dall sheep and upland game birds could be affected. For a majority of the study communities, caribou, moose, non-salmon fish, salmon, and vegetation are resources of high importance (see Appendix L). Alternative C would have greater noise impacts compared to Alternatives A and B as it would affect more previously undisturbed land than Alternatives A and B, and noise would spread wider under Alternative C due to terrain differences. Therefore, impacts on resource availability and user avoidance related to noise may occur over a greater area under Alternative C (Section 3.2.6, Acoustical Environment).

Alternative C does not cross through the primary migratory range for the WAH and does not intersect the primary north-south movement of the herd. Therefore, the alternative would be less likely to affect WAH migration routes and behavior and less likely to have direct and indirect effects on resource availability for the caribou study communities. However, Alternative C does occur within the wintering grounds for the WAH and affects an overall greater amount of WAH habitat; therefore, direct impacts to caribou availability along the road corridor may occur for the communities of Allakaket, Hughes, Kobuk, Shungnak, Ambler, Alatna, Huslia, Anaktuvuk Pass, Selawik, and Tanana, all of which have caribou hunting areas overlapped by the alternative. For Anaktuvuk Pass, the road corridor is on the periphery of their caribou hunting areas. Alternative C bisects the overall and summer ranges of the RMH. Due to the small population size and herd range, impacts to the RMH could be amplified; however, the RMH is difficult to access and hunted by the subsistence study communities only occasionally so direct impacts to local hunters would be possible but unlikely. Alternative C would not affect the HHH.

Compared to Alternatives A and B, Alternative C crosses areas of higher value moose habitat and therefore could have greater impacts to moose availability in nearby communities. Impacts would be relatively localized along the road system, and therefore would affect communities who have the highest reliance on moose and moose hunting areas closest to the road corridor (e.g., Hughes, Huslia, Alatna, Allakaket). Alternative C could directly affect fish availability for a greater number of communities than Alternatives A and B (8 communities versus 4). Alternative C crosses the Kobuk River directly downstream from sheefish spawning habitat. Therefore, any changes to waterways that obstruct access to spawning grounds or affect water quality could have larger indirect impacts to communities who harvest sheefish upstream and downstream from the road corridor (Alatna, Allakaket, Bettles, Evansville, Hughes, Kobuk, Shungnak, Ambler, Huslia, Kiana). However, Alternative C would be less likely to have direct impacts on sheefish spawning grounds. In addition, while Alternative C would cross more fish streams than Alternatives A and B, it would construct more bridges and fewer minor culverts, which are more likely to obstruct fish passage. In addition to sheefish spawning grounds, Alternative C also crosses streams that support spawning for Chinook and chum salmon. Impacts to salmon spawning grounds could also have larger impacts to communities that harvest salmon downstream from the road corridor along the Yukon and Koyukuk rivers.

Mining, Access, and other Indirect and Cumulative Impacts

The cumulative impacts to subsistence resulting from the proposed road and other reasonably foreseeable developments could result in reduced harvesting opportunities for local residents and alterations in subsistence harvesting patterns (see Appendices H, L, and M). A recent study comparing road-connected to non-road-connected communities showed that road-connected communities have substantially lower subsistence harvests than non-road-connected communities (Guettabi et al. 2016). The study's road-connected communities were located on publicly-accessible roads in more densely populated areas, and therefore the study is not directly comparable to this project because the currently proposed road is an industrial access-only road. AIDEA has proposed allowing some commercial access to communities, which could result in increased access to and decreased costs of goods, such as food and equipment. While the project may not reduce subsistence harvests to levels seen along other road-connected communities in the state, the combination of reduced resource availability, decreased user access, increased income (for some communities), and increased access to commercial goods (for some communities), would likely alter subsistence harvesting patterns across the region and affect overall subsistence harvests for certain communities. Decreased harvests among the study communities could have wide-ranging effects due to the potential impacts on sharing networks within the region in addition to networks that extend to other regions (Kofinas et al. 2016). Sharing is central to subsistence and is a key value across the study region. Decreased harvests could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed.

Indirect and cumulative impacts of Alternatives A and B related to resource abundance and availability would likely be greater than those under Alternative C, as they would be more likely to affect resource availability of migrating caribou to the subsistence study communities, particularly during fall, and are most likely to have population-level effects on sheefish and whitefish, key subsistence species among the study communities. However, impacts related to user access and on resource availability along the road corridors would be similar across all alternatives and would affect a similar number of study communities.

When subsistence users' opportunities to engage in subsistence activities are limited, their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited. If residents stop using portions of the project area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about those traditional use areas would be diminished. While communities would likely maintain a cultural connection to these areas and acknowledge them as part of their traditional land use area, the reduction in direct use of the land could lead to reduced knowledge among the younger generation regarding place names, stories, and traditional ecological knowledge associated with those areas. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of affected communities. Any changes to residents' ability to participate in subsistence activities, harvest subsistence resources in traditional places at the appropriate times, and consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

3.4.8 Cultural Resources

Affected Environment

Cultural resources include archaeological, historical, and architectural resources; structures; travel corridors; and places of religious, spiritual, or cultural significance to tribes, including Traditional Cultural Properties (TCPs), Sacred Sites, traditional use areas, cultural landscapes, and geographic features. The study area for cultural resources extends for 5 miles on either side of each action alternative and related infrastructure components. This buffer is assumed to capture all traditional land-use patterns that may have occurred in the region, throughout history. The study area crosses a large portion of Interior Alaska, which Alaska Natives have used for thousands of years.

The data for the cultural resource analysis are compiled from the National Register of Historic Places (NRHP), the Alaska Heritage Resources Survey (AHRS) database (ADNR 2019), the ADNR Division of Mining, Land and Water RS2477 trails database (ADNR n.d.), and recent cultural resources investigations and ethnographic studies within the study area (e.g., Blanchard et al. 2014a, 2014b, 2015; Watson 2018), the Cultural Data Gap Report (Appendix K) that was developed for the proposed project, and an archaeological sensitivity model prepared on behalf of this project (Sweeney and Simmons 2019).

Ethnographic Overview

All action alternatives cross the traditional homeland of many Alaska Native groups, including Koyukon and Tanana Athabascans along the southern and eastern portions of the project area, and Iñupiat peoples along the western and northern portions of the study area. The Koyukon traditionally occupied a vast area from the middle Kobuk River, throughout the Koyukuk drainage, to the Yukon River, while the Tanana lived in the Tanana River drainage (Andrews 1977; Simeone 1985). In general, both groups followed a seasonal subsistence pattern where several families would camp at the junction of major rivers and streams during summer to fish and collect game and plant resources, and then relocate to upland lakes during fall to hunt caribou. In early winter, families would build semi-subterranean moss houses, living in them for part of winter. Towards the end of winter when food stores were depleted, family groups would disperse to hunt caribou, harvest small game, and sometimes travel long distances to trade with their Iñupiat partners (Brown 2007).

Historically, individual Iñupiat nations occupied the Kotzebue region (the Qikiqtaġruŋmiut nation), the Kobuk River Valley (the Akuniġmiut, Kuuvaum Kaŋiaġmiut, Kuuŋmiut nations), and the Central Brooks Range (the Tulugagmiut and Nuataaġmiut nations) (Brown 1988; Burch 1998). Iñupiat settlement and subsistence patterns varied somewhat from Athabascan groups. Generally, winter was spent in a sod house in a village of several families, and summers were spent moving between short-term camps in pursuit of seasonal resources. Both villages and short-term camps were located in areas with reliable subsistence resources and fresh water. Villages often had a community men's house called a qargi and a hallmark of Iñupiat culture were pottery or soapstone oil lamps were used to provide heat and light inside houses (Burch 1998; Oswalt 1967).

Caribou was a key subsistence resource and was harvested throughout the year for both Athabascan and Iñupiat groups. Migratory waterfowl, fish, fur-bearing animals, small game, and plants were all harvested for both food and for material resources. Some Iñupiat groups also harvested marine resources (subsistence resources are also discussed in Section 3.4.7, Subsistence Uses and Resources). Variations in subsistence and settlement patterns depended on the seasonal availability and abundance of different resources and the timing of gathering for trading fairs and other events.

There are a number of traditional place-names in the study area, indicating long-term prehistoric and historic land use and complex patterns of trade and migration were present in the region for millennia. Just as they are currently, rivers were heavily used for transportation, and the Kobuk River was a major travel and trade route between the Kotzebue Sound and the Koyukuk River and the central Brooks Range region. Similarly, the Koyukuk River, which flows into the Yukon, was a major transportation route for goods and people into Interior Alaska. Appendix K summarizes additional ethnographic information.

Archaeological and Historic Overview

The archaeology of Interior and Northern Alaska spans nearly 14,000 years of human history. The term "archaeological tradition" is used to describe a recurring assemblage of artifacts that are found together and date to a specific period of time, which archaeologists use to understand and interpret past human behavior and lifeways. Archaeological traditions that are present, or may be present, in the study area include the Paleoindian tradition (13,700 to 9,600 years before present [BP]); American Paleoarctic tradition (11,300 to 7,800 BP); Northern Archaic tradition (7,000 to 3,000 BP); Arctic Small Tool tradition (5,000 to 1,200 BP); Norton Tradition (2,500 to 1,800 BP), which is considered ancestral to the culture and heritage of modern Iñupiat people; and the Athabascan tradition (1,200 BP to approximately 1880 AD), which is considered ancestral to the culture and heritage of modern Koyukon and Tanana people. Appendix F, Table 19, and Appendix K describe these traditions in more detail.

From approximately 1880 on, there was a heavy Euro-American presence in Interior and Northwest Alaska. Between approximately 1850 and 1910, commercial whaling in the Kotzebue Sound and Bering Straits region had a major impact to traditional Iñupiat lifeways, and their economy became increasingly cash-based. During this time, marine resources and caribou herd numbers significantly decreased, likely due to the increased resource pressures from the commercial whaling crews. In the 1880s, the caribou crash became so dire that a famine occurred in Northwest Alaska and the Central Brooks Range, and hundreds of Iñupiat people died or permanently relocated to the coast where marine resources were more readily available (Burch 2012). Beginning the 1880s, miners began prospecting along the Kobuk and Koyukuk rivers and in response, several trading posts were established to supply the miners. The influx of non-Natives into Interior Alaska brought epidemics like measles and influenza, which depopulated whole villages along the Yukon River and its tributaries and had major and lasting impact to Alaska Native communities. Sickness was also compounded by the caribou crash during this time, and many of the individuals that survived were faced with starvation (Brown 2007). Other Euro-American presence also included traders, missionaries, and teachers, many of whom contributed to the establishment of permanent settlements and villages. Appendix K provides additional information on the history and prehistory of the study area.

Previous Cultural Resources Investigations

Archaeological and ethnographic research has been conducted since the nineteenth century in Interior and Northwestern Alaska as a result of early exploration, academic research, and compliance-based work carried out by public and private entities. However, the only archaeological surveys for the project occurred in 2013 and 2014 by Northern Land Use Research, Alaska, on behalf of AIDEA, and included both a reconnaissance survey (Blanchard et al. 2014b) and pedestrian survey (Blanchard et al. 2015) for the route alignments at that time. Very little cultural resources fieldwork has occurred along the Alternative C corridor, with approximately 6 miles of the 2013 reconnaissance survey coinciding with the Alternative C alignment west and north of its intersection with Alternatives A and B. If an alternative is permitted, AIDEA will be required to inventory archaeological, historic, and ethnographic resources within the Area of Potential Effects (APE) for the entire route, according to the stipulations in the Section 106 Programmatic Agreement (Appendix J).

In an effort to understand the types of archaeological resources that are likely to be identified in the direct and indirect APEs and the potential to locate these resources in a large area, Northern Land Use Research, Alaska, prepared a prehistoric archaeological resources sensitivity model specific to the project, using independent and dependent variables (Sweeney and Simmons 2019). The model statistically compared the independent variables associated with prehistoric and protohistoric AHRS resource locations to randomized non-site points within a 20-mile study area centered on the alternative centerlines. This was completed to determine if specific independent variables have a statistically significant association with prehistoric and protohistoric AHRS resource locations within the model's boundary. The model results divided the model study area into high, medium, and low potential zones for cultural resources (see Appendix F, Tables 18 through 20). Although the lack of previous cultural resources surveys in the region limits the accuracy of the model, the model suggests that 80 to 90 percent of the modelled area is either high or medium probability for prehistoric archaeological resources.

Known Resources

A total of 516 previously recorded AHRS sites are located within the study area, as of March 2019 (ADNR 2019). The majority of previously recorded sites are prehistoric, although a portion are historic. Site types include cairns, roads and trails, caribou fences, activity areas, hunting stations, cabins, traps, mining camp remains, historic shelters, and historic debris and artifact scatters. Many of these sites contain subsurface components as established through subsurface archaeological tests (ADNR 2019).

In addition to AHRS sites, this analysis identified 17 RS2477 trails in the study areas. RS2477 derives from Section 8 of the Mining Law of 1866 and provides for ROW for the construction of highways over public lands. Pack trails, sled dog trails, and wagon roads are all examples of RS2477 roads and trails. In general, many RS2477 trails meet the age requirements necessary to be considered historic sites and therefore consideration as historic properties under the NRHP. Appendix F, Table 20, provides information regarding RS2477 trails in the study area.

There are hundreds of traditional place names across the study area. Research has included documentation of Koyukon place names in the communities of Huslia, Hughes, and Koyukuk (McCloskey et al. 2014); documentation of place names in the communities of Alatna, Allakaket, and Hughes (YRDFA 2008); and documentation of place names in Koyukon communities (Jones 1986). GAAR, in association with anthropologist Eileen Devinney, developed the Iñupiaq Place Names project in the 1990s, which compiled Iñupiaq place names from several projects in the region into a single source. The NAB has been recently involved in the Iñuuniałiqput Iḷiḷugu Nunaŋŋuanun (Documenting Our Way of Life Through Maps) compilation of Iñupiaq place names in the region.

Few ethnographic resources have been documented in the study area. Reasons for this include the general overall lack of research in the region and the relatively new addition and focus on resources such as TCPs, Sacred Sites, and cultural landscapes in the cultural resource regulatory review. However, based on the long history of land use in the region, ethnographic resources could exist within the study area and include sites, landscapes, structures, objects, or natural resources such as plants, fish and wildlife, minerals, or water bodies that have legendary, religious, subsistence, or other significance in the cultural system of the group traditionally associated with them.

Environmental Consequences

This section addresses the impacts of the construction, operations and maintenance, and reclamation of the proposed road on cultural resources. Federal agencies encourage environmental review coordination under NEPA and the National Historic Preservation Act (NHPA) (CEQ and ACHP 2013) and coordination of review under these laws is codified in the NEPA's implementing regulations at 40 CFR 1500–1508 (40 CFR 1502.25[a]). While the NHPA deals with a subset of cultural resources known as historic properties, NEPA takes a broader approach and addresses both cultural resources and historic properties. The term "historic properties" refers to cultural resources that have been determined eligible for listing on the NRHP. For a cultural resource to be determined eligible for listing on the NRHP, it must typically be a minimum of 50 years in age and meet the eligibility requirements for historic properties described in the implementing regulations of the NHPA.

For the purposes of the NHPA, historic properties are considered within an APE, which is the geographic area within which a proposed project may result in direct or indirect adverse effects to historic properties. The APE for direct effects includes the 250-foot-wide, and in some cases (e.g., water crossings, steep terrain) 400-foot-wide project corridor, plus a 100-foot buffer on both sides of the corridor, while the APE for indirect and cumulative effects includes a 1-mile buffer around the APE for direct effects.

Impacts to cultural resources are being addressed through the Section 106 process by means of the Programmatic Agreement, which applies to all project activities, regardless of land ownership, and to all phases of the project. See Appendix J for a draft of the agreement. This analysis has identified AHRS sites and RS2477 trails within the APE; however, only 3 have been evaluated for NRHP eligibility (see Appendix J, Attachment C). Due to a lack of evaluation and comprehensive cultural resources and ethnographic investigations in the project area, non-evaluated resources within the APE will be evaluated for NRHP eligibility through compliance with the Section 106 Programmatic Agreement (Appendix J). Additional historic properties could be identified within the APE that could be adversely affected by the proposed project. The Programmatic Agreement (Appendix J) addresses the process for identifying historic properties and resolving potential adverse effects through avoidance, minimization, or mitigation.

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in impacts to cultural resources.

Impacts Common to All Action Alternatives

The proposed road could result in direct and indirect impacts to cultural resources. Direct impacts to cultural resources could include destruction, removal, or partial damage to cultural resources[48] as a result of ground disturbing activities. Indirect impacts to cultural resources are more varied and could include the introduction of visual, audible, or atmospheric elements that may diminish the setting of a cultural resource, altering its sense of feeling and overall character. Other indirect impacts could include increased unauthorized access to areas with cultural resources, resulting in possible damage, looting, or loss of privacy. Indirect impacts could also include changes to the physical environment that structurally affect the resource, such as through permafrost thawing and vibration from construction. Some indirect impacts may be short term (i.e., limited to the construction or operation phases), but others may be longer term (e.g., loss of resource or changes to patterns of use, such as for ethnographic resources).

AHRS sites and RS2477 trails are located within the direct and indirect APEs for all action alternatives. Therefore, direct and indirect impacts to cultural resources, including previously undiscovered or unreported cultural resources, are likely under all action alternatives in these direct and indirect APEs. As shown in Appendix F, Tables 18 through 20, the archaeological resources probability model (Sweeney and Simmons 2019) indicates nominal differences in the estimated percentages of high, medium, and low probability areas among the alternatives for the occurrence of prehistoric or proto-historic resources. This model is limited by the number of (or lack of, in some instances) previous archaeological investigations that have been conducted in the area. However, the Programmatic Agreement (Appendix J) addresses the process for identifying historic properties and resolving potential effects to these properties.

Alternative A Impacts

Based on the information available, Alternative A could affect the greatest number of documented cultural resources. However, the higher number of documented cultural resources along this route is likely due to the higher number of archaeological investigations conducted along this route within GAAR. There are 15 previously recorded AHRS sites within the Alternative A direct APE, and 60 additional AHRS sites in the Alternative A indirect APE. There are 7 RS2477 trails in the Alternative A direct APE, and 12 trails in the indirect APE. The majority of the AHRS sites consist of prehistoric chipped stone scatters, although 2 sites are transportation features, including the Dalton Highway and a section of the abandoned Hickel Highway. The location of cultural resources in the direct and indirect APEs indicates the possibility for direct and indirect impacts. The potential for indirect impacts would decrease with distance from the infrastructure footprint, but would persist throughout the duration of the development. The likelihood for previously undiscovered cultural resources in the direct and indirect APEs is high. Archaeological probability modeling suggests that the Alternative A direct and indirect APEs contain extensive high and medium probability zones for cultural resources (Appendix F, Table 21).

One of the resources in the Alternative A APE, the Dalton Highway, has been determined eligible for the NRHP, and is therefore a historic property. None of the other resources in the Alternative A APE have been evaluated for eligibility for listing on the NRHP; therefore, these sites are not formally considered historic properties. However, the evaluation of many of the sites for NRHP eligibility, such as

[48] Subsistence resources support Alaska Native village cultures. Section 3.4.7, Subsistence Uses and Resources, and Appendix L address impacts to subsistence resources.

archaeological sites with intact subsurface deposits, would likely result in sites being identified as historic properties.

Alternative B Impacts

There are 10 previously recorded AHRS sites within the Alternative B direct APE, and 37 in the indirect APE. The same RS2477 trails are located in the direct and indirect APEs for Alternative A as for Alternative B. The extent and duration of direct impacts to AHRS sites in the Alternative B direct APE would be similar to those described for Alternative A, although fewer resources have been identified to date. The probability is high that previously undocumented AHRS sites, ethnographic resources, and historic properties exist within the direct and indirect APEs for Alternative B. Archaeological probability modeling suggests that the Alternative B direct and indirect APEs contain extensive high and medium probability zones for cultural resources (Appendix F, Table 22).

Alternative C Impacts

There are 4 previously recorded AHRS sites within the Alternative C direct APE, and 13 within the indirect APE. There are 8 RS2477 trails in the direct APE, and 9 in the indirect APE. These sites include 2 historic transportation routes, a historic prospecting camp, a portion of the Dalton Highway, and a prehistoric artifact scatter. Potential direct and indirect impacts to these resources would be the same as those described for Alternatives A and B, although fewer resources have been identified to date. While Alternative C would affect the least amount of documented resources, this is likely due to the relative absence of previous archaeological investigations along the route. Archaeological probability modeling suggests that the Alternative C direct and indirect APEs contain extensive high and medium probability zones for cultural resources (Appendix F, Table 23). Therefore, the probability is high that previously undocumented AHRS sites, ethnographic resources, and historic properties exist within the direct and indirect APEs for Alternative C.

Mining, Access, and other Indirect and Cumulative Impacts

The anticipated mining scenario would result in the development of several large mining projects in the District. These projects would include actions such as infrastructure development and the excavation of open pit mines over large areas. The projects would carry a high potential for additional direct and indirect impacts to cultural resources, although the specific locations and timeframes for individual projects are unknown. Few cultural resources investigations in the District have previously occurred. Additional mining impacts could result from development of mining projects outside the District along all action alternatives. Development of the mines would require additional evaluation and consultation to comply with the NHPA prior to their approval.

Improvements to the Dalton Highway may be needed due to increased industrial traffic resulting from future mining development and arctic oil development, which could cumulatively result in a greater quantity of Dalton Highway improvements (e.g., widening or realignment), increasing the probability for direct and indirect impacts to cultural resources.

As a result of climate change, environmental changes such as permafrost melt could result in relocation or modification of facilities and infrastructure associated with the access road and mining projects. Such actions could result in direct and indirect impacts to cultural resources.

3.5. Short-Term Uses versus Long-Term Productivity

This section discusses the relationship of local, short-term impacts and uses of resources that would occur if the Ambler Road were authorized, and the maintenance and enhancement of long-term productivity of the project area's environmental resources. Short-term uses of the environment generally are understood to be the impacts of the project, compared to long-term productivity of various resources.

In this EIS, short-term refers to the total duration of the activities described in Chapter 2, Alternatives, and includes the mining development and community access activities described in Appendix H. Generally, this period is anticipated to be 50 years, which is the duration of AIDEA's requested ROW authorization. Each of the action alternatives would involve varying degrees of the short-term uses of resources through the conversion of natural areas to road ROW. Productivity of the land as a natural and recreational resource would be affected as part of a transportation facility for the life of the proposed project. Short-term impacts are described in Sections 3.2, Physical Environment, through 3.4, Social Systems.

Long-term productivity refers to an indefinite period after mining in the District is complete and the road has been removed and reclaimed. Over the long term, decades after the cessation of mining and reclamation of the road, environmental conditions and productivity are generally expected to recover. In the Arctic, recovery can take longer than in other environments, and recovery does not mean the productivity would return to original conditions. At the mine sites and certain damaged areas where water courses may have been altered or permafrost accidently melted, recovery is less likely. Other reasonably foreseeable actions, such as rising temperatures, could continue to influence change in the productivity of the project area in both the short and long term.

3.6. Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources refers to impact to or use of resources that cannot be reverse or recovered. Such commitments refer primarily to nonrenewable resources. There would be irreversible and irretrievable commitments of resources associated with any of the action alternatives, including:

- Use of gravel resources for construction of the road, maintenance camp pads, and airstrips. Gravel resources are considered to be in limited supply along much of the Dalton Highway. Along the proposed route, this also is likely to be the case, especially for gravels not containing NOA.
- Ground disturbance and permanent change to permafrost, and associated topography and vegetation changes, that would be expected to occur with gravel extraction and road cuts.
- Use of fuel for energy during road construction and operation.
- Use of concrete and steel resources for bridges, culverts, and buildings. These resources are not known to be scarce but likely would be transported long distances to reach the project site.
- Change of land use to transportation purposes, with partial recovery of land uses at closure and reclamation.
    - Reduction or change of vegetation and wetlands, which also serve as wildlife habitat, where gravel is removed or placed.
    - Reduction or abandonment of wildlife habitat.
    - Reduction or change of subsistence use areas.
- Commitment of financial resources for road construction.

In general, the longer the alternative, the greater the commitment of resources to establish and maintain the road. Therefore, Alternatives A and B would have similar commitments of resources, and Alternative C would have greater commitments. These changes and impacts are discussed in 3.2, Physical Environment, through 3.4, Social Systems, and some quantities appear in Appendix C, Tables 1 and 2, which summarize impacts of the alternatives.

As indirect (induced) impacts of road construction, the mining scenario described in Appendix H also would result in irreversible and irretrievable commitments of resources, including use of marketable mineral resources such as copper and gold. Other irreversible and irretrievable mine impacts would be similar to those bulleted above for the road, would be in addition to those for the road.

Appendix A:

Figures

(Figures for Chapters 1–3)

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Table of Contents

Figures

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1. Introduction

Chapter 1, Introduction, includes no figures.

2. Alternatives

Figure 2-1 shows a typical cross section of the proposed road.

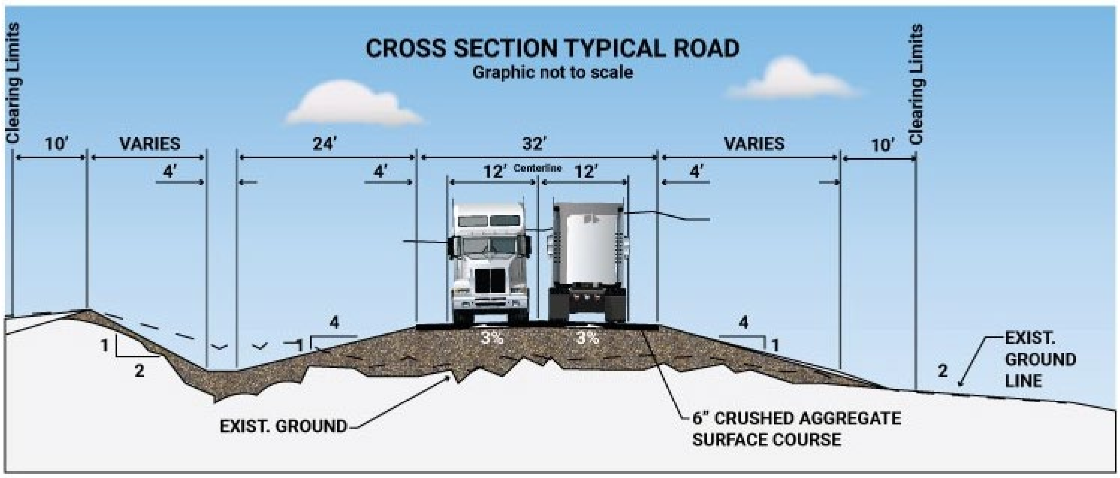

Figure 2-1. Typical roadway section
Source: Adapted from DOWL 2016: Appendix 5C Typical Section

Figure 2-2 depicts a typical truck and container system.

Figure 2-2. Typical vehicle with containerized concentrate
Source: Trilogy Metals 2018

Figure 2-3 illustrates typical maintenance station facilities.

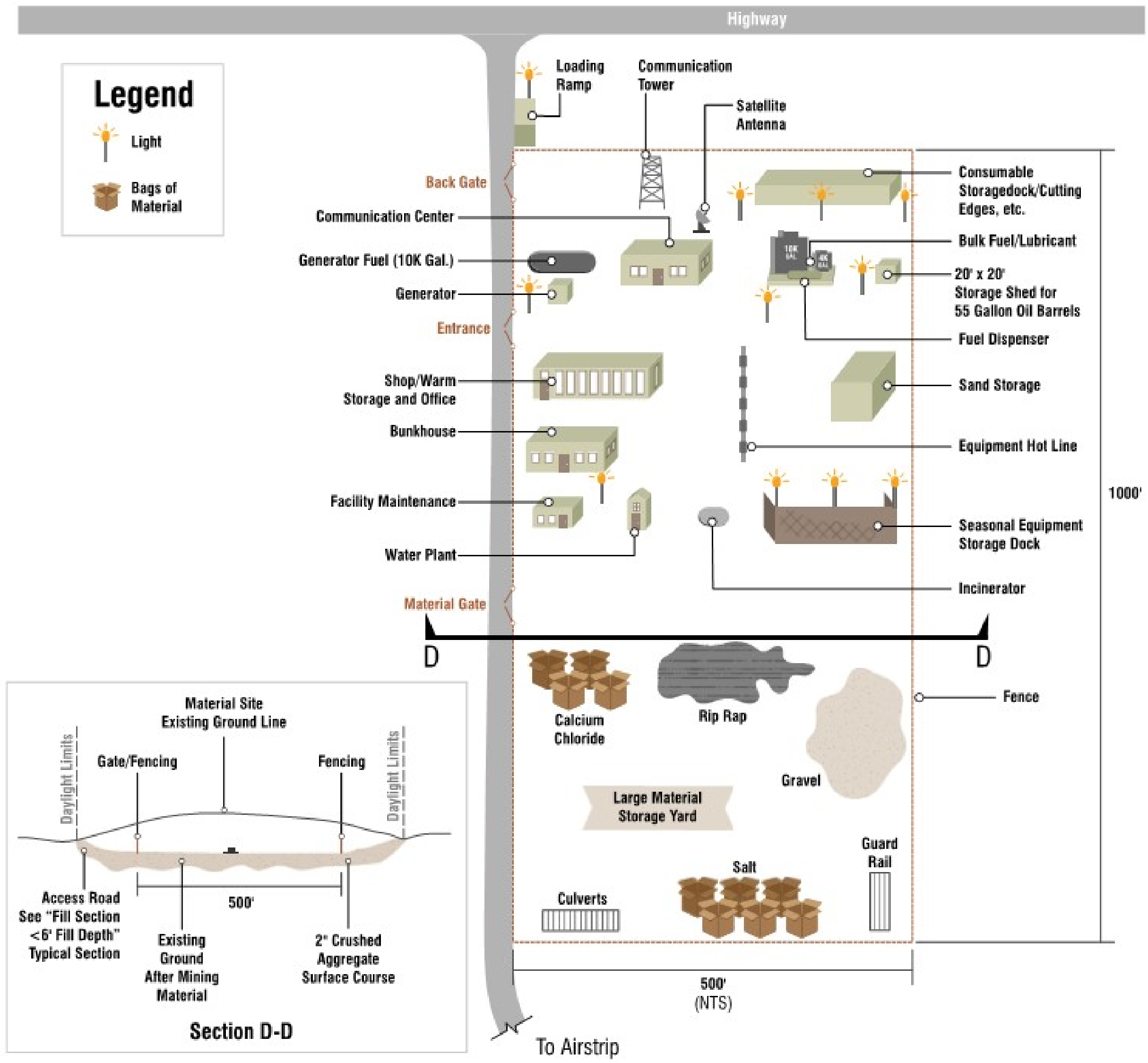

Figure 2-3. Typical maintenance station layout
Source: DOWL 2019

Figure 2-4 illustrates proposed communications facilities.

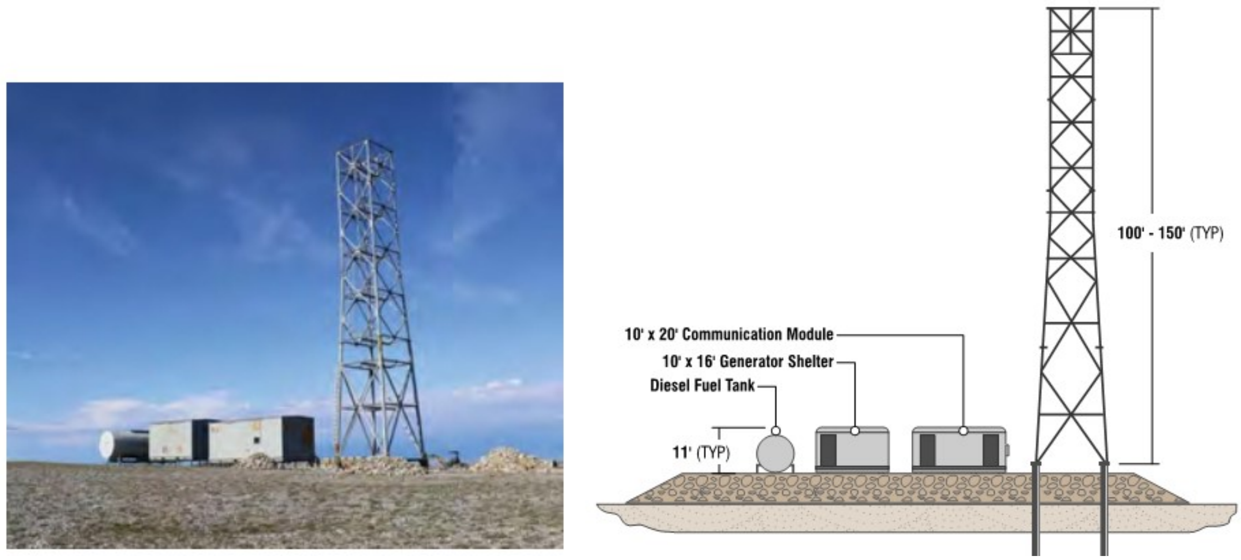

Figure 2-4. Typical communication site layout
Source: DOWL 2019

3. Affected Environment and Environmental Consequences

3.1. Introduction

Section 3.1, Introduction, includes no figures.

3.2. Physical Environment

Section 3.2, Physical Environment, includes no figures. See Appendix D, Attachment A, for figures regarding noise.

3.3. Biological Environment

3.3.1 Vegetation and Wetlands

Section 3.3.1, Vegetation and Wetlands, includes no figures.

3.3.2 Fish and Amphibians

Section 3.3.2, Fish and Amphibians, includes no figures.

3.3.3 Birds

Section 3.3.3, Birds, includes no figures.

3.3.4 Mammals

Figure 3-1 shows the estimated population of the Western Arctic Caribou Herd based on surveys conducted between 1970 and 2017.

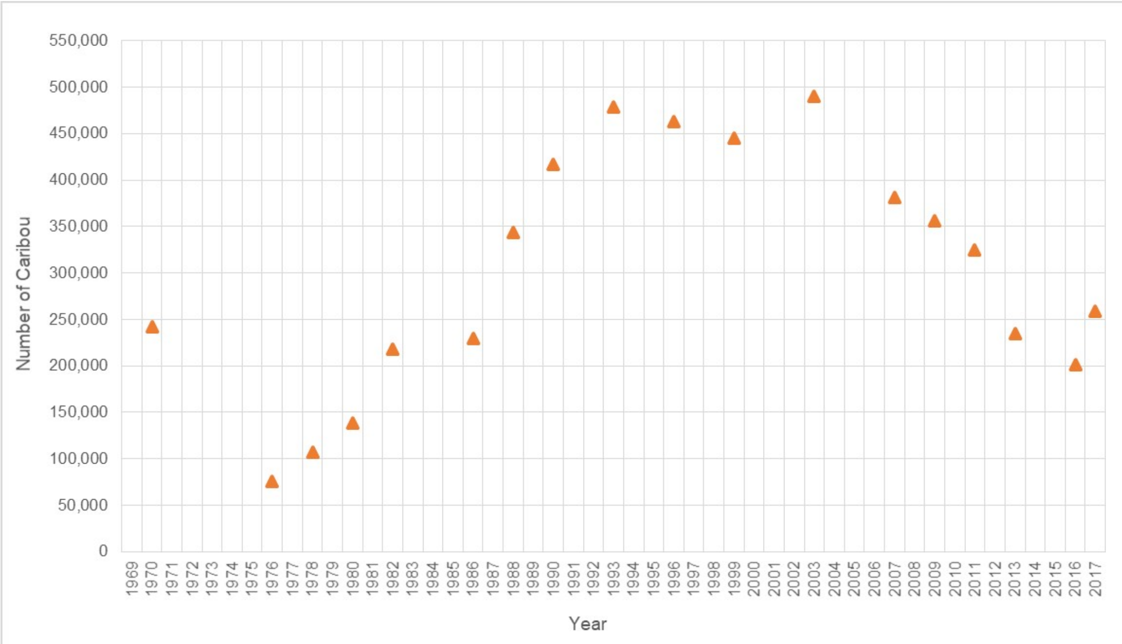

Figure 3-1. Western Arctic Caribou Herd population estimates from 1970 to 2017
Source: Dau 2015

Figure 3-2 shows the estimated population of the Ray Mountains and Hodzana Hills caribou herds based on surveys conducted between 1991 and 2011.

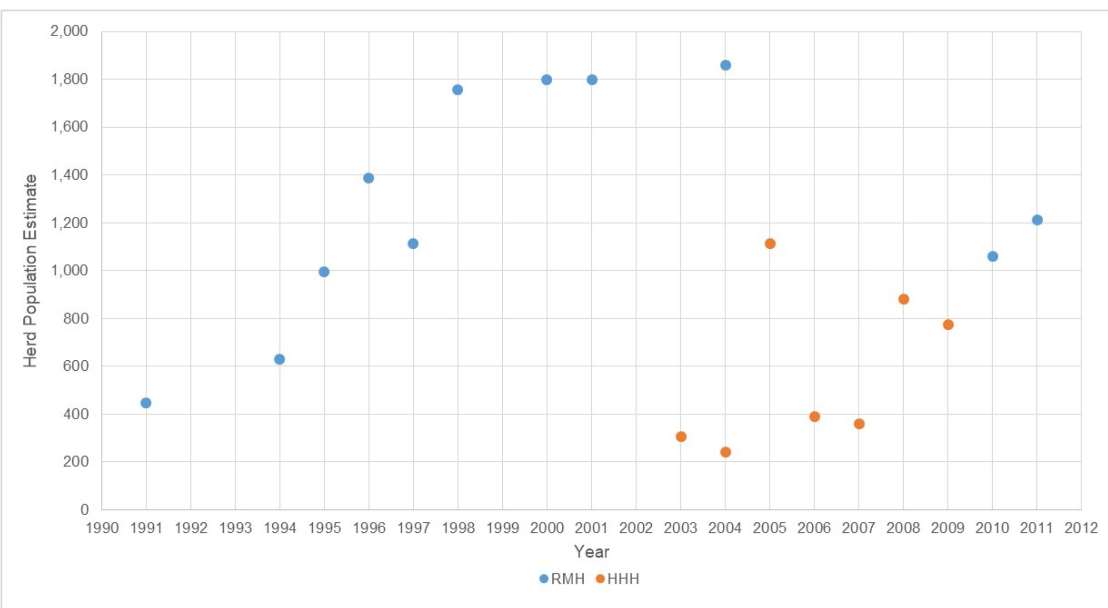

Figure 3-2. Ray Mountains and Hodzana Hills Caribou Herds population estimates from 1991 to 2011
Source: Pamperin 2015
Note: RMH = Ray Mountains herd; HHH = Hodzana Hills herd

3.4. Social Environment

3.4.1 Land Ownership, Use, Management, and Special Designations

Figure 3-3 shows the Bureau of Land Management's land use and management boundaries in the study area.

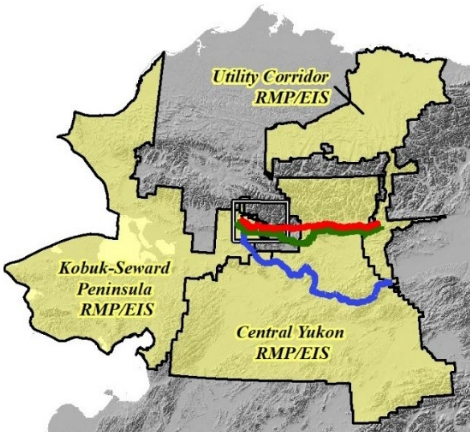

Figure 3-3. Bureau of Land Management Resource Management Plan boundaries
Source: HDR 2019

Figure 3-4 shows the State of Alaska Department of Natural Resources' land use and management boundaries in the study area.

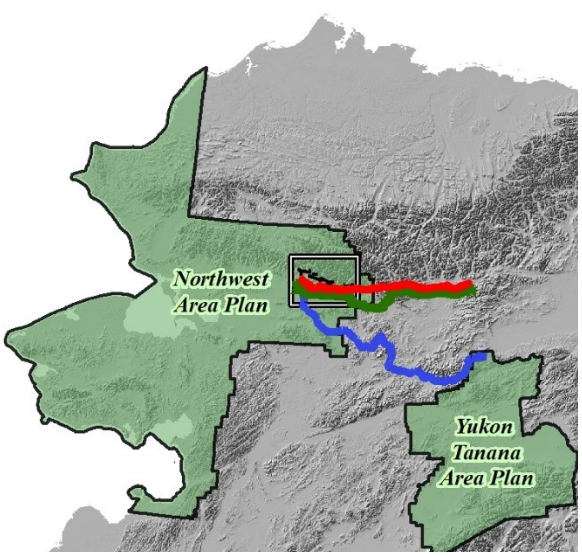

Figure 3-4. State of Alaska Department of Natural Resources Area Plan boundaries
Source: HDR 2019

Figure 3-5 shows the Northwest Arctic Borough's land use and management boundaries in the study area.

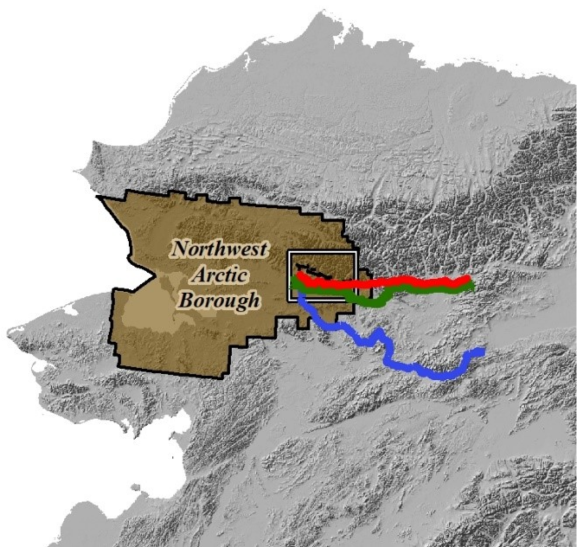

Figure 3-5. Northwest Arctic Borough planning boundary
Source: HDR 2019

3.4.2 Transportation and Access

Section 3.4.2, Transportation and Access, includes no figures.

3.4.3 Recreation and Tourism

Section 3.4.3, Recreation and Tourism, includes no figures.

3.4.4 Visual Resources

Figure 3-6 shows a view from a key observation point (KOP) upriver of the Alternative B alignment on the Kobuk River. It illustrates a river-level view. Shown are (1) existing conditions and (2) a simulation of the view of the proposed Kobuk River bridge, with concrete bridge girders visible running horizontally and multiple vertical concrete piers in the river. This is representative in general of what large, multi-span bridges might look like at any major river crossing on any alternative but is specific to Alternative B and the Kobuk Wild and Scenic River.

KOP 7 - Kobuk RS 1 Existing - Looking South (South Route)

KOP 7 - Kobuk RS 1 After Construction - Looking South (South Route)

Figure 3-6. Example visual simulation—river crossing
Source: DOWL 2014

Figure 3-7 shows a view from a KOP west of Walker Lake. It illustrates a view from a promontory. Shown are (1) existing conditions and (2) a simulation of the view of Alternative A winding across a relatively level landscape with moderate mountains in the background and hill slopes dropping away in the foreground. This is representative in general of what the proposed Ambler Road might look like in a combination of flat and mountainous terrain on any alternative but is specific to Alternative A near Walker Lake.

KOP 3 - ROW West High Existing - Looking Southeast (North Route)

KOP 3 - ROW West High After Construction- Looking Southeast (North Route)

Figure 3-7. Example visual simulation—road on the landscape
Source: DOWL 2014

3.4.5 Socioeconomics and Communities

Section 3.4.5, Socioeconomics and Communities, includes no figures.

3.4.6 Environmental Justice

Section 3.4.6, Environmental Justice, includes no figures.

3.4.7 Subsistence Uses and Resources

Section 3.4.7, Subsistence Uses and Resources, includes no figures.

3.4.8 Public Health

Section 3.4.8, Public Health, includes no figures.

3.4.9 Cultural Resources

Section 3.4.9, Cultural Resources, includes no figures.

4. References

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Trilogy Metals Inc. 2018. High Grade, High Quality, Solid Partners: Copper-Zinc-Lead-Gold-Silver and now… Cobalt. 2018 Precious Metals Summit Colorado, presentation dated September 21, 2018. Available at: https://trilogymetals.com/assets/docs/presentations/Trilogy-Metals---Corporate-Presentation----Precious-Met.pdf

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Appendix B:

Introduction Tables and Supplemental Information

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Table of Contents

Tables

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1. Introduction

1.1. Introduction

This section includes no tables or supplemental information.

1.2. Project Background and Overview

This section includes no tables or supplemental information.

1.3. Applicant's Purpose and Need for the Project

This section includes no tables or supplemental information.

1.4. Purpose and Need for Federal Action

This section includes no tables or supplemental information.

1.5. Collaboration and Coordination

Table 1 summarizes key anticipated authorizing laws, regulations, and permits for the project.

Table 1. Key permits, approvals, and other requirements by agency

Responsible agency	Jurisdiction/legal authority	Key permit, approval, or other requirement
DOI BLM and federal cooperating agencies	NEPA	Disclose and review environmental impacts of proposed federal actions
DOI BLM/federal cooperating agencies	NHPA	NHPA consultation, Section 106 determinations/PA includes consideration of effects of federal undertakings on historic properties
DOI BLM	FLPMA	Decision whether to grant ROW permit and authorization to regulate the use, occupancy, and development of public lands and to take action to prevent unnecessary or undue degradation of public lands
DOI BLM	ANILCA Section 201 and Title XI	Authorization for Transportation and Utility Systems and Facilities on Federal Lands and ANILCA-defined conservation system units
DOI BLM	ANILCA Section 810	Section 810 evaluation and findings include analysis of impacts to subsistence resources and access to those resources
DOI BLM	ANCSA	Coordination with ANCSA landowners (DOI Policy on Consultation with Alaska Native Claims Settlement Act Corporations [2011])
DOI NPS	ANILCA Section 201(4)(b)	Grant ROW permit across GAAR if BLM selects a route that goes through GAAR
USACE	CWA Section 404	Department of the Army Permit for discharge of dredged or fill material into waters of the United States, including wetlands

Responsible agency	Jurisdiction/legal authority	Key permit, approval, or other requirement
USACE	Rivers and Harbors Act Section 10	Department of the Army Permit for construction in any navigable water; the excavation or discharge of material into such water; or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters
USCG	Rivers and Harbors Act Section 9	Section 9 permit for development of a bridge or causeway in or over any navigable river or navigable water of the United States
DOI USFWS	Bald and Golden Eagle Protection Act	Permits to take, haze, relocate, or destroy eagles or their nests
DOI USFWS	MBTA	Consultation/permits for actions that could take migratory birds or the parts, nests, or eggs of such birds
DOI USFWS	Fish and Wildlife Coordination Act	Consultation on impacts on fish and wildlife resources
NMFS	MSA	EFH Assessment: consultation on the effects to EFH
ADEC	CWA Section 401	Section 401 Water Quality Certification issued to accompany the USACE Section 404 permit
ADEC	CWA Section 402	APDES permit for point-source discharge of wastewater or storm water into waters of the United States
ADF&G	AS Title 16	Title 16 Fish Habitat Permit required for proposed activity conducted below mean high water of anadromous fish streams
ADNR	AS 38.35.050; AS 38.05.550-565	ROW permit for state land
ADNR	AS 38.05.810(a)	Material sales (e.g., gravel) permit for state land
ADNR	AS 46.15 and 11 AAC 93	Temporary water use/water rights
SHPO	AS 41.35 (AHPA); NHPA Section 106	AHPA and NHPA Section 106 review of activities that may affect cultural resources/historic properties
NAB	NAB Home Rule Charter Title 9	Borough permitting
DOI BLM/federal cooperating agencies	EO 11988	Floodplain Management: avoid short- and long-term adverse impacts to wetlands whenever a practicable alternative exists
DOI BLM/federal cooperating agencies	EO 11990	Protection of Wetlands: minimize the destruction, loss, or degradation of wetlands, and preserve and enhance the natural and beneficial values of wetlands
DOI BLM/federal cooperating agencies	EO 12898	Environmental Justice: identify/address disproportionately high and adverse effects of the project on minority and low-income populations
DOI BLM/federal cooperating agencies	EO 13045	Protection of Children from Environmental Health and Safety Risks: identify/assess environmental health and safety risks that may disproportionately affect children
DOI BLM/federal cooperating agencies	EO 13112	Invasive Species: prevent the introduction of invasive species; control invasive species already introduced; and minimize the economic, ecological, and human health impacts of invasive species

Responsible agency	Jurisdiction/legal authority	Key permit, approval, or other requirement
DOI BLM/federal cooperating agencies	EO 13175	Consultation and Coordination with Indian Tribal Government: consult with tribal governments when considering polices that would impact tribal communities

Notes: AAC = Alaska Administrative Code; ADEC = Alaska Department of Environmental Conservation; ADF&G = Alaska Department of Fish and Game; ADNR = Alaska Department of Natural Resources; AHPA = Alaska Historic Preservation Act; ANCSA = Alaska Native Claims Settlement Act; ANILCA = Alaska National Interest Lands Conservation Act; APDES = Alaska Pollutant Discharge Elimination System; AS = Alaska Statute; CWA = Clean Water Act; DOI = Department of the Interior; BLM = Bureau of Land Management; EFH = Essential Fish Habitat; EO = Executive Order; FLPMA = Federal Land Policy and Management Act; GAAR = Gates of the Arctic National Park and Preserve; MBTA = Migratory Bird Treaty Act; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NAB = Northwest Arctic Borough; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act; NMFS = National Marine Fisheries Service; NPS = National Park Service; PA = Programmatic Agreement; ROW = right-of-way; SHPO = State Historic Preservation Officer; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service

1.6. EIS Development Process and Coordination

This section includes no tables or supplemental information.

2. References

None cited.

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Appendix C:

Chapter 2 Alternatives Tables and Supplemental Information

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Table of Contents

Tables

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1. Alternatives

1.1. Introduction

No tables or supplemental information.

1.2. Alternatives Development Process

No tables or supplemental information.

1.3. Alternatives Considered but Eliminated from Detailed Analysis

No tables or supplemental information.

1.4. Alternatives Retained for Detailed Analysis

No tables or supplemental information.

1.5. Summary of Impacts

Table 1 provides a summary and comparison of key impacts by alternative.

Table 1. Summary of major project components for each action alternative

Component	Alternative A	Alternative B	Alternative C
Terminus (Project Start)	MP 161 Dalton Highway	MP 161 Dalton Highway	MP 59.5 Dalton Highway
Terminus (Project End)	Ambler River/Ambler Mining District	Ambler River/Ambler Mining District	Ambler River/Ambler Mining District
Length of industrial access road (miles)	211	228	332
Total footprint of industrial access road (acres)	2,318	2,551	5,262
Total footprint of support access roads (acres)	137	214	239
Number of maintenance stations (12 acres each)	3 stations (36 acres)	3 stations (36 acres)	5 stations (60 acres)
Number of material sites	41	46	45
Total footprint of material sites (acres)	1,863	2,155	2,408
Number of airstrips (150 feet by 3,000 feet)	3	3	5
Total footprint of airstrips (acres)	153	153	255
Number of vehicle turnouts (1 every 10 to 11 miles)	20	22	32
Number of communications towers: At maintenance stations + At materials sites = Total number	3 + 9 = 12	3 + 10 = 13	5 + 14 = 19
Total footprint of project (acres)	4,471	5,074	8,210
Total footprint of project on NPS-managed lands (acres)	332	343	0
Gravel needed for maintenance (cubic yards, annually)	220,000	238,000	347,000
Number of minor culverts (to 3 feet wide)	2,869	3,155	4,076
Number of moderate culverts (4 to 10 feet wide)	15	12	131
Number of major culverts (10 to 20 feet wide)	19	12	141
Number of small bridges (less than 50 feet long)	3	3	79
Number of medium bridges (50 to 140 feet long)	15	12	158
Number of large bridges (greater than 140 feet long)	11	11	14

Component	Alternative A	Alternative B	Alternative C
Costs of construction (based on 2-lane road): 1. Road 2. Landing strips (number of strips) 3. Maintenance stations (number of stations) 4. Communications (VHF radio, fiber optic, and satellite) 5. Total	1. $447 million 2. $2.5 million (3) 3. $26.4 million (4) 4. $43.4 million 5. $519.3 million	1. $481 million 2. $2.5 million (3) 3. $26.4 million (4) 4. $46.9 million 5. $556.8 million	1. $880 million 2. $4.2 million (5) 3. $39.7 million (6) 4. $68.3 million 5. $992.2 million
Costs of annual maintenance: 1. Road 2. Maintenance stations (landing strips not separated) 3. Communications 4. Total	1. $6.6 million/year 2. $2 million/year (4) 3. $586,000/year 4. $9.2 million/year	1. $7.2 million/year 2. $2 million/year (4) 3. $633,000/year 4. $9.8 million/year	1. $10.4 million/year 2. $3 million/year (6) 3. $917,000/year 4. $14.3 million/year

Source: DOWL 2016, 2019; Analysis by BLM
Note: MP = Milepost

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Table 2 summarizes the impacts by resource category and resources affected for each alternative. Unless otherwise noted, impacts given are for the road entire project, including the road, airstrips, maintenance camps, material sites, and material/water access roads. For additional information, see Chapter 3 (Affected Environment and Environmental Consequences), appendices, and technical reports for each resource category.

Table 2. Summary of impacts for each alternative

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C
Geology and Minerals	Permafrost, NOA, ARD.	Thawing of some permafrost likely based on current trends.	Road construction likely to exacerbate thawing of permafrost and resultant ground settlement in the road corridor. All alternatives cross areas of NOA, and asbestos dust is a health hazard. Disturbing soils has potential to generate ARD.	Similar to Alternative A.	Similar to Alternative A, with somewhat less known NOA.
Geology and Minerals	Indirect effects.	Unlikely to result in removal of minerals from the District to market.	Would lead to removal of minerals from the District to market.	Same as Alternative A.	Same as Alternative A.
Soils and Permafrost	Area underlain by continuous permafrost.	N/A	4,177 acres (92% of route)	4,691 acres (91% of route)	3,945 acres (48% of route)
Soils and Permafrost	Area underlain by discontinuous permafrost.	N/A	347 acres (8% of route)	447 acres (9% of route)	4,254 acres (52% of route)
Soils and Permafrost	Area (acres) of project footprint with known potential for NOA.	N/A	Known High: 88 acres Known Medium: 106 acres Known 0 to Low: 202 acres Unknown (unevaluated surface deposits): 4,120 acres Other (water): 8 acres	Known High: 168 acres Known Medium: 198 acres Known 0 to Low: 367 acres Unknown: 4,395 acres Other (water): 9 acres	Known High: 0 acres Known Medium: 1,279 acres Known 0 to Low: 2,267 acres Unknown: 4,645 acres Other (water): 20 acres
Sand and Gravel	Number of material sites and projected total acreage.	N/A	Road construction and maintenance would use a large volume of material with 41 potential material sites identified (estimated to total 1,863 acres).	Similar to Alternative A but 46 potential material sites (estimated to total 2,155 acres).	Similar to Alternative A but 44 potential material sites (estimated to total 2,408 acres).
Hazardous Waste	Risk of toxic releases to the environment.	N/A	Toxic spills and dust are likely to occur at a small scale under any action alternative. Large spills or releases from a truck rollover could occur and damage adjacent waterways and habitat.	Similar to Alternative A.	Similar to Alternative A. Alternative C is approximately 50% longer than Alternative A, so would have greater direct risk of spill from truck rollover on the new road, but overall driving distance to Fairbanks would be similar, so overall risk would be similar.
Paleontological Resources	Area of project footprint by PFYC (Classes 1–5; water and unknown areas not given).	N/A	Class 1–2 (very low/low): 4,518 acres Class 3–5 (moderate–very high): 0 acres	Class 1–2 (very low/low): 5,131 acres Class 3–5 (moderate–very high): 0 acres	Class 1–2 (very low/low): 7,785 acres Class 3–5 (moderate–very high): 0 acres
Paleontological Resources	Effects on fossil and non-fossil evidence of ancient life.	Weathering and erosion of resources would occur naturally.	Construction could affect fossil and non-fossil evidence of ancient life.	Same as Alternative A.	Same as Alternative A.
Water Resources	Effects to water resources.	N/A	Ice road, bridge, and culvert construction; gravel extraction; gravel placement; water withdrawal; and wastewater discharge would likely alter surface and subsurface flow patterns and water quality. The impacts of each alternative would be similar, with extent of impact governed largely buy the length of the alternative.	Similar to Alternative A, but slightly longer alignment means slightly greater impact.	Similar to Alternative A, but much longer alignment means correspondingly greater impact.

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C
Water Resources	Miles of alignment in floodplain (including bridge and culvert crossings).	N/A	4.6 miles	5.4 miles	53.6 miles
Water Resources	Miles of alignment located within 1,000 feet of floodplain.	N/A	16.1 miles (8%)	17.3 miles (8%)	96.3 miles (29%)
Water Resources	Area of assumed floodplain impact by bridges and culverts (includes multiple assumptions).	N/A	2,110 acres	2,110 acres	4,526 acres
Acoustical Environment	Direct effects to soundscape.	N/A	Road construction and operation would create new sounds from vehicles, aircraft, and generators at maintenance stations and communications sites. Longer alternatives would create new sounds in more new places. Alternative A would cross GAAR and the Kobuk Wild and Scenic River and would run near the designated Wilderness boundary, all managed for natural soundscape.	Similar to Alternative A. Alternative B would cross GAAR and the Kobuk Wild and Scenic River, both managed for natural soundscape. However, road noise generally would not extend to Wilderness.	Similar to Alternative A. However, Alternative C would not cross GAAR. It would pass near Kobuk and Hughes and could create noise impacts in and near these communities.
Acoustical Environment	Indirect and cumulative effects.	N/A	Mining in the District would be the same under all action alternatives and would create substantial industrial noise from continual blasting and earth moving with oversize vehicles, in addition to road and air traffic noise. Ambler Road noise combined with mine-related noise would create cumulative impacts over substantial parts of the District.	Same as Alternative A.	Same as Alternative A.
Air Quality and Climate	Emissions and effects on air quality.	N/A	Pollutants, including dust, would be emitted from construction and operation of the road under all action alternatives. The areas affected would differ by the location and length of each alignment. Effects mostly would be small and localized to the road corridor. No criteria pollutants would be expected to exceed thresholds established for human health. Alternative A would pass through GAAR, a Class I designated air quality area.	Similar to Alternative A.	Similar to Alternative A, but Alternative C would not pass through any designated air quality area. As a much longer alternative, it would create new emissions in a larger area.
Vegetation and Wetlands	Vegetation impact, 10-foot construction zone.	N/A	610 acres	676 acres	913 acres
Vegetation and Wetlands	Vegetation impact/cut-fill in project footprint.	N/A	4,517 acres	5,130 acres	8,111 acres
Vegetation and Wetlands	Vegetation impact, primary dust zone.	N/A	17,728 acres	19,656 acres	25,865 acres
Vegetation and Wetlands	Wetland impact, 10-foot construction zone.	N/A	343 acres	396 acres	572 acres
Vegetation and Wetlands	Wetland impact/cut-fill in project footprint.	N/A	2,079 acres	2,416 acres	3,890 acres
Vegetation and Wetlands	Wetland impact, primary dust zone.	N/A	10,837 acres	12,270 acres	16,289 acres
Wetlands	Percent of route going through wetlands.	N/A	57%	60%	63%

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C
Fish and Amphibians	Number of crossings of known and/or assumed anadromous fish streams.	N/A	40	43	270
Fish and Amphibians	Number of gravel mines within floodplain or in low-lying areas within 500 feet of fish streams/total number of gravel mines proposed.	N/A	21/41	22/46	16/44
Birds	Birds and bird habitat.	N/A	The impacts from a road on birds would include cut and fill in and alteration of terrestrial and aquatic habitat, disturbance and displacement of birds, and injury or mortality. The types of potential effects would be similar for each alternative, with different areas affected. Alternative A and B would have nearly identical impacts.	Same as Alternative A.	Similar to Alternative A, but Alternative C would be the longest alignment and would affect more habitat. It would affect an area noted for richness of waterfowl species and would cross more alpine habitat areas.
Mammals	Caribou habitat affected – WAH.	N/A	Migratory: 1,287 acres Winter: 1,128 acres Peripheral: 1,745 acres Total: 4,161 acres	Migratory: 1,347 acres Winter: 1,128 acres Peripheral: 2,300 acres Total: 4,775 acres	Migratory: 419 acres Winter: 1,615 acres Peripheral: 2,086 acres Total: 4,120 acres
Mammals	Caribou habitat affected – RMH.	N/A	0 acres	0 acres	1,964 acres
Land	Land ownership of proposed ROW (generally 250 feet wide; where footprint is outside this area, the ROW is considered to be 10 feet beyond the footprint).	N/A	Federal: 3,498 acres State: 8,635 acres Borough: 261 acres Alaska Native Corporation: 2,439 acres Native Allotment: 0.05 acres Private: 0 acres Undetermined: 42 acres Total: 14,874 acres	Federal: 3,083 acres State: 10,148 acres Borough: 593 acres Alaska Native Corporation: 2,437 acres Native Allotment: 0.44 acres Private: 0 acres Undetermined: 45 acres Total: 16,306 acres	Federal: 19,090 acres State: 426 acres Borough: 0 acres Alaska Native Corporation: 3,390 acres Native Allotment: 12 acres Private: 152 acres Undetermined: 73 acres Total: 23,143 acres
Land	Miles of proposed ROW within special designation areas.	N/A	29 miles (GAAR, Special Recreation Management Area, Kobuk Wild and Scenic River)	21 miles (GAAR, Special Recreation Management Area, Kobuk Wild and Scenic River)	105 miles (Tozitna River and Indian River Areas of Critical; Environmental Concern, Special Recreation Management Area)
Transportation and Access	Direct effect: AADT on the Ambler Road over the 50-year term of the ROW permit (based on assumed mining scenario in Appendix H, Indirect and Cumulative Impacts Associated with the Ambler Road).	N/A	Phase 1: 7–57 trips per day Phase 2: 58–118 trips per day Phase 3 (early): 104–168 trips per day Phase 3 (late): 83, tapering to 3, trips per day	Phase 1: 7–57 trips per day Phase 2: 58–118 trips per day Phase 3 (early): 104–168 trips per day Phase 3 (late): 83, tapering to 3, trips per day	Phase 1: 7–57 trips per day Phase 2: 58–118 trips per day Phase 3 (early): 104–168 trips per day Phase 3 (late): 83, tapering to 3, trips per day
Transportation and Access	Indirect effect: AADT increase on Dalton Highway (current AADT is 300 (projected traffic level is the same for all action alternatives).	N/A	Dalton Highway miles affected: 161 Phase 1: 7–57 trips per day Phase 2: 58–179 trips per day Phase 3 (early): 160–238 trips per day Phase 3 (late): 123, tapering to 3, trips per day	Dalton Highway miles affected: 161 Phase 1: 7–57 trips per day Phase 2: 58–179 trips per day Phase 3 (early): 160–238 trips per day Phase 3 (late): 123, tapering to 3, trips per day	Dalton Highway miles affected: 59.5 Phase 1: 7–57 trips per day Phase 2: 58–179 trips per day Phase 3 (early): 160–238 trips per day Phase 3 (late): 123, tapering to 3, trips per day

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C
Transportation and Access	Indirect effect: new rail and port traffic associated with 4 likely mines (same for all action alternatives).	N/A	Arctic: 4.3 trains per week; 10 ships per year Bornite: 2.2 trains per week; 5 ships per year Sun: 1.5 trains per week; 3 ships per year Smucker: 1.5 trains per week; 3 ships per year	Arctic: 4.3 trains per week; 10 ships per year Bornite: 2.2 trains per week; 5 ships per year Sun: 1.5 trains per week; 3 ships per year Smucker: 1.5 trains per week; 3 ships per year	Arctic: 4.3 trains per week; 10 ships per year Bornite: 2.2 trains per week; 5 ships per year Sun: 1.5 trains per week; 3 ships per year Smucker: 1.5 trains per week; 3 ships per year
Transportation and Access	Communities most likely to arrange commercial deliveries directly or by connecting boat or snowmobile.	N/A	Direct: Kobuk Via connecting boat or snowmobile: Shungnak, Ambler, Bettles-Evansville	Direct: Kobuk Via connecting boat or snowmobile: Shungnak, Ambler, Bettles-Evansville	Direct: Kobuk Via new road: Hughes Via connecting boat or snowmobile: Shungnak, Ambler
Recreation and Tourism	Common float trips crossed by alignment (with relationship to Wild and Scenic River segment), and other major streams used for transportation and recreation.	N/A	Alatna River (downstream of Wild and Scenic River portion) John River (downstream of Wild and Scenic River portion) Kobuk River (at Wild and Scenic River portion) North Fork Koyukuk (downstream of Wild and Scenic River portion) Other major river corridors: None	Alatna River (downstream of Wild and Scenic River portion) John River (downstream of Wild and Scenic River portion) Kobuk River (at Wild and Scenic River portion) North Fork Koyukuk (downstream of Wild and Scenic River portion) Other major river corridors: None	Does not affect common float trips Other major river corridors: Koyukuk, Kobuk (downstream of Wild and Scenic River segment), Hogatza
Visual Resources	Miles of road alignment within BLM VRI classifications (broad indicator of visual value without management implications).	N/A	BLM VRI Class I: 0 miles BLM VRI Class II: 107.3 miles BLM VRI Class III: 0 miles BLM VRI Class IV: 21.5 miles Unclassified (GAAR): 26.1 miles Unclassified (Other): 56.4 miles	BLM VRI Class I: 0 miles BLM VRI Class II: 119.3 miles BLM VRI Class III: 0 miles BLM VRI Class IV: 25.7 miles Unclassified (GAAR): 17.8 miles Unclassified (Other): 65.5 miles	BLM VRI Class I: 0 miles BLM VRI Class II: 75.5 miles BLM VRI Class III: 64.4 miles BLM VRI Class IV: 168.7 miles Unclassified (GAAR): 0 miles Unclassified (Other): 23.9 miles
Visual Resources	Miles of road alignment within BLM VRM classifications (indicator of consistency with management plan near Dalton Highway).	N/A	BLM VRM Class I/II: 0 miles BLM VRM Class III: 16.9 miles BLM VRM Class IV: 1.9 miles	BLM VRM Class I/II: 0 miles BLM VRM Class III: 16.9 miles BLM VRM Class IV: 1.9 miles	BLM VRM Class I/II: 0 miles BLM VRM Class III: 7.9 miles BLM VRM Class IV: 4.4 miles
Socioeconomics and Communities	Direct road construction jobs (assuming each alternative would be built in 4 years).	N/A	Road construction total jobs per year: 680 Portion of total jobs to Alaskans: 550 Portion of total jobs to area residents: 110 Road operations jobs: 50 Portion of operations jobs to area residents: 10	Road construction total jobs per year: 730 Portion of total jobs to Alaskans: 590 Portion of total jobs to area residents: 120 Road operations jobs: 60 Portion of operations jobs to area residents: 12	Road construction total jobs per year: 1,310 Portion of total jobs to Alaskans: 1,060 Portion of total jobs to area residents: 210 Road operations jobs: 80 Portion of operations jobs to area residents: 16
Socioeconomics and Communities	Indirect effects of mines in the District.	N/A	The mines would create new jobs and pay fees and taxes to the State of Alaska, Northwest Arctic Borough, and Native corporations. This would occur equally under all action alternatives. See also Transportation and Access for individual communities that could have cheaper commercial delivery of goods. This impact would occur during road operations, but the jobs could lead to decreased population in some small communities due to urban migration.	Same as Alternative A.	Same as Alternative A.

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C
Environmental Justice	Disproportionate effects to minority and low-income populations.	N/A	Impacts to subsistence and public health, including stress, subsistence-food insecurity, and potential exposure to asbestos, would disproportionately affect low-income and minority populations, specifically Alaska Native villages that live in and near the project area and depend on the surrounding area for their subsistence lifeway. Impacts to employment would occur but would not be expected to disproportionately affect low-income and minority populations. The effects would be more likely for Bettles-Evansville under Alternative A and less likely for Hughes.	Same as Alternative A.	Same as Alternative A, but the effects would be more likely for Hughes under Alternative C and less likely for Bettles-Evansville.
Subsistence	Number of communities with subsistence use areas that would be crossed by the project, affecting subsistence travel patterns and subsistence species movements.	N/A	Moose: 9 Caribou: 9 Dall sheep: 6 Bear: 5 Small land mammals: 8 Migratory birds: 6 Upland game birds: 4 Eggs: 2 Salmon: 3 Other fish: 3 Vegetation: 6	Moose: 9 Caribou: 9 Dall sheep: 6 Bear: 5 Small land mammals: 9 Migratory birds: 5 Upland game birds: 4 Eggs: 2 Salmon: 3 Other fish: 3 Vegetation: 7	Moose: 8 Caribou: 10 Dall sheep: 3 Bear: 7 Small land mammals: 15 Migratory birds: 6 Upland game birds: 3 Eggs: 0 Salmon: 5 Other fish: 8 Vegetation: 6
Subsistence	Communities with impacts to 5 or more of their subsistence use areas.	N/A	Seven communities: Ambler, Bettles, Coldfoot, Evansville, Kobuk, Shungnak, Wiseman	Eight communities: Alatna, Ambler, Bettles, Coldfoot, Evansville, Kobuk, Shungnak, Wiseman	Seven communities: Alatna, Allakaket, Ambler, Hughes, Kobuk, Shungnak, Stevens Village
Subsistence	Alternative passes through primary migratory range of the WAH.	N/A	Yes	Yes	No
Cultural Resources	Number of cultural sites and potentially historic trails in the proposed ROW (the direct APE) and in the adjacent indirect APE.	N/A	Direct APE: 15 sites, 7 trails Indirect APE: 60 sites, 12 trails The locations of ethnographic resources and cultural properties are unknown but have a high likelihood for occurrence in the APE.	Direct APE: 10 sites, 7 trails Indirect APE: 37 sites, 12 trails The locations of ethnographic resources and cultural properties are unknown but have a high likelihood for occurrence in the APE.	Direct APE: 4 sites, 8 trails Indirect APE: 9 sites, 9 trails The locations of ethnographic resources and cultural properties are unknown but have a high likelihood for occurrence in the APE.

Source: Analysis by BLM.
Notes: AADT = Annual Average Daily Traffic; APE = Area of Potential Effect; ARD = acid rock drainage; BLM = Bureau of Land Management; District = Ambler Mining District; GAAR = Gates of the Arctic National Park and Preserve; N/A = Not applicable; NOA = naturally occurring asbestos; PFYC = Potential Fossil Yield Classification; RMH = Ray Mountains Herd; ROW = right-of-way; VRI = Visual Resource Inventory; VRM = Visual Recreation Management; WAH = Western Arctic Caribou Herd

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2. References

DOWL. 2016. Ambler Mining District Industrial Access Road SF299 Revised Permit Application. Prepared for the Alaska Industrial Development and Export Authority. Available at: eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=111130

DOWL. 2019. Ambler Mining District Industrial Access Project SF299 Application Communications Amendment. April 2019. Prepared for AIDEA by DOWL. Anchorage, Alaska.

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Appendix D:

Chapter 3 Physical Environment Tables and Supplemental Information

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Table of Contents

Tables

Attachment

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1. Affected Environment and Environmental Consequences – Physical Environment

1.1. Geology and Soils

Table 1 identifies the geologic units crossed by the alternative footprints in the project area. The largest unit is unconsolidated surficial deposits, which predominantly consists of alluvial and glacial deposits.

Table 1. Geologic units crossed by alternative footprints

State unit	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Andesitic volcanic rocks	0	0	162
Calcareous graywacke and conglomerate	9	125	1,096
Dikes and subvolcanic rocks	0	0	13
Igneous rocks	130	210	1,214
Intermediate granitic rocks	0	0	19
Mafic igneous-clast conglomerate, sandstone, and mudstone	111	111	0
Marble, northern Alaska	7	10	68
Melange facies	7	92	0
Metagraywacke and phyllite	34	31	9
Pelitic and quartzitic schist of the Ruby terrane	0	0	256
Pyroclastic rocks	0	0	216
Quartz-mica schist of the Brooks Range	104	104	73
Quartz-pebble conglomerate, west-central Alaska	32	77	60
Unconsolidated surficial deposits, undivided	4,084	4,370	4,455
Volcanic graywacke and conglomerate	0	0	143
Water	6	7	19
Total acres	**4,523**	**5,138**	**8,210**

Source: USGS n.d.
Note: The total acreage of Alternative C includes a 406-acre area undefined by a state unit or water body.

Table 2 identifies the footprint acreage and percentage within mapped permafrost areas.

Table 2. Acreage and percent of alternative footprint within mapped permafrost areas

Permafrost	Alternative A (acres)	Alternative A (%)	Alternative B (acres)	Alternative B (%)	Alternative C (acres)	Alternative C (%)
Mountainous Area underlain by continuous permafrost	3,510	78	3,738	73	283	3
Mountainous Area underlain by discontinuous permafrost	0	0	0	0	3,031	37
Lowland and Upland Area underlain by moderately thick to thin permafrost	667	15	953	19	3,662	45
Lowland and Upland Area underlain by discontinuous permafrost	347	8	447	9	1,234	15
Total	**4,524**	**100**	**5,138**	**100**	**8,210**	**100**

Source: Geo-references map and attribute data derived from Ferrians 1965
Notes: Totals may exceed 100 percent due to rounding. The lowland and upland area underlain by moderately thick to thin permafrost is considered continuous permafrost for summation purposes.

Table 3 identifies the acreage and percentage of each alternative footprint on the mapped asbestos potential in the project area.

Table 3. Asbestos potential of alternative footprint

Naturally occurring asbestos potential	Alternative A (acres [% total])	Alternative B (acres [% total])	Alternative C (acres [% total])
High	88 (2)	168 (3)	0 (0)
Medium	106 (2)	198 (4)	1,279 (16)
Zero to low	202 (4)	367 (7)	2,267 (28)
Unknown (unevaluated surficial deposits)	4,120 (91)	4,395 (86)	4,645 (57)
Other/Water	8 (<1)	9 (<1)	20 (<1)
Total	**4,524 (100)**	**5,138 (100)**	**8,211 (100)**

Source: Solie and Athey 2015

1.2. Sand and Gravel Resources

No tables or supplemental information.

1.3. Hazardous Waste

Table 4 lists Alaska Department of Environmental Conservation (ADEC) identified contaminated sites located within 5 miles of Alternative C. There are no sites located within 5 miles of Alternatives A and B. Volume 4, Map 3-3 depicts this information.

Table 4. ADEC identified contaminated sites in the study area

ADEC Hazard ID	Site name	Status	Distance from Alternative C (miles)
23352	BLM Fire Service Dahl Creek	Cleanup Complete	0.9
25387	Alyeska Five Mile Airstrip	Cleanup Complete	1.3
3100	DOT&PF SREB - Kobuk	Active	1.5
4615	Kobuk Abandoned Tank Farm	Active	1.5
26573	DOT&PF 7 Mile Maintenance Station Class V Injection Well	Active	1.9
24594	DOTPF 7 Mile Maintenance Station	Cleanup Complete – Institutional Controls	2.0
873	DOT&PF 7 Mile Camp	Cleanup Complete – Institutional Controls	2.0
1078	Central Alaska Gold Company	Cleanup Complete	3.2
1601	Hughes Power Plant Pipeline	Active	3.2
2645	Hughes School and Community Tank Farm	Active	3.4
26270	Alyeska PS 06 Former Fire Training Area	Active	4.3
4611	Alyeska PS 06 Former Mainline Turbine Sump	Cleanup Complete	4.4
2965	Alyeska PS 06 Leach Field/Fuel Island	Active	4.4
2529	Alyeska PS 06 Therminol Spill Site	Cleanup Complete – Institutional Controls	4.4
3115	Alyeska PS 06 Jet Shed	Cleanup Complete – Institutional Controls	4.4
1437	Alyeska PS 06 JP4 Fueling Facility	Cleanup Complete	4.4
1731	Alyeska PS 06 Former Turbine Fuel Loading	Cleanup Complete –Institutional Controls	4.4

Source: ADEC 2019
Notes: DOT&PF = Alaska Department of Transportation and Public Facilities; ADEC = Alaska Department of Environmental Conservation; BLM = Bureau of Land Management; ID = Identification; PS = Pump Station; SREB = snow removal equipment building

Table 5 describes characteristics of spill conditions and descriptions by season.

Table 5. Spill characteristics by seasons

Season	Conditions	Description
Summer (ice-free)	Most rivers and creeks are ice-free or flowing; ponds and lakes are open water; tundra is snow-free; and biological use of tundra and water bodies is high.	Currents, winds, and passive spreading forces would disperse spills that reach the water bodies. Spills to tundra would directly affect the vegetation, although the dispersal of the spilled material is likely to be impeded by the vegetation. Spills to wet tundra may float on the water or be dispersed over a larger area than would spills to dry tundra or to snow-covered tundra. Spills under pressure that spray into the air may be distributed downwind over substantial areas and affect the tundra vegetation and water bodies.
Fall (freeze-up)	Waterbodies are beginning to ice over, but the ice cover might vary, depending on temperature, wind, currents, and river flow velocities. Snow begins to cover tundra, and most of the migratory birds are leaving the North Slope.	Spilled material could be dispersed when it reaches flowing water but slowed or stopped when it reaches snow or surface ice. The spilled material could be contained by the snow or ice but dispersed if the ice breaks up and moves before it refreezes. The spilled material also could flow into ice cracks to the underlying water, where it could collect.
Winter (ice cover)	Waterbodies are covered by mostly unbroken ice, and snow covers the tundra.	Dispersal of material spilled to the tundra generally would be slowed though not necessarily stopped by the snow cover. Depending on the depth of snow cover as well as temperature and volume of spilled material, it may reach the underlying dormant vegetation or tundra ponds and lakes. Similarly, spills to rivers and creeks generally would be restricted in distribution by the snow and ice covering the waterbody, compared to seasons when there is no snow or ice cover. Spills under the ice to creeks, rivers, and tundra ponds and lakes might disperse slowly, as the currents are generally slow to nonexistent in the winter.
Spring (breakup)	Thawing begins in the higher foothills of the Brooks Range and river flows increase substantially and quickly, often to flood stages. This is a short period of the year. These increased flows cause river ice cover to break up and flow downriver. River floodwaters usually flow over sea ice, which hastens the breakup of the sea ice. Snow cover begins to melt off the tundra and many migratory species, especially birds, return to the tundra.	Spills to waterbodies during breakup are likely to be widely dispersed and difficult to contain or clean up. Spills to the tundra might be widely dispersed if the flooding overtops the river and creek banks and entrains the spilled material.

Source: Coastal Plain DEIS (BLM 2019), based on Alpine Satellite Development Plan EIS (BLM 2004)

1.4. Paleontological Resources

The Potential Fossil Yield Classification (PFYC) system allows BLM employees to make initial assessments of paleontological resources to analyze potential effects of a proposed action under the National Environmental Policy Act. The PFYC system can also highlight areas for paleontological research efforts or predict illegal collecting. The system provides a consistent and streamlined approach to determine in a potential action may affect paleontological resources.

Occurrences of paleontological resources are known to be correlated with mapped geologic units. The PFYC is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that occur in that geologic unit. PFYC assignments should be considered as only a first approximation of the potential presence of paleontological resources, subject to change, based on ground verification.

Table 6 descriptions for the class assignments below are guidelines. The assignments were developed by BLM for geologic units within the Central Yukon Planning Area boundary, using criteria outlined in the BLM Instruction Memorandum 2016-124 and summarized in the following table.

Table 6. PFYC system description

Class	PYFC system description
Class 1 – Very Low	These are geologic units that are not likely to contain recognizable paleontological resources. Management concerns for paleontological resources in Class 1 units are usually negligible or not applicable. Paleontological mitigation is unlikely to be necessary, except in very rare or isolated circumstances that result in the unanticipated presence of paleontological resources, such as unmapped geology contained in a mapped geologic unit. The probability of affecting significant paleontological resources is very low, and further assessment of paleontological resources is usually unnecessary. An assignment of Class 1 normally does not trigger a further analysis, unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized, in order to accommodate an unanticipated discovery.
Class 2 – Low	This is assigned to geologic units that are not likely to contain paleontological resources. Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary, except in occasional or isolated circumstances. Paleontological mitigation is necessary only where paleontological resources are known or found to exist. The probability of affecting significant paleontological resources is low. Localities containing important paleontological resources may exist, but they are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized to accommodate unanticipated discoveries.

Class	PYFC system description
Class 3 – Moderate	This is assigned to sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary, except in occasional or isolated circumstances. Paleontological mitigation is necessary only where paleontological resources are known or found to exist. The probability of affecting significant paleontological resources is low. Localities containing important paleontological resources may exist, but they are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized to accommodate unanticipated discoveries.
Class 4 – High	This is assigned to geologic units that are known to contain a high occurrence of paleontological resources. Management concerns for paleontological resources in Class 4 are moderate to high, depending on the proposed action. Paleontological mitigation strategies will depend on the nature of the proposed activity, but field assessment by a qualified paleontologist is normally needed to assess local conditions. The probability for affecting significant paleontological resources is moderate to high and depends on the proposed action. Mitigation planners must consider the nature of the proposed disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access that could result in looting. Detailed field assessment is normally required and on-site monitoring or spot-checking may be necessary during land-disturbing activities. In some cases, avoiding known paleontological resources may be necessary.
Class 5 – Very High	This is assigned to sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Management concerns for paleontological resources are moderate because the existence of significant paleontological resources is known to be low. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for casual collecting. Paleontological mitigation strategies will be proposed, based on the nature of the proposed activity. This classification includes units of moderate or infrequent occurrence of paleontological resources. Management considerations cover a broad range of options that may include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Surface-disturbing activities may require assessment by a qualified paleontologist to determine whether significant paleontological resources occur in the area of a proposed action and whether the action could affect the paleontological resources.

Class	PYFC system description
Class U – Unknown Potential	These are such geologic units that cannot receive an informed PFYC assignment. Until a provisional assignment is made, geologic units that have an unknown potential have medium to high management concerns. Lacking other information, field surveys are normally necessary, especially before a ground-disturbing activity is authorized. An assignment of Class U may indicate the unit or area is poorly studied, and field surveys are needed to verify the presence or absence of paleontological resources. Literature searches or consultation with professional colleagues may allow an unknown unit to be provisionally assigned to another PFYC, but the geological unit should be formally assigned to a class after adequate survey and research is performed to make an informed determination.
Class W – Water	This class is assigned to any surface area that is mapped as water. Most bodies of water do not normally contain paleontological resources; however, shorelines should be carefully considered for uncovered or transported paleontological resources.

Source: BLM 2016
Note: PFYC = Potential Fossil Yield Classification

Table 7 summarizes the PFYC acreages for the project construction footprints of each action alternative.

Table 7. PFYC acreages by alternative

PFYC	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Class 1 – Very Low	306	514	2,023
Class 2 – Low	4,212	4,617	5,762
Class 3 – Moderate	0	0	0
Class 4 – High	0	0	0
Class 5 – Very High	0	0	0
Class W – Water	6	7	19
Class U – Unknown Potential	0	0	406
Total	**4,524**	**5,138**	**8,210**

Source: USGS Scientific Investigations Map 3340, Geological Map of Alaska, GIS Data accessed online at https://mrdata.usgs.gov/sim3340/, PFYC rankings for the Central Yukon Management Planning area assigned by BLM Regional Paleontologist, March 2019. Per BLM IM 2016-124, Class U (unknown potential) has moderate-high management concerns until evaluation is performed (BLM 2016).
Note: PFYC = Potential Fossil Yield Classification

1.5. Water Resources

Table 8 summarizes temperature and precipitation levels at Coldfoot Station, including mean highs and lows, and number of years or values available for both.

Table 8. Monthly temperature and precipitation levels, Coldfoot Station

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/ values (mean)	Number of years/ values (high)	Number of years/ values (low)	Number of years/ values (precip.)
January	-6.2	1.4	-14.4	0.91	18	19	18	23
February	1.0	10.3	-8.3	1.00	21	21	21	22

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/ values (mean)	Number of years/ values (high)	Number of years/ values (low)	Number of years/ values (precip.)
March	7.6	22.0	-6.8	0.57	20	20	20	23
April	27.0	39.2	14.8	0.67	21	21	21	23
May	45.1	56.3	34.0	0.98	20	21	20	23
June	57.4	69.6	45.5	1.52	21	22	21	23
July	58.3	69.2	47.6	2.92	19	20	19	23
August	51.7	62.0	40.6	3.25	19	19	21	23
September	40.1	48.7	31.6	2.38	21	21	22	23
October	22.6	29.6	15.6	1.28	21	21	21	23
November	1.6	8.6	-5.4	0.85	21	21	21	24
December	-2.0	5.4	-9.4	1.07	19	19	19	23

Source: NCEI n.d.
Note: °F = degrees Fahrenheit; in. = inches; precip. = precipitation; temp. = temperature

Table 9 summarizes temperature and precipitation levels at Bettles Station, including mean highs and lows, and number of years or values available for both. The meteorological record at Bettles is extensive and National Centers for Environmental Information (NCEI) has produced long-term average daily values of maximum, minimum, and mean daily temperatures as well as mean daily precipitation and snowfall, presented as year to date values.

Table 9. Monthly temperature and precipitation levels, Bettles Station

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/values (mean temp.)	Number of years/values (precip.)
January	-15.9	-8.0	-23.8	1.0	16	36
February	-6.7	3.4	-16.7	1.2	15	35
March	-1.1	13.5	-15.8	0.8	15	35
April	22.6	36.0	9.2	0.8	15	35
May	41.9	54.6	29.2	1.0	15	35
June	53.9	66.9	40.9	1.3	15	35
July	54.9	66.8	43.0	2.1	15	35
August	48.8	60.0	37.7	2.7	15	35
September	36.5	45.6	27.3	2.1	14	35
October	19.0	25.9	12.0	1.4	17	35
November	-5.1	2.2	-12.5	1.0	17	36
December	-10.3	-2.8	-17.8	1.2	17	36

Source: NCEI n.d.
Note: °F = degrees Fahrenheit; in. = inches; precip. = precipitation; temp. = temperature

Table 10 summarizes temperature levels at Hogatza River Station, including mean highs and lows, and number of years or values available for both.

Table 10. Monthly temperature levels, Hogatza River Station

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Number of years/values (mean temp.)	Number of years/values (high temp.)	Number of years/values (low temp.)
January	-5.7	0.7	-12.1	7	7	7
February	5.9	14.4	-2.7	9	9	9
March	11.4	25.4	-2.6	13	13	13
April	30.6	44.0	17.2	13	13	13
May	46.5	59.6	33.4	15	15	15
June	58.5	72.0	45.2	28	28	28
July	60.2	72.1	48.3	31	31	31
August	54.0	65.0	42.9	28	28	28
September	42.9	52.5	33.4	27	27	27
October	24.8	31.9	17.6	26	26	26
November	6.7	13.4	0.0	19	20	19
December	1.0	7.0	-5.1	10	10	10

Source: NCEI n.d.
Note: °F = degrees Fahrenheit; temp. = temperature

Table 11 summarizes temperature and precipitation levels at Selawik Station, including mean highs and lows, and number of years or values available for both.

Table 11. Monthly temperature and precipitation levels, Selawik Station

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/values (temp.)	Number of years/values (precip.)
January	-5.7	2.0	-13.3	0.33	2	2
February	-0.2	7.3	-7.6	0.27	2	3
March	-0.4	8.5	-9.3	0.36	2	3
April	23.8	32.5	15.2	0.25	3	3
May	42.0	51.7	32.3	1.01	3	3
June	55.4	65.1	45.7	0.91	3	3
July	60.8	68.9	52.7	1.78	3	3
August	53.2	61.0	45.6	2.81	3	3
September	42.5	50.5	34.5	1.44	4	4
October	30.2	36.3	24.1	1.39	4	4
November	12.5	18.7	6.3	0.43	3	3
December	8.1	15.1	1.2	0.76	2	2

Source: NCEI n.d.
Note: precip. = precipitation; temp. = temperature; in. = inches; °F = degrees Fahrenheit

Table 12 summarizes temperature levels at Kiana Station, including mean highs and lows, and number of years or values available for both.

Table 12. Monthly temperature levels, Kiana Station

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Number of years/values
January	-2.0	4.6	-8.6	12
February	1.8	9.6	-6.0	16
March	5.2	15.3	-4.8	17
April	23.3	33.2	13.4	20
May	41.3	51.2	31.3	21
June	54.7	65.2	44.1	25
July	58.0	67.4	48.7	28
August	52.4	61.4	43.5	28
September	41.7	50.0	33.5	27
October	24.8	30.8	18.8	25
November	5.4	11.3	-0.6	18
December	0.2	6.6	-6.2	13

Source: NCEI n.d.
Note: °F = degrees Fahrenheit; temp. = temperature

Table 13 lists the large rivers in the project area, including their headwater origin and receiving waters, drainage areas, and alternatives crossings.

Table 13. Large rivers in the project area

Large river	Headwater origin	Receiving water	Route alternatives crossing
Koyukuk River	Chandalar Shelf/Brooks Range	Yukon River	A, B, C
Wild River	Brooks Range	Koyukuk River	A, B
John River	Brooks Range	Koyukuk River	A, B
Malamute Fork Alatna River	Brooks Range	Alatna River	A, B
Alatna River	Brooks Range	Koyukuk River	A, B
Indian River	Indian Mountains	Koyukuk River	C
Hughes Creek	Hogatza Hills	Koyukuk River	C
Hogatza River	Helpmejack Hills	Koyukuk River	B, C
Yukon River	Coastal Range, Northern British Columbia	Bering Sea	None
Ray River	Ray Mountains	Yukon River	C
Big Salt River	Ray Mountains	Yukon River	C
Tozitna	Ray Mountains	Yukon River	C

Large river	Headwater origin	Receiving water	Route alternatives crossing
Melozitna	Slokhenjikh Hills	Yukon River	C
Kobuk River	Brooks Range	Chukchi Sea	A, B, C
Reed River	Brooks Range	Kobuk River	A, B
Beaver Creek	Brooks Range	Kobuk River	A, B
Mauneluk RIver	Brooks Range	Kobuk River	A, B
Kogoluktuk River	Brooks Range	Kobuk River	A, B
Shungnak River	Brooks Range	Kobuk River	A, B, C

Source: USGS n.d.

Hydrologic data within the project area is limited, with only 3 currently operating USGS gages: 15564879 Slate Creek at Coldfoot, 15743850 Dahl Creek near Kobuk, and 15453500 Yukon River near Stevens Village (at the Dalton Highway crossing). Additional information is available for discontinued USGS gages for 15564885 Jim River near Bettles, 15564900 Koyukuk River at Hughes, and 15564875 Middle Fork of the Koyukuk River near Wiseman. All stations include water quality information. The U.S. Fish and Wildlife Service (USFWS) is currently monitoring 8 gage stations within the Kanuti National Wildlife Refuge (NWR), including the Koyukuk River near Bettles just downstream from its confluence with the John River. Table 14 summarizes drainage data from the U.S. Geological Survey (USGS) gages in the project area and vicinity, by station. Map 3-5 in Volume 4 depicts the locations of the gages.

Table 14. USGS gages in the project area and vicinity

USGS ID	Station name and nearby town	Coordinates (NAV27)[a]	Drainage area (sq. mi.)	Period of record	Type of data[b]
15453500	Yukon River near Stevens Village (Dalton Highway Crossing)	65°52'32" N 149°43'04" W	194,000	October 1991–current	Discharge, field measurements, water-quality measurements
15564875	Middle Fork of the Koyukuk River near Wiseman	67°26'18" N 150°04'30" W	1,170	January 1970–September 1987	Discharge, field measurements, water-quality measurements
15564879	Slate Creek at Coldfoot	67°15'16" N 150°10'38" W (NAD83)	73.1	May 1995–current	Discharge, temperature, field measurements, water-quality measurements
15564885	Jim River near Bettles	66°47'10" N 150°52'23" W	458	August 1970–September 1977	Discharge, field measurements, water-quality measurements
15564900	Koyukuk River at Hughes	66°02'51"N 154°15'30" W	17,990	January 1960–September 1982	Discharge, field measurements, water-quality measurements
15743850	Dahl Creek near Kobuk	66°56'46" N 156°54'32" W	10.9	September 1994–current	Discharge, field measurements

Source: USGS 2019
Notes: N = North; W = West; sq. mi. = square mile; USGS = U.S. Geological Survey
[a] NAV27 is used unless otherwise noted.

Kane et al. (2015) monitored gages and water quality at 5 river stations: the Koyukuk River near Bettles (in cooperation with the USFWS), the South Fork of Bedrock Creek (tributary to the Alatna), Alatna River, Kobuk River, and Reed River. The last 4 stations were close to the Alternative A alignment. Table 15 summarizes location information for the University of Alaska Fairbanks (UAF) Water and Environmental Research Center gages, by station. Volume 4, Map 3-5, depicts the locations of these gages.

Table 15. University of Alaska Fairbanks – Water and Environmental Research Center gages

Station	Basin	Location	Period of record	Data types[a]
Alatna River	Alatna	67.022°N 153.302°W	July 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
Bettles	Koyukuk	66.9064°N 151.6772°W	September 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
Reed River	Kobuk	66.9973°N 151.6772°W	July 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
S. Fork Bedrock Creek	Alatna	67.0924°N 152.7292°W	July 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
Upper Iniakuk	Alatna	67.1354°N 153.1354°W	July 2012 to Aug 2015	Meteorological
Upper Kogoluktuk	Kobuk	67.3071°N 156.2446°W	July 2012 to August 2015	Meteorological
Upper Reed	Kobuk	67.1853°N 154.9361°W	July 2012 to August 2015	Meteorological
Wild	Koyukuk	67.4152°N 151.6837°W	July 2012 to August 2015	Meteorological

Source: Kane et al. 2015
Notes: H = Hydrological; M= Meteorological; N = North; W = West
Meteorological data includes air temperature, relative humidity, wind speed, wind direction, snow depth, soil moisture, soil temperature, barometric pressure, net radiation, and rainfall. Four stations were close to the proposed Alternative A and B alignments, and 4 sites were farther north and upslope in the river basins to provide information on variations with altitude.
[a] Hydrologic data include water level, turbidity, suspended sediment, and water velocity.

Table 16 identifies Alaska Department of Natural Resources (ADNR)-listed permits, certificates, and pending actions for surface and subsurface water uses within approximately 5 miles of project alternatives.

Table 16. ADNR-listed surface and subsurface water uses

Water type	ADNR file type and number	Name	Distance from alternative in miles	Description
Subsurface	ADL 400049	Helmericks	4.6 (Alternative A)	Drilled well, 500 GPD
Subsurface	LAS 21006	City of Kobuk	1.6 (Alternative C)	Public water supply for homes, water treatment plant, washateria, and school

Water type	ADNR file type and number	Name	Distance from alternative in miles	Description
Subsurface	LAS 3454	Bamford	1.8 (Alternative C)	Water withdrawn from drilled well and unnamed tributary to Hogatza River
Subsurface	ADL 67134	City of Hughes	3.3 (Alternative C)	Drilled well, 4,000 GPD
Subsurface	ADL 53264	Yukon Koyukuk School District	3.3 (Alternative C)	Drilled well for grade school, 5,000 GPD
Subsurface	LAS 6660	Alyeska Pipeline Services	0.5 (Alternative C)	Drilled well for Pump Station 6, 10,000 GPD
Subsurface	LAS 3037	Sukakpak Inc.	3.0 (Alternative C)	Drilled well at gas station, 8,000 GPD
Surface	ADL 75781	Stewart, deceased	4.8 (Alternative A); 4.8 (Alternative B); 2.9 (Alternative C)	Water for gold mining sourced from Dahl, Harry, and Wye creeks
Surface	TWUA P2018-128	City of Shungnak	5.2 (Alternative C)	Withdrawal from Kobuk River for public water supply, 16,000 GPD

Source: ADNR 2019
Notes: ADL = Alaska Division of Lands; ADNR = Alaska Department of Natural Resources; GPD = gallons per day; LAS = Land Administration System; TWUA = Temporary Water Use Authorization

Table 17 estimates floodplain area impacted by the installation of crossing structures. The average culvert length is assumed to be 96 feet, which is the proposed typical Phase III road width (32 feet lane road surface width, constructed with 8 feet of fill and 4:1 slopes). Minor culverts are assumed to be 3 feet in diameter, moderate culverts are 10 feet in diameter, and major culverts are 20 feet in diameter. Small bridges are assumed to be 50 feet long, medium bridges are assumed an average of 120 feet long, and large bridge lengths are calculated based on estimated individual bridge lengths. Floodplain impact width is 3 times the culvert diameter/bridge length, and floodplain impact length extends 5 times the culvert diameter/bridge length upstream and downstream of the crossing structure.

Table 17. Approximated floodplain area impacts by crossing structures

Structure type	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Number of minor culverts (≤ 3 feet)	2,869	3,155	4,076
Number of moderate culverts (≤ 10 feet)	15	12	131
Number of major culverts (≤ 20 feet)	19	12	141
Number of small bridges (≤ 50 feet)	3	3	79
Medium bridges (≤ 140 feet)	15	12	158
Large bridges (≥ 140 feet)	11	11	14

Structure type	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Approximated floodplain area impacted by culverts	84	88	181
Approximated floodplain impacts by bridges	2,025	2,021	4,345
Total approximated floodplain impacts	2,110	2,110	4,526

Source: AIDEA
Note: This analysis has been performed to estimate relative impacts. Hydrology investigations during design would inform the specific number, placement and size of each crossing structure to be constructed.

Table 18 summarizes water quality impacts estimated based on the miles of roadway embankment either in the floodplain or within 1,000 feet of the floodplain. This analysis seeks to include impacts associated with linear infrastructure construction alongside water bodies. Embankment erosion and spills would have a higher likelihood to enter rivers and streams within 1,000 feet of floodplain.

Table 18. Roadway impacts on water quality

Measurement	Alternative A	Alternative B	Alternative C
Miles of alignment in the floodplain (including crossings)	4.6	5.4	53.6
Miles of alignment located within 1,000 feet of floodplain	16.1	17.3	96.3
Total Miles of alternative	211	228	332
Percent alternative impacting or within 1,000 feet of floodplain	8%	8%	29%

Notes: Floodplain impacts are estimated by the floodplain vegetation mapping layer intersected by the alignment alternatives. Miles of alignment within 1,000 feet of floodplain includes the miles that are in the floodplain.

1.6. Air Quality and Climate

No tables or supplemental information.

1.7. Acoustical Environment (Noise)

Table 19 summarizes noise levels generated by individual pieces of typical construction equipment and construction operations. These include stationary noise equipment such as generators and pumps that produce constant levels of noise, and jackhammers and pile drivers that produce impulsive, high-intensity, short-duration noise levels. Mobile equipment such as trucks and earth moving equipment can have different power cycles and is expected to move locations over time. Noise levels are reported at 50 feet, and attenuate over distance. See Attachment A, Predictive Noise Modeling of the Ambler Road, for further information.

Table 19. Construction equipment noise emission reference levels

Equipment description	Impact device?	Lmax at 50 feet (dBA)
Auger drill rig, rock drill	No	85
Blasting	Yes	94
Compactor (ground)	No	80
Dozer, excavator, grader, scraper, other (greater than 5HP)	No	85
Drill rig, dump, or flatbed trucks	No	84
Front end loader	No	80
Generator	No	82
Impact pile driver	Yes	95
Jackhammer	Yes	85
Pickup truck	No	55
Pneumatic tools	No	85
Pumps	No	77
Vibratory pile driver	No	95
Warning horn	No	85

Source: FHWA 2006:Table 9.1
Note: L_{max} = maximum noise level; dBA = A-weighted decibels; HP = horsepower

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Attachment A:

Predictive Noise Modeling of the Ambler Road

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Appendix E:

Chapter 3 Biological Resources Tables and Supplemental Information

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Table of Contents

Tables

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1. Affected Environment and Environmental Consequences – Biological Resources

1.1. Vegetation and Wetlands

1.1.1 Affected Environment

Vegetation

Table 1 describes affected ecoregions in the project area (see also Volume 4, Maps, Map 3-7).

Table 1. Ecoregions and descriptions

Ecoregion	Description
Brooks Range	This east-west range is the northernmost extension of the Rocky Mountains and includes the Brooks Range, British Mountains, and Richardson Mountains. Many of the mountains are comprised of steep, angular summits flanked by rubble and scree. On the western and eastern ends of the range, the topography becomes less rugged. Rivers and streams cut narrow ravines into the terrain. During the Pleistocene, glaciers covered the higher portions of the range. Only a few small cirque glaciers remain. A dry, polar climate dominates the land. Winters are long and cold, and summers are short and cool. Air temperatures decrease rapidly with increased elevation. Permafrost is mostly continuous south of the ridge crest. Dominant vegetation classes on the south side of the range are sedge tussocks and shrubs in valleys and lower slopes, sparse conifer-birch forests in large valleys, and alpine tundra and barrens at higher elevations. The ecoregion provides habitat for Dall sheep, caribou, marmots, gray wolves, and brown bears. Groundwater fed springs and streams provide habitat for Arctic grayling and Dolly Varden.
Kobuk Ridges and Valleys	The Kobuk ridges and valleys ecoregion is comprised of a series of paralleling ridges and valleys that radiate south from the Brooks Range, created partially by high-angle reverse faults and interceding troughs. In the past, ice sheets descending from the north covered the area. Alluvial and glacial sediments cover the broad valleys, while rubble covers the intervening ridges. The climate is dry continental with long, cold winters and short, cool summers. During winter, cold air drains from the Brooks Range into the valleys. Permafrost is thin to moderately thick throughout much of the area. Forests and woodlands dominate much of the area. Trees become increasingly sparse in the west. Tall and short shrub communities of birch, willow, and alder occupy ridges.
Ray Mountains	The Ray Mountains are comprised of compact, east-west oriented ranges. Rubble covers the metamorphic bedrock, and soils are shallow and rocky. During the Pleistocene, the Ray Mountains remained largely unglaciated. The climate is continental with dry, cold winters and somewhat moist, warm summers. Permafrost is discontinuous and ranges from thin to moderately thick. Dominant vegetation classes are black spruce woodlands; white spruce, birch, and aspen on south-facing slopes; white spruce, balsam poplar, alder, and willows on floodplains; and shrub birch and Dryas-lichen tundra at higher elevations. Clear headwater streams are important habitat for Arctic grayling. Moose, brown bears, gray wolves, red fox, lynx, and marten are common.

Source: Boucher et al. 2016 in Trammell et al. 2016
Note: Only affected ecoregions are described.

Table 2 describes the vegetation types that occur in the project area (see also Volume 4, Map 3-8).

Table 2. Vegetation types and descriptions

Vegetation type	Description
Alpine and Arctic Tussock Tundra	Generally composed of tussock-forming sedges, often in combination with dwarf and low shrubs. Tussock cottongrass (*Eriophorum vaginatum)* is often the dominant sedge species. Shrubs tend to provide at least 25% cover and include ericaceous, willow (*Salix* spp.), and birch (*Betula* spp.) species. Herbaceous cover and diversity are low and often includes bluejoint grass (*Calamagrostis* spp.)
Alpine Dwarf Shrub Tundra	Widespread above the tree line on ridges, summits, side slopes, late-lying snow beds, and high elevation valleys. Plant species and vegetation community diversity is high. Vegetation is usually composed of dwarf evergreen or deciduous shrubs and may also include grasses, sedges, and lichen.
Upland Low and Tall Shrub	Dominates the landscape above the tree line, but below alpine dwarf shrubs on sites with deep active layers and well-drained soils, such as riparian zones and side slopes. The low shrub tundra type generally occurs above the tree line, dominated by birch and low willow species. Tall shrub thickets are often composed of alder (*Alnus* spp.) and willow species and occur on side slopes, drainages, and avalanche terrain.
Upland Mesic Spruce Forest	Often occurs near elevational tree line. Generally characterized by woodland and open forest canopies with a well-developed dwarf and low shrub understory. White spruce is often the dominant conifer. The shrub layer is typically composed of bog blueberry (*Vaccinium uliginosum)*, Labrador tea (*Rhododendron* spp.), tealeaf willow (*Salix pulchra),* and birch species. Feathermoss groundcover is common.
Upland Mesic Spruce Hardwood Forest	Generally occurs on well-drained slopes on eastern, southern, or western aspects. Forest composition comprises all post-fire seral stages, including conifer, deciduous, or mixed forest. Dominant species include white spruce, Alaska birch *(Betula neoalaskaana)*, and trembling aspen (*Populus tremuloides)*. A variety of shrub species, such as green alder (*Alnus viridis)*, resin birch (*Betula glandulosa),* and Labrador tea species, commonly occur. The herbaceous cover and species diversity is low.
Riparian Forest and Shrub	Occurs where fluvial processes are the major disturbance and includes a mix of successional stages linked to flooding frequency. Balsam poplar *(Populus balsamifera)* is the dominant deciduous tree and white spruce (*Picea glauca)* may be co-dominant or dominant. Alder or willow species usually dominate the shrub canopy. The herbaceous layer composition is diverse and varies by substrate type and successional stage.
Lowland Woody Wetland	Occurs on gently sloping to flat lowland terrain. Generally composed of coniferous wetlands and associated sedge-shrub bogs and fens that form mosaics of forested and non-forested wetland habitats. Dominant vegetation may include black spruce (*Picea mariana),* sedges (*Carex* spp.), cottongrass, and ericaceous and birch species.

Source: Boucher et al. 2016 in Trammell et al. 2016
Note: Descriptions do not include unvegetated barren landcover or open water.

Table 3 lists the percentages of each vegetation type within Study Areas A, B, and C.

Table 3. Percentage of vegetation types that occur within the extent of Volume 4, Map 3-8

Vegetation type	Percent of assessment area (%)
Alpine Arctic Tussock Tundra	5.7
Alpine Dwarf Shrub Tundra	14.5
Upland Low and Tall Shrub	29
Upland Mesic Spruce Forest	22
Upland Mesic Spruce Hardwood Forest	7
Riparian Forest and Shrub	5.3
Lowland Woody Wetland	4.5
Emergent Herbaceous Wetlands	0.3
Grassland/Herbaceous	0.4
Sedge/Herbaceous	0.9
Moss	<0.1
Barren Land	1.9
Developed	<0.1
Perennial Ice/Snow	<0.1
Open Water	1.3
Unmapped	7.1[a]
Total assessment area	**100.0**

Source: Boucher et al. 2016 in Trammell et al. 2016
[a]Unmapped area occurs well outside of the area that would be affected by the project.

Wetlands

Waters of the U.S. (WOTUS) are defined as "surface waters, including streams, streambeds, rivers, lakes, reservoirs, arroyos, washes, and other ephemeral watercourses and wetlands" (33 Code of Federal Regulations [CFR] 328.3(a)). Wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3(b)). Wetlands are a subset of WOTUS and must possess the following: (1) a vegetation community dominated by plant species, typically adapted for life in saturated soils; (2) inundation or saturation of the soil during the growing season; and (3) soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions (USACE 1987, 2007). Table 4 and Table 5 describe the wetland and waterbody types found in the study areas (see also Volume 4, Map 3-9).

Table 4. Description of wetland and waterbody types in the study areas

Wetland and waterbody types	Description
Palustrine Forested (PFO; Freshwater Forested/Shrub Wetland)	Vegetated wetlands characterized by woody plants that are 20 feet tall or taller and exceeding 25% cover. Functions may include nutrient and toxicant removal, general habitat suitability, and native plant species richness.
Palustrine Scrub-shrub (PSS; Freshwater/Shrub Wetland)	Vegetated wetlands dominated by woody vegetation less than 20 feet tall. Species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions. Functions may include flood flow alteration, nutrient and toxicant removal, and general habitat suitability.
Palustrine Emergent (PEM; Freshwater Emergent Wetland)	Vegetated wetlands characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Perennial plants usually dominate these wetlands. Functions may include flood flow alteration, nutrient and toxicant removal, erosion control, shoreline stabilization, and general habitat suitability.
Palustrine Moss-Lichen (PML; Freshwater Bryophyte)	Vegetated wetlands that include areas where mosses or lichens cover substrates other than rock and where emergent, shrubs, or trees make up less than 30% of the areal cover.
Palustrine Waterbody (Freshwater Pond)	Generally characterized as waterbodies (ponds) less than 20 acres in size, lacking active wave-formed or bedrock shoreline features no deeper than 6.6 feet, and salinity less than 0.5 ppt. Functions may include sediment removal, nutrient and toxicant removal, erosion control, shoreline stabilization, and general habitat suitability.
Lacustrine Waterbody (lake or deep pond)	Generally characterized as wetlands and deepwater habitats (lake or deep pond) with the following characteristics: situated in a topographic depression or a dammed river channel; lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with 30% or greater areal coverage; total area of at least 20 acres; and salinity less than 0.5 ppt.
Riverine	Generally includes all wetlands and deepwater habitats that are contained within a channel, with the following exceptions: wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens; and habitats with water containing ocean-derived salts of 0.5 ppt or greater.
Estuarine and Marine Deepwater	Does not occur within project area.

Sources: ACCS 2019a; Cowardin et al. 1979; DOWL 2014
Note: ppt = parts per thousand

Table 5. Wetland and waterbody types in the study areas

Wetland and waterbody types	Aggregated wetland type	Description
PFO1	PFO	Forested wetlands dominated by broad-leaved evergreen tree species
PFO1/4	PFO	Forested wetlands dominated by broad-leaved evergreen tree species and co-dominated by needle-leaved evergreen tree species
PFO1/SS1	PFO	Forested wetlands dominated by broad-leaved evergreen tree species with broad-leaved deciduous scrub-shrub understory
PFO4	PFO	Forested wetlands dominated by needle-leaved evergreen tree species
PFO4/1	PFO	Forested wetlands dominated by needle-leaved evergreen tree species and co-dominated by broad-leaved evergreen tree species

Wetland and waterbody types	Aggregated wetland type	Description
PFO4/SS1	PFO	Forested wetlands dominated by needle-leaved evergreen tree species with broad-leaved deciduous scrub-shrub understory
PFO4/SS4	PFO	Forested wetlands dominated by needle-leaved evergreen tree species with a needle-leaved evergreen scrub-shrub understory
PML	PML	Wetlands dominated by moss and lichen with less than 30% cover of other vegetation
PSS1	PSS	Scrub-shrub wetlands dominated by broad-leaved deciduous species
PSS1/3	PSS	Scrub-shrub wetlands dominated by broad-leaved deciduous species and co-dominated by broad-leaved evergreen species
PSS1/4	PSS	Scrub-shrub wetlands dominated by broad-leaved deciduous species and co-dominated by needle-leaved evergreen scrub-shrub species
PSS3	PSS	Scrub-shrub wetlands dominated by broad-leaved evergreen species
PSS4	PSS	Scrub-shrub wetlands dominated by needle-leaved evergreen scrub-shrub species
PSS4/1	PSS	Scrub-shrub wetlands dominated by needle-leaved evergreen scrub-shrub species and co-dominated by broad-leaved deciduous species
PSS1/EM1	PSS	Scrub-shrub wetlands dominated by broad-leaved deciduous scrub/shrub species with persistent emergent plant species as groundcover
PSS4/EM1	PSS	Scrub-shrub wetlands dominated by needle-leaved evergreen scrub-shrub with persistent emergent plant species as groundcover
PSS1/FO4	PSS	Scrub-shrub wetlands dominated by broad-leaved deciduous species and co-dominated by needle-leaved evergreen tree species
PEM1	PEM	Emergent wetlands dominated by persistent non-woody species, such as sedges, that remain standing at least until the beginning of the next growing season
PEM1/SS1	PEM	Emergent wetlands dominated by persistent non-woody species, such as sedges, that remain standing at least until the beginning of the next growing season and are co-dominated by broad-leaved scrub-shrub species
PUB	Palustrine waterbody (Pond)	Palustrine waterbody with unconsolidated bottom
L1UB	Lacustrine waterbody (lake)	Lacustrine limnetic unconsolidated bottom characterized by deep-water habitats with over 6.6 feet of water and surface area larger than 20 acres
L2UB	Lacustrine waterbody (lake)	Lacustrine littoral unconsolidated bottom characterized by shallow (less than 6.6 feet), nearshore portion of deep-water habitats with a surface area larger than 20 acres
R2	Riverine	Lower perennial river or stream
R3	Riverine	Upper perennial river or stream

Sources: Cowardin et al. 1979; DOWL 2014, 2019; USFWS 1995
Notes: EM = Emergent; FO = Forested; L = Lacustrine; PAB = Palustrine Aquatic Bed; PEM = Palustrine Emergent; PFO = Palustrine Forested; PML = Palustrine Moss-Lichen; PSS = Palustrine Scrub-shrub; PUB = Palustrine Unconsolidated Bottom; R = Riverine; SS = Scrub-shrub; UB = Unconsolidated Bottom

Table 6. ACCS wetland types that occur within the extent of Volume 4, Map 3-9

ACCS wetland type	Percent of assessment area (%)[a]
Freshwater Bryophyte Wetland	0.1
Freshwater Emergent Wetland	1.7
Freshwater Forested/Shrub Wetland	10.1
Total freshwater wetlands	**11.9**
Freshwater Pond	0.3
Lake	0.8
Riverine	0.9
Estuarine and Marine Deepwater	<0.1
Total waterbodies	**2.0**
Total wetland and waterbodies	**13.8**
Upland	86.2
Total assessment area	**100.0**

Source: ACCS 2019
Note: ACCS = Alaska Center for Conservation Science.
[a] Percent rounded to nearest 0.10.

The analysis used coarse-scale Alaska Center for Conservation Science (ACCS) wetland mapping (ACCS 2019a) to provide broad context (see Volume 4, Map 3-9) and finer-scale (1 inch equals 1,000 feet or less) wetland mapping, and to assess specific wetland types. DOWL (2014) prepared field-verified mapping, for Alternatives A and B, apart from the eastern 50 miles of the two alignments. Field-verified mapping was not available for Alternative C. DOWL (2019) also prepared coarser-scale (1 inch equals 1,000 feet) desktop mapping, which was used where field-verified mapping was unavailable. This analysis mapped wetland types using the National Wetlands Inventory (NWI) classification system (Cowardin et al. 1979). For a description of field efforts and mapping methods, see DOWL (2014). Also see DOWL (2012, 2014, 2016) and ABR (2017) for reports on wetlands associated with the project.

Wetland delineation mapping conducted by DOWL in 2014 was completed using ArcMap GIS; a geo-referenced aerial photograph from 2012 was used as a base to digitally map wetlands, vegetation community boundaries, and riverine habitats and to then calculate habitat size. Final mapping was based on aerial photograph interpretation, site photographs, Light Detection and Ranging (LiDAR) 2-foot contours, and 1:24,000 scale hydrologic stream data. Field data was used to ground truth aerial photograph interpretations of preliminarily mapped communities. Polygons were coded as wetland or upland and provided Cowardin and Alaska Vegetation Classifications.

Wetland delineation mapping conducted by DOWL in 2019 was completed using publicly available aerial imagery services to delineate habitat types based on landscape position, water sources, vegetation structure, and topography. Creation of habitat boundary polygons used a scale of 1 inch = 1,000 feet. Minimum mapped polygon size was approximately of 0.25 acre. Other resources used for aerial interpretation of wetlands included National Wetland Inventory maps and United States Geological Survey (USGS) National Hydrography Dataset. The best available imagery from multiple publicly available sources, including ESRI World Imagery, Bing, and Alaska Department of Natural Resources, were used for delineation purposes. Polygons were coded as wetland or upland and provided Cowardin and Alaska Vegetation Classifications.

Table 7 lists the rare plants in the project area (see also Volume 4, Map 3-10).

Table 7. Rare plants in the project area

Common name	Scientific name	State rank	Global rank	BLM[a]
Alaska moonwort	*Botrychium alaskense*	S3	G4	Watch List
Baikal sedge	*Carex sabulosa ssp. leiophylla*	S1	G5	N/A
Bristleleaf sedge	*Carex eburnea*	S3	G5	N/A
Drummond's rockcress	*Boechera stricta*	SU	G5	N/A
False melic	*Schizachne purpurascens*	S2	G5	N/A
Field locoweed	*Oxytropis tananensis*	S3/S4Q	GNR	N/A
Fowl mannagrass	*Glyceria striata*	S3	G5	N/A
Fragile rockbrake	*Cryptogramma stelleri*	S3/S4	G5	N/A
Glacier buttercup	*Ranunculus camissonis*	S3	GNR	Watch List
Hudson bay sedge	*Carex heleonastes*	S3	G4	N/A
Knotted rush	*Juncus nodosus*	S1/S2	G5	N/A
Kokrine's locoweed	*Oxytropis kokrinensis*	S3	G3	Sensitive
Lapland Sedge	*Carex lapponica*	S3/S4	G4/G5Q	N/A
Longstem sandwort	*Arenaria longipedunculata*	S3/S4	G3/G4Q	Watch List
MacKenzie Valley mannagrass	*Glyceria pulchella*	S3/S4	G5	N/A
Northern bugleweed	*Lycopus uniflorus*	S3S4	G5	N/A
Northern fescue	*Festuca viviparoidea* and *Festuca viviparoidea ssp. viviparoidea*	SU	G4/G5	N/A
Northern sedge	*Carex deflexa var. deflexa*	S2/S3	G5	Watch List
Richardson's phlox	*Phlox richardsonii*	SU	G4	N/A
Rock stitchwort	*Minuartia dawsonensis*	S3S4	G5	N/A
Selkirk's violet	*Viola selkirkii*	S3/S4	G5?	N/A
Siberian oatgrass	*Trisetum sibiricum ssp. litorale*	S3	G5/T4Q	N/A
Siberian polypody	*Polypodium sibiricum*	S3	G5?	N/A
Small-leaf bittercress	*Cardamine blaisdellii*	S3/S4	G3/G4	Watch List
Thinleaf cottonsedge	*Eriophorum viridicarinatum*	S2/S3	G5	N/A
Umbrella starwort	*Stellaria umbellata*	S3/S4	G5	N/A
Western quillwort	*Isoetes occidentalis*	S3/S4	G4/G5	N/A
Yellow avens	*Geum aleppicum ssp. strictum*	S3	G5/T5	N/A
Yellow lady's slipper	*Cypripedium parviflorum var. exiliens*	S2/S3	G5	Watch List
Yukon aster	*Symphyotrichum yukonense*	S3	G3	Sensitive
Yukon lupine	*Lupinus kuschei*	S2	G3/G4	N/A

Source: ACCS, UAA 2019a; BLM 2019
Note: BLM = Bureau of Land Management; N/A = Not Applicable
[a] BLM (2019) Special Status Species list is updated every 3 years and therefore subject to change.

Non-native and Invasive Plants

Executive Order (EO) 13112 and 64 CFR 6183 define non-native plant species as species that are alien to a particular ecosystem; EO 13112 and 64 CFR 6183 define invasive species as non-native species whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. Table 8 lists the invasive, non-native plant species recorded within or near the study areas, including their invasiveness potential and legal status (see also Volume 4, Map 3-11).

Table 8. Invasive non-native plant species recorded within the vicinity of the project area

Common name	Scientific name	Invasiveness rank[a]	Invasiveness category[a]	Legal status[b]
Alfalfa	*Medicago sativa L. ssp. sativa*	59	Modestly Invasive	None
Alsike clover	*Trifolium hybridum L.*	57	Modestly Invasive	None
Bird vetch	*Vicia cracca L. ssp. cracca*	73	Highly Invasive	Restricted
Bird's-foot trefoil	*Lotus corniculatus L.*	65	Moderately Invasive	None
Blue lettuce	*Lactuca tataricav (L.) C.A. Mey.*	Not ranked	Not ranked	None
Butter and eggs	*Linaria vulgaris P. Mill.*	69	Moderately Invasive	Restricted
Charlock mustard	*Sinapis arvensis L.*	Not ranked	Not ranked	None
Common dandelion	*Taraxacum officinale F.H. Wigg.*	58	Modestly Invasive	None
Common pepperweed	*Lepidium densiflorum Schrad.*	25	Very Weakly Invasive	None
Common plantain	*Plantago major L.*	44	Weakly Invasive	None
Common tansy	*Tanacetum vulgare L.*	60	Moderately Invasive	None
European bird cherry	*Prunus padus L.*	74	Highly Invasive	None
Foxtail barley	*Hordeum jubatum L.*	63	Moderately Invasive	None
Herb Sophia	*Descurainia sophia (L.) Webb ex Prantl*	41	Weakly Invasive	None
Icelandic poppy	*Papaver croceum Ledeb.*	39	Very Weakly Invasive	None
Italian tyegrass	*Lolium multiflorum Lam.*	41	Weakly Invasive	None
Lambsquarters	*Chenopodium album L.*	37	Very Weakly Invasive	None
Lupine clover	*TrifoliumtlupinasterwL.*	Not ranked	Not ranked	None
Meadow foxtail	*Alopecurus pratensis L.*	52	Modestly Invasive	None
Narrowleaf hawksbeard	*Crepis tectorum L.*	56	Modestly Invasive	None
Narrowleaf hawkweed	*Hieracium umbellatum L.*	51	Modestly Invasive	None
Orange hawkweed	*Hieracium aurantiacum L.*	79	Highly Invasive	Prohibited
Oxeye daisy	*Leucanthemum vulgare Lam.*	61	Moderately Invasive	None

Common name	Scientific name	Invasiveness rank[a]	Invasiveness category[a]	Legal status[b]
Pineappleweed	*Matricaria discoidea DC.*	32	Very Weakly Invasive	None
Prostrate knotweed	*Polygonum aviculare L.*	45	Weakly Invasive	None
Quackgrass	*Elymus repens (L.) Gould*	59	Modestly Invasive	Prohibited
Red sandspurry	*Spergularia rubra (L.) J.& K. Presl*	34	Very Weakly Invasive	None
Shepherd's purse	*Capsella bursa-pastoris (L.) Medik.*	40	Weakly Invasive	None
Siberian peashrub	*Caragana arborescens Lam.*	74	Highly Invasive	None
Smooth brome	*Bromus inermis Leyss.*	62	Moderately Invasive	None
Spreading bluegrass or Kentucky bluegrass	*Poa pratensis L. ssp. irrigata (Lindm.) H. Lindb. or Poa pratensis L. ssp. pratensis*	52	Modestly Invasive	None
White sweetclover	*Melilotus albus Medik.*	81	Extremely Invasive	None
Yellow sweetclover [c]	*Melilotus officinalis (L.) Lam.*	69	Moderately Invasive	None

Sources: ADNR 2019; ANHP 2019; Carlson et al. 2008; Trammell et al. 2016

[a] Invasiveness category is based on invasiveness rank scores, which were developed based on total scores from 21 assessment questions used by Carlson et al. (2008). Scores >80 = "Extremely Invasive;" 70–79 = "Highly Invasive;" 60–69 = "Moderately Invasive;" 50–59 = "Modestly Invasive;" 40–49 = Weakly Invasive;" < 40 = "Very Weakly Invasive"

[b] Restricted species are generally considered nuisances or economically detrimental, but can be controlled more easily.

[c] Per the BLM, it should be noted that yellow sweetclover records are the result of a recording error. These data actually reflect white sweetclover.

Wildfire Ecology and Management

Table 9 describes the fire management options that are currently planned in the project area (see also Volume 4, Map 3-14).

Table 9. Fire management options planned in the project area

Fire management option	Description
Critical	Lands in wildland urban interface and other densely populated areas where there is an immediate threat to human life, primary residences, inhabited property, community-dependent infrastructure, and structural resources designated as National Historic Landmarks should be considered for this designation. This classification is applicable to an entire village or town as well as a single inhabited structure. Excluding fire from Critical Management Option areas may necessitate vegetation (fuels) management projects to reduce and mitigate the risks of damage from a wildfire.

Fire management option	Description
Full	This option provides for protection of moderately populated areas, cultural and paleontological sites, developed recreational facilities, physical developments, administrative sites and cabins, structures, high-value natural resources, and other high-value areas. Structures on or eligible for inclusion on the National Register of Historic Places and non-structural sites on the National Register are placed within this category. Either broad areas or specific sites qualify to be designated as Full. The long-range effects on fire-dependent ecosystems are a land management consideration when designating Full at the landscape scale. The attempt to exclude fire may necessitate implementing vegetation (fuels) management programs.
Modified	This option provides a management level between Full and Limited. It allows for a response to wildfire that tailors the initial action to the time of year that the fire starts. It provides for an initial response designed to protect identified sites early in the season when the probability is high that they will eventually be affected; but later in the year allows fire-related land-use and resource objectives to be accomplished in a cost-effective manner while still providing appropriate levels of site protection. The option is based on the assumption that in a normal fire year early season ignitions are more likely to spread to the point that they threaten values than late season ignitions. Prior to a pre-identified “conversion date” the initial response to a fire is similar to the Full Management Option, recognizing that lands placed in this category will usually be suited to indirect attack. After the conversion date, when it is less likely that the fire will spread and threaten values, the initial response is similar to the Limited Management Option in order to balance acres burned with suppression costs, and to accomplish land and resource management objectives when conditions are favorable. Sites that warrant higher levels of protection may occur within the Modified area.
Limited	This option is designed for broad, landscape-scale areas where the low density and wide distribution of values to be protected best allows for fire to function in its ecological role. Wildland fire can be managed to protect, maintain, and enhance natural and cultural resources and, as nearly as possible, enable fire to function in its ecological role and maintain the natural fire regime. In these areas, fire is routinely able to function in its natural roles as an essential ecological process. Limited may also be assigned to areas where the cost of suppression may exceed the value of the resources to be protected, where the environmental impacts of fire suppression activities may have more negative impacts on the resources than the effects of the fire, and where safety considerations preclude the commitment of firefighters to an area (e.g. military impact zones). Wildland fires occurring within this designation will be allowed to burn within predetermined areas while continuing protection of human life and site-specific values. Periodic surveillance will be conducted to evaluate the need for action to protect human life or site-specific values.
Unplanned	No management option is planned.

Sources: AICC 2019

1.1.2 Environmental Consequences

Vegetation

Impacts to vegetation were analyzed using the cut and fill footprint and a 10-foot temporary construction zone surrounding the cut and fill footprint. Impacts outside of the construction zones were assessed using a 328-foot buffer off the edge of the road, based on impacts from fugitive dust.

Impacts were calculated by overlaying the construction daylight limits and associated 10-foot and 328-foot buffers onto the CYR REA vegetation mapping in GIS to quantify acres of each vegetation type that will be impacted. Table 10, Table 11, and Table 12 provide acreages of impacts to vegetation types within the construction footprint, the 10-foot temporary construction zone, and a 328-foot buffer surrounding the footprint. For all action alternatives, the project would be constructed in three phases. The Phase 3 construction footprint was used as the basis for this analysis, as it encompasses both Phase 1 and Phase 2 construction footprints.

Table 10 Alternative A vegetation impact acres and percentages

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Upland low and tall shrub	258.5	42.3	1,897.6	41.9	7,466.5	41.7
Upland mesic spruce forest	213.8	35.0	1,336.8	29.5	6,308.5	35.3
Upland mesic spruce-hardwood forest	38.5	6.3	218.2	4.8	1,106.0	6.2
Lowland woody wetland	24.0	3.9	215.8	4.8	683.9	3.8
Grassland/Herbaceous	20.9	3.4	230.6	5.1	592.9	3.3
Alpine and Arctic tussock tundra	18.1	3.0	130.8	2.9	495.0	2.8
Alpine dwarf shrub tundra	15.7	2.6	235.0	5.2	488.1	2.7
Riparian forest and shrub	13.4	2.2	115.5	2.6	382.9	2.1
Sedge/Herbaceous	6.6	1.1	136.6	3.0	200.4	1.1
Open water	2.0	0.3	6.7	0.1	162.9	0.9
Emergent herbaceous wetlands	0.0	0.0	0.2	0.0	4.1	0.0
Barren land	0	0.0	0	0.0	0	0.0
Developed	0.0	0.0	0	0.0	4.7	0.0
Grand total	**611.5**	**100.0**	**4,523.9**	**100.0**	**17,895.8**	**100.0**

[a] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 11. Alternative B vegetation impact acres and percentages

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Upland low and tall shrub	275.2	40.6	2,127.4	41.4	7,867.9	39.7
Upland mesic spruce forest	266.3	39.3	1,622.8	31.6	7,899.4	39.8
Upland mesic spruce-hardwood forest	36.3	5.4	254.8	5.0	1,035.8	5.2
Lowland woody wetland	24.4	3.6	228.3	4.4	683.0	3.4
Alpine and Arctic tussock tundra	18.1	2.7	146.3	2.8	503.1	2.5
Grassland/Herbaceous	18.1	2.7	225.8	4.4	529.1	2.7
Riparian forest and shrub	16.0	2.4	150.6	2.9	470.8	2.4
Alpine dwarf shrub tundra	15.8	2.3	248.3	4.8	490.4	2.5
Sedge/Herbaceous	5.8	0.8	125.9	2.5	173.7	0.9
Open water	2.0	0.3	6.8	0.1	166.4	0.8
Barren land	0.2	0.0	0.9	0.0	6.6	0.0

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Emergent herbaceous wetlands	0	0.0	0	0.0	3.1	0.0
Developed	0.0	0.0	0	0.0	4.7	0.0
Grand total	**678.3**	**100.0**	**5,137.9**	**100.0**	**19,834.2**	**100.0**

[a] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 12. Alternative C vegetation impact acres and percentages

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Upland mesic spruce forest	259.7	28.0	2,111.4	25.7	7,551.5	28.9
Upland low and tall shrub	222.2	24.0	1,914.6	23.3	6,311.6	24.2
Riparian forest and shrub	119.2	12.9	1,178.2	14.4	3,247.8	12.4
Lowland woody wetland	110.5	11.9	729.7	8.9	3,138.0	12.0
Alpine and Arctic tussock tundra	74.4	8.0	578.9	7.1	2,045.2	7.8
Upland mesic spruce-hardwood forest	56.1	6.1	809.1	9.9	1,517.7	5.8
Sedge/Herbaceous	28.5	3.1	234.7	2.9	840.9	3.2
Alpine dwarf shrub tundra	27.2	2.9	405.5	4.9	829.7	3.2
Developed	11.6	1.3	79.0	1.0	94.3	0.4
Grassland/Herbaceous	10.3	1.1	115.2	1.4	243.0	0.9
Emergent herbaceous wetlands	4.7	0.5	34.0	0.4	139.4	0.5
Open water	2.5	0.3	11.9	0.1	128.9	0.5
Barren land	0.1	0.0	7.6	0.1	3.2	0.0
Unmapped	0.1	>0.1	0.3	>0.1	1.2	>0.1
Grand total	**927.3**	**100.0**	**8,210.2**	**100.0**	**26,092.3**	**100.0**

[a] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Wetlands

Impacts to wetlands were calculated in the same manner as identified above in the vegetation section using the wetland mapping provided for the project (DOWL 2014 and 2019). Mapped wetland types were aggregated to the Cowardin Class levels to better facilitate comparison of impacts among the alternatives. Wetland types were aggregated first by System then by dominant Class, as shown in Table 5. Waterbodies in the Lacustrine and Palustrine Systems were aggregated as Lake or Pond, respectively.

It should be noted that approximately 9 acres within the 328-foot buffer of Alternatives A and B are unmapped. However, this unmapped area occurs on the easternmost extent of these action alternatives and is largely composed of the Dalton Highway.

Table 13, Table 14, and Table 15 provide acreages of impacts to wetland types within the construction footprint, the 10-foot temporary construction zone, and a 328-foot buffer surrounding the footprint.

Table 13. Alternative A wetland impact acres and percentages

Aggregated wetland type	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
PEM total	14.8	2.4	116.3	2.6	477.2	2.7
PFO total	111.3	18.2	601.4	13.3	3,370.7	18.8
PSS total	212.4	34.7	1,341.0	29.6	6,677.4	37.3
Total freshwater wetlands	**338.5**	**55.4**	**2,058.6**	**45.5**	**10,525.2**	**58.8**
Pond rotal	0.1	>0.1	1.5	>0.1	56.9	0.3
Lake total	0	N/A	0	N/A	0	N/A
Riverine total	4.7	0.8	19.1	0.4	254.9	1.4
Total waterbodies	**4.8**	**0.8**	**20.6**	**0.5**	**311.8**	**1.7**
Total wetland and waterbodies	**343.3**	**56.1**	**2,079.2**	**46.0**	**10,837.1**	**60.5**
Upland total	268.2	43.9	2,444.7	54.0	7,058.8	39.4
Grand total	**611.5**	**100.0**	**4,523.9**	**100.0**	**17,895.8**	**100.0**

Note: PEM = Palustrine Emergent; PFO = Palustrine Forest; PSS = Palustrine Scrub-shrub; N/A = Not applicable
[a] The direct footprint impacts are not meant to represent a complete loss for riverine wetlands; rather, direct footprint acreages of riverine wetlands represent alterations to these wetland types where bridges and culverts would be constructed.
[b] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 14. Alternative B wetland impact acres and percentages

Aggregated wetland type	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
PEM total	15.0	2.2	118.6	2.3	485.6	2.4
PFO total	152.2	22.4	858.1	16.7	4,464.8	22.5
PSS total	223.5	33.0	1,414.5	27.5	6,974.8	35.2
Total freshwater wetlands	**390.7**	**57.6**	**2,391.3**	**46.5**	**11,925.2**	**60.1**
Pond total	0.2	>0.1	1.5	>0.1	59.9	0.3
Lake total	0	N/A	0	N/A	3.7	>0.1
Riverine total	5.4	0.8	23.0	0.4	281.1	1.4
Total waterbodies	**5.6**	**0.8**	**24.6**	**0.5**	**344.8**	**1.7**
Total wetland and waterbodies	**396.3**	**58.4**	**2,415.8**	**47.0**	**12,269.9**	**61.9**
Upland total	282.0	41.6	2,722.0	53.0	7,564.2	38.1
Grand total	**678.3**	**100.0**	**5,137.9**	**100.0**	**19,834.2**	**100.0**

Note: PEM = Palustrine Emergent; PFO = Palustrine Forest; PSS = Palustrine Scrub-shrub; N/A = Not applicable
[a] The direct footprint impacts are not meant to represent a complete loss for riverine wetlands; rather, direct footprint acreages of riverine wetlands represent alterations to these wetland types where bridges and culverts would be constructed.
[b] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 15. Alternative C wetland impact acres and percentages

Aggregated wetland type	Area (acres) construction zone / temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
PEM total	35.0	3.8	249.8	3.1	1,000.2	3.8
PFO total	97.1	10.5	677.2	8.2	2,731.2	10.5
PML total	4.8	0.5	30.3	0.4	136.2	0.5
PSS total	425.0	45.7	2,865.4	34.8	12,037.4	46.1
Total freshwater wetlands	**562.0**	**60.5**	**3,822.6**	**46.5**	**15,905.0**	**61.0**
Pond total	1.3	0.1	9.1	0.1	59.0	0.2
Lake total	>0.1	>0.1	0	N/A	5.5	0.0
Riverine total	8.3	0.9	58.3	0.7	320.2	1.2
Total waterbodies	**9.6**	**1.0**	**67.4**	**0.8**	**384.8**	**1.5**
Total wetland and waterbodies	**571.6**	**61.5**	**3,890.0**	**47.3**	**16,289.7**	**62.4**
Upland total	355.7	38.5	4,320.2	52.7	9,802.6	37.6
Grand total	**927.3**	**100.0**	**8,210.2**	**100.0**	**26,092.3**	**100.0**

Note: PEM = Palustrine Emergent; PFO = Palustrine Forest; PML = Palustrine Moss-Lichen; PSS = Palustrine Scrub-shrub; N/A = Not applicable

[a] The direct footprint impacts are not meant to represent a complete loss for riverine wetlands; rather, direct footprint acreages of riverine wetlands represent alterations to these wetland types where bridges and culverts would be constructed.

[b] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

1.2. Fish and Amphibians

Table 16 identifies species documented in the study area and highlights species key to this analysis. The analysis identifies a fish species as key if it is a major target of subsistence, sport, or commercial fisheries, has specialized habitat (e.g. spawning areas) in the study area that is limited elsewhere, or has essential fish habitat (EFH) designated in the study area. See also Volume 4, Map 3-17 and Map 3-18.

Table 16. Fish species documented to occur in drainages intersected by the alternatives

Common name(s)	Traditional name(s)	Scientific name	Life history	Considerations specific to the study area	Species of Greatest Conservation Need throughout Alaska[a]
Arctic grayling[b]	***Suluqpaugaq[d], tleghelbaaye[e]***	***Thymallus arcticus***	**Resident**	**Subsistence target, sport**	**Cultural Importance**
Round whitefish	*Quptik, Savaigutnik[d], hulten’[e]*	*Prosopium cylindraceum*	Resident	Prey species; subsistence (bycatch)	Cultural Importance
Sheefish (Inconnu)[b]	***Siid, ledlaagha e***	***Stenodus leucichthys***	**Mostly Anadromous in study area**	**Subsistence target, sport, commercial**	**Stewardship Species**
Humpback whitefish[b]	***Qaalgiq, Ikkuiyiq[d], holehge[e]***	***Coregonus pidschian***	**Anadromous or Resident**	**Subsistence target**	**Cultural Importance**
Broad whitefish[b]	***Quasriluk, Siiguliaq[d], taaseze[e]***	***Coregonus nasus***	**Anadromous or Resident**	**Subsistence target**	**Cultural Importance**
Least cisco	*Qalusraaq, Iqalusaaq[d], tsaabaaye[e]*	*Coregonus sardinella*	Anadromous or Resident	Sport, prey species, subsistence	Cultural Importance
Burbot, mudshark, lush[b]	***Tittaaliq, Tiktaaliq[d] Ts’oneye[e]***	***Lota lota***	**Resident**	**Subsistence**	**Cultural and Ecological Importance**
Dolly Varden	*Qalukpik, Agalukpiq[d], sełyee lookk’[e]*	*Salvelinus malma*	Anadromous or Resident	Subsistence, sport	Cultural Importance; Stewardship Species
Chinook salmon[b, c]	***Iqalsugruk, Tagayukpuk[d]***	***Oncorhynchus tshawytscha***	**Anadromous**	**Subsistence target, EFH**	**Cultural and Economic Importance; Stewardship**
Chum salmon[b, c]	***Qalugruaq, Aqalugruaq[d]***	***Oncorhynchus keta***	**Anadromous**	**Subsistence target, EFH, commercial**	**Cultural and Economic Importance**
Coho salmon[b]	***Not applicable***	***Oncorhynchus kisutch***	**Anadromous**	**Subsistence target, EFH**	**Cultural and Economic Importance; Stewardship**
Sockeye salmon[b]	***Not applicable***	***Oncorhynchus nerka***	**Anadromous**	**EFH**	**Cultural and Economic Importance; Stewardship**
Northern pike[b]	***Siulik, Siilik[d], K’oolkkoye[e]***	***Esox lucius***	**Resident**	**Subsistence target, sport**	**Cultural and Economic Importance**
Arctic lamprey, eel	*Dots’e tl’ egheze, Dots’ e tl’ ool[e]*	*Lampetra camtschatica*	Anadromous	Prey species (subsistence outside of study area)	Cultural Importance
Arctic char	*Igalukpiq, Qalukpik[d]*	*Salvelinus alpinus*	Resident	Subsistence, sport	Cultural Importance
Lake trout	*Kanaak, Akmaguk[d], qalukpik, tl’uhlaaghe[e]*	*Salvelinus namaycush*	Resident	Subsistence, sport	Cultural Importance
Alaska blackfish[b]	***Iłuuqiñiq, Iłuiqiñiq[d] Oonyeeyh[e]***	***Dallia pectoralis***	**Resident**	**Subsistence; culturally significant**	**Cultural Importance**
Lake chub	*Lake herring, tokkodooze[e]*	*Couesius plumbeus*	Resident	Prey species	Ecological Importance
Longnose sucker	*Kaviqsuaq, Milugiaq[d] toonts’ode[e]*	*Catostomus catostomus*	Resident	Prey species	Not applicable
Slimy sculpin	*Netsoo tlee’[e]*	*Cottus cognatus*	Resident	Prey species	Not applicable
Ninespine stickleback	*Kakilniuk[d]*	*Pungitius pungitius*	Resident	Prey species	Ecological Importance

Sources: ABR 2014a; ADF&G 2015, 2019; Anderson et al. 2004; Esse and Kretsinger 2009; Johnson and Blossom 2018a, 2018b; Jones 2006; Kretsinger et al. 1994; Lemke et al. 2013; McKenna 2015; Scannell 2015; Wuttig et al. 2015
Note: EFH = Essential Fish Habitat
[a] ADF&G (2015) identifies 58 fish species as species of greatest conservation need (SGCN) in Alaska; none is listed as “at-risk’ (species whose population is small, declining, or under significant threat). SGCN, based on multiple criteria, include species that are culturally, ecologically, or economically important; species with a high percentage of their North American or global population in Alaska (stewardship species); and species that function as indicators of environmental change (sentinel species).
[b] Species shown in bold (strong text) and followed with a superscript of “b” are major targets of a subsistence, sport, or commercial fishery in the study area; have specialized habitat (e.g., spawning area) in the study area that is limited elsewhere; or have EFH designated in the study area and are considered key to this analysis. The Alaska blackfish is a focus species for this analysis because of its cultural significance within the study area (S. Whiting, personal communication 2019).
[c] Chinook and chum salmon returns to the Yukon and other rivers in northwest Alaska have declined since the late 1990s (McKenna 2015). Chum salmon in Clear Creek, a tributary of the Hogatza River, is the only fish on the BLM sensitive species list whose range extends into the study area (Esse and Kretsinger 2009; Kretsinger et al. 1994).
[d] Iñupiaq names based on Jones 2006.
[e] Koyukon names based on Anderson et al. 2004.

Table 17. Considerations for assessing impacts to fish habitat – anadromous stream crossings and Essential Fish Habitat in streams

Number of stream crossings and proximity of road and gravel sites to fish streams	Alternative A	Alternative B	Alternative C
Number of Essential Fish Habitat[a] crossings	13	14	21
Number of known anadromous streams[b] crossings	17	18	26
Number of crossings of assumed anadromous[c] streams	23	25	244
Total number of known and/or anadromous[d] fish stream crossings	40	43	270
Number of bridge crossings	29	26	251
Number of moderate and major culverts proposed[d]	34	24	272
Number of minor culverts proposed[f]	2,869	3,155	4,076
Acreage of fish habitat affected by bridges[g], which may result in loss of spawning habitat	2,025	2,021	4,092
Acreage of fish habitat affected by culverts[h], which may result in loss of spawning habitat	84.5	88.5	181
Linear miles of fish stream habitat affected by properly maintained bridges[g]	13.4	10.5	57.4
Linear miles of fish stream habitat affected by properly maintained fish passage culverts[h]	70.1	76.4	110
Total length of road in miles, excluding access roads	211	228	332
Miles of road located within major floodplains[i], excluding access roads	4.6	5.4	53.6
Miles of road located within 1,000 feet of major floodplain[i], excluding access roads	16.1	17.3	96.3
Miles of road located within 1,000 feet of National Hydrography Dataset streams, excluding access roads	16.0	20.2	83.3
Total number of gravel mines proposed	41	46	44
Number of gravel mines within floodplain[i] or in low-lying areas within 500 feet of fish streams[j]	21	22	16
Number of gravel mines located within 300 feet of Essential Fish Habitat a streams	3	4	6
Number of gravel mines within 300 feet of known and/or assumed anadromous[d] streams	8	11	18

[a] Based on crossings of salmon streams identified in the Anadromous Waters Catalog (Johnson and Blossom 2018a, 2018b) and streams recently nominated for inclusion into the AWC, by ADF&G staff (Geifer et al. 2019).
[b] Based on crossings of streams identified in the Anadromous Waters Catalog (Johnson and Blossom 2018a, 2018b) and streams recently nominated for inclusion into the AWC, by ADF&G staff (Geifer et al. 2019).
[c] Based on streams assumed by AIDEA and DOWL to support anadromous fish (received GIS data 2019).
[d] Includes data from the AWC and those streams that AIDEA and DOWL assume to be anadromous.
[e] Moderate culverts would be 4 to 10 feet in diameter, which depending on stream and basin characteristics, may support fish passage. Major culverts would be 10 to 20 feet wide, which should satisfy fish passage requirements.
[f] Minor culverts would be 3 feet or less in diameter, which would likely not provide adequate fish passage. AIDEA estimated the number of minor culvert crossings but did not provide crossing locations or stream data at the same resolution for all alternatives, so it is difficult to estimate the number of minor culverts intended to convey perennial stream flow and pass fish. If these streams are found to be anadromous, they may be required to be resized during permitting.
[g] The bridge length was assumed to be an average of 50 feet for small bridges, 120 feet for medium bridges, and the actual length for the large bridges. Assuming that the stream/floodplain would be impacted by the bridge crossings up to five times the bridge length both upstream and downstream allowed an estimate of the area of floodplain impacts due to the bridges.
[h] The culvert width was assumed to be an average of 3 feet for minor culverts, 10 feet for moderate culverts, and 20 feet for major culverts. Assuming that the stream/floodplain would be impacted by the culvert crossings up to five times the culvert width plus a roadway embankment at a 4:1 slope for Phase 3 width both upstream and downstream allowed an estimate of the area of floodplain impacts due to culverts.
[i] Based on vegetative floodplain mapping for the Central Yukon Region (BLM 2016)
[j] Based on review of aerial imagery, LIDAR, contour data, available stream and fish data from multiple sources and proposed material site locations in geographic information systems (GIS) software.

1.3. Birds

Table 18 identifies the avian species that occur in the project area, including their common and scientific names, relative abundance, and special status designations.

Table 18. Avian species in the project area

Species group	Common name	Scientific name[a]	Species relative abundance in the project area	Species occurrence	BCC[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]	AOU No.	Reference
Waterfowl	Greater white-fronted goose	*Anser albifrons*	U	B	N/A	N/A	N/A	N/A	N/A	14	Alaska Center for Conservation Science Web Mapper
Waterfowl	Snow goose	*Anser caerulescens*	R	M	N/A	N/A	N/A	N/A	N/A	15	Alaska Center for Conservation Science Web Mapper
Waterfowl	Brant	*Branta bernicula*	R	M	N/A	N/A	N/A	N/A	N/A	19	Kanuti NWR
Waterfowl	Cackling goose	*Branta hutchinsii*	U	B	N/A	N/A	N/A	N/A	N/A	21	Alaska Center for Conservation Science Web Mapper
Waterfowl	Canada goose	*Branta canadensis*	C	B	N/A	N/A	N/A	N/A	N/A	22	Alaska Center for Conservation Science Web Mapper

Species group	Common name	Scientific name[a]	Species relative abundance in the project area	Species occurrence	BCC[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]	AOU No.	Reference
Waterfowl	Trumpeter swan	*Cygnus buccinator*	C	B	N/A	W	N/A	N/A	N/A	25	Alaska Center for Conservation Science Web Mapper
Waterfowl	Tundra swan	*Cygnus columbianus*	U	M	N/A	N/A	N/A	N/A	N/A	26	Alaska Center for Conservation Science Web Mapper
Waterfowl	Mallard	*Anas platyrhynchos*	C	B	N/A	N/A	N/A	N/A	N/A	37	Alaska Center for Conservation Science Web Mapper
Waterfowl	Northern pintail	*Anas acuta*	C	B	N/A	N/A	N/A	N/A	N/A	46	Alaska Center for Conservation Science Web Mapper
Waterfowl	Gadwall	*Mareca strepera*	U	M	N/A	N/A	N/A	N/A	N/A	46.5	Alaska Center for Conservation Science Web Mapper
Waterfowl	American wigeon	*Mareca americana*	C	B	N/A	N/A	N/A	N/A	N/A	47	Alaska Center for Conservation Science Web Mapper
Waterfowl	Northern shoveler	*Spatula clypeata*	C	B	N/A	N/A	N/A	N/A	N/A	48	Alaska Center for Conservation Science Web Mapper
Waterfowl	Green-winged teal	*Anas crecca*	C	B	N/A	N/A	N/A	N/A	N/A	49	Alaska Center for Conservation Science Web Mapper
Waterfowl	Canvasback	*Aythya valisineria*	R	B	N/A	N/A	N/A	N/A	N/A	50	Alaska Center for Conservation Science Web Mapper
Waterfowl	Redhead	*Aythya americana*	R	B	N/A	N/A	N/A	N/A	N/A	51	Alaska Center for Conservation Science Web Mapper
Waterfowl	Ring-necked duck	*Aythya collaris*	U	B	N/A	N/A	N/A	N/A	N/A	53	Alaska Center for Conservation Science Web Mapper
Waterfowl	Greater scaup	*Aythya marila*	C	B	N/A	N/A	N/A	RL	N/A	55	Alaska Center for Conservation Science Web Mapper
Waterfowl	Lesser scaup	*Aythya affinis*	C	B	N/A	N/A	N/A	N/A	N/A	56	Alaska Center for Conservation Science Web Mapper
Waterfowl	Harlequin duck	*Histrionicus histrionicus*	R	B	N/A	N/A	N/A	N/A	N/A	61	Alaska Center for Conservation Science Web Mapper
Waterfowl	Surf scoter	*Melanitta perspicillata*	C	B	N/A	N/A	N/A	N/A	N/A	63	Alaska Center for Conservation Science Web Mapper
Waterfowl	White-winged scoter	*Melanitta fusca*	C	B	N/A	N/A	N/A	N/A	N/A	64	Alaska Center for Conservation Science Web Mapper
Waterfowl	Black scoter	*Melanitta americana*	U	B	N/A	N/A	AR	RL	NT	65	Alaska Center for Conservation Science Web Mapper
Waterfowl	Long-tailed duck	*Clangula hyemalis*	C	B	N/A	N/A	N/A	N/A	VU	66	Alaska Center for Conservation Science Web Mapper
Waterfowl	Bufflehead	*Bucephala albeola*	U	B	N/A	N/A	N/A	N/A	N/A	67	Alaska Center for Conservation Science Web Mapper
Waterfowl	Common goldeneye	*Bucephala clangula*	U	B	N/A	N/A	N/A	N/A	N/A	68	Alaska Center for Conservation Science Web Mapper
Waterfowl	Common merganser	*Mergus merganser*	R	B	N/A	N/A	N/A	N/A	N/A	72	Kanuti NWR
Waterfowl	Red-breasted merganser	*Mergus serrator*	C	B	N/A	N/A	N/A	N/A	N/A	73	Alaska Center for Conservation Science Web Mapper
Loons and Grebes	Red-throated loon	*Gavia stellata*	R	B	N/A	S	AR	N/A	N/A	134	Alaska Center for Conservation Science Web Mapper
Loons and Grebes	Pacific loon	*Gavia pacifica*	U	B	N/A	N/A	N/A	N/A	N/A	135	Alaska Center for Conservation Science Web Mapper
Loons and Grebes	Common loon	*Gavia immer*	C	B	N/A	N/A	N/A	N/A	N/A	136	Alaska Center for Conservation Science Web Mapper
Loons and Grebes	Horned grebe	*Podiceps auritus*	C	B	C	N/A	N/A	N/A	VU	1986	Alaska Center for Conservation Science Web Mapper
Loons and Grebes	Red-necked grebe	*Podiceps grisegena*	U	B	N/A	N/A	N/A	RL	N/A	1987	Alaska Center for Conservation Science Web Mapper
Grouse and Ptarmigan	Ruffed grouse	*Bonasa umbellus*	U	RE	N/A	N/A	N/A	N/A	N/A	98	Alaska Center for Conservation Science Web Mapper
Grouse and Ptarmigan	Spruce grouse	*Falcipennis canadensis*	C	RE	N/A	N/A	N/A	N/A	N/A	101	Alaska Center for Conservation Science Web Mapper
Grouse and Ptarmigan	Willow ptarmigan	*Lagopus lagopus*	C	RE	N/A	N/A	N/A	N/A	N/A	102	DeGroot and McMillan
Grouse and Ptarmigan	Rock ptarmigan	*Lagopus muta*	C	R	N/A	N/A	N/A	N/A	N/A	103	Alaska Center for Conservation Science Web Mapper
Grouse and Ptarmigan	Sharp-tailed grouse	*Tympanuchus phasianellus*	U	R	N/A	N/A	N/A	N/A	N/A	107	Alaska Center for Conservation Science Web Mapper
Cranes	Sandhill crane	*Antigone canadensis*	R	B	N/A	N/A	N/A	N/A	N/A	365	Alaska Center for Conservation Science Web Mapper
Kingfishers	Belted kingfisher	*Megaceryle alcyon*	U	B	N/A	N/A	AR	N/A	N/A	912	Alaska Center for Conservation Science Web Mapper
Woodpeckers	Downy woodpecker	*Dryobates pubescens*	C	RE	N/A	N/A	N/A	N/A	N/A	963	Alaska Center for Conservation Science Web Mapper
Woodpeckers	Hairy woodpecker	*Dryobates villosus*	C	RE	N/A	N/A	N/A	YL	N/A	964	Alaska Center for Conservation Science Web Mapper
Woodpeckers	American three-toed woodpecker	*Picoides dorsalis*	R	RE	N/A	N/A	N/A	N/A	N/A	969	Alaska Center for Conservation Science Web Mapper
Woodpeckers	Black-backed woodpecker	*Picoides arcticus*	R	RE	N/A	N/A	N/A	N/A	N/A	970	Alaska Center for Conservation Science Web Mapper
Woodpeckers	Northern flicker	*Colaptes auratus*	C	B	N/A	N/A	AR	N/A	N/A	979	Alaska Center for Conservation Science Web Mapper

Species group	Common name	Scientific name[a]	Species relative abundance in the project area	Species occurrence	BCC[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]	AOU No.	Reference
Raptors	Bald eagle	*Haliaeetus leucocephalus*	C	B	N/A	N/A	N/A	N/A	N/A	270	ABR Raptor Report
Raptors	Northern harrier	*Circus cyaneus*	C	B	N/A	N/A	AR	N/A	N/A	274	ABR Raptor Report
Raptors	Sharp-shinned hawk	*Accipiter striatus*	U	B	N/A	N/A	N/A	N/A	N/A	278	ABR Raptor Report
Raptors	Northern goshawk	*Accipiter gentilis*	C	R	N/A	N/A	N/A	N/A	N/A	282	ABR Raptor Report
Raptors	Red-tailed hawk	*Buteo jamaicensis*	C	B	N/A	N/A	N/A	N/A	N/A	305	ABR Raptor Report
Raptors	Rough-legged hawk	*Buteo lagopus*	U	B	N/A	N/A	N/A	N/A	N/A	307	ABR Raptor Report
Raptors	Osprey	*Pandion haliaetus*	C	B	N/A	N/A	N/A	N/A	N/A	308	ABR Raptor Report
Raptors	Golden eagle	*Aquila chrysaetos*	C	B	N/A	N/A	N/A	N/A	N/A	310	ABR Raptor Report
Raptors	American kestrel	*Falco sparverius*	U	B	N/A	N/A	AR	N/A	N/A	323	ABR Raptor Report
Raptors	Merlin	*Falco columbarius*	U	B	N/A	N/A	N/A	N/A	N/A	325	ABR Raptor Report
Raptors	Gyrfalcon	*Falco rusticolus*	R	RE	N/A	W	AR	N/A	N/A	330	ABR Raptor Report
Raptors	Peregrine falcon	*Falco peregrinus*	C	B	C	N/A	N/A	N/A	N/A	331	ABR Raptor Report
Raptors	Great horned owl	*Bubo virginianus*	U	R	N/A	N/A	N/A	N/A	N/A	681	ABR Raptor Report
Raptors	Snowy owl	*Bubo scandiacus*	R	M	N/A	N/A	N/A	N/A	N/A	682	Kanuti NWR
Raptors	Northern hawk owl	*Surnia ulula*	U	RE	N/A	N/A	AR	N/A	N/A	683	ABR Raptor Report
Raptors	Great gray owl	*Strix nebulosa*	U	RE	N/A	N/A	AR	N/A	N/A	698	ABR Raptor Report
Raptors	Short-eared owl	*Asio flammeus*	U	B	N/A	N/A	N/A	N/A	N/A	701	ABR Raptor Report
Raptors	Boreal owl	*Aegolius funereus*	U	B	N/A	N/A	AR	N/A	N/A	704	ABR Raptor Report
Shorebirds	American golden-plover	*Pluvialis dominica*	U	B	N/A	N/A	AR	RL	N/A	373	Alaska Center for Conservation Science Web Mapper
Shorebirds	Semipalmated plover	*Charadrius semipalmatus*	U	M	N/A	N/A	N/A	N/A	N/A	381	Alaska Center for Conservation Science Web Mapper
Shorebirds	Spotted sandpiper	*Actitis macularius*	U	B	N/A	N/A	AR	N/A	N/A	397	Alaska Center for Conservation Science Web Mapper
Shorebirds	Solitary sandpiper	*Tringa solitaria*	U	B	C	N/A	AR	YL	N/A	399	Alaska Center for Conservation Science Web Mapper
Shorebirds	Wandering tattler	*Tringa incana*	U	B	N/A	N/A	N/A	YL	N/A	401	Alaska Center for Conservation Science Web Mapper
Shorebirds	Surfbird	*Aphriza virgata*	U	B	N/A	N/A	AR	YL	N/A	402	Alaska Center for Conservation Science Web Mapper
Shorebirds	Lesser yellowlegs	*Tringa flavipes*	C	B	C	N/A	AR	RL	N/A	406	Alaska Center for Conservation Science Web Mapper
Shorebirds	Upland sandpiper	*Bartramia longicauda*	R	B	C	N/A	AR	N/A	N/A	410	Alaska Center for Conservation Science Web Mapper
Shorebirds	Whimbrel	*Numenius phaeopus*	U	B	C	S	AR	YL	N/A	413	Alaska Center for Conservation Science Web Mapper
Shorebirds	Hudsonian godwit	*Limosa haemastica*	U	B	C	N/A	AR	N/A	N/A	420	Alaska Center for Conservation Science Web Mapper
Shorebirds	Semipalmated sandpiper	*Calidris pusilla*	U	B	N/A	N/A	AR	N/A	NT	429	Alaska Center for Conservation Science Web Mapper
Shorebirds	Least sandpiper	*Calidris minutilla*	C	B	N/A	N/A	N/A	N/A	N/A	435	Alaska Center for Conservation Science Web Mapper
Shorebirds	Baird's sandpiper	*Calidris bairdii*	U	B	N/A	N/A	N/A	N/A	N/A	437	Alaska Center for Conservation Science Web Mapper
Shorebirds	Pectoral sandpiper	*Calidris melanotos*	U	M	N/A	N/A	N/A	N/A	N/A	438	Kanuti NWR
Shorebirds	Long-billed dowitcher	*Limnodromus scolopaceus*	U	M	N/A	N/A	N/A	N/A	N/A	450	Alaska Center for Conservation Science Web Mapper
Shorebirds	Wilson's snipe	*Gallinago delicata*	U	B	N/A	N/A	N/A	N/A	N/A	452	Alaska Center for Conservation Science Web Mapper
Shorebirds	Red-necked phalarope	*Phalaropus lobatus*	U	B	N/A	N/A	N/A	N/A	N/A	458	Alaska Center for Conservation Science Web Mapper
Larids	Bonaparte's gull	*Chroicocephalus philadelphia*	R	B	N/A	N/A	N/A	N/A	N/A	463	Alaska Center for Conservation Science Web Mapper
Larids	Mew gull	*Larus canus*	C	B	N/A	N/A	N/A	N/A	N/A	464	Alaska Center for Conservation Science Web Mapper
Larids	Herring gull	*Larus argentatus*	C	B	N/A	N/A	AR	N/A	N/A	467	Alaska Center for Conservation Science Web Mapper
Larids	Glaucous gull	*Larus hyperboreus*	R	M	N/A	N/A	N/A	N/A	N/A	476	Kanuti NWR

Species group	Common name	Scientific name[a]	Species relative abundance in the project area	Species occurrence	BCC[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]	AOU No.	Reference
Larids	Arctic tern	*Sterna paradisaea*	C	B	CC	N/A	AR	N/A	N/A	502	Alaska Center for Conservation Science Web Mapper
Larids	Long-tailed jaeger	*Stercorarius longicaudus*	R	B	N/A	N/A	N/A	N/A	N/A	512	Kanuti NWR
Passerines	Olive-sided flycatcher	*Contopus cooperi*	U	B	CC	S	AR	RL	N/A	1127	DeGroot and McMillan
Passerines	Western wood-pewee	*Contopus sordidulus*	R	B	N/A	N/A	AR	RL	N/A	1131	Alaska Center for Conservation Science Web Mapper
Passerines	Yellow-bellied flycatcher	*Empidonax flaviventris*	R	V	N/A	N/A	N/A	N/A	N/A	1138	Kanuti NWR
Passerines	Alder flycatcher	*Empidonax alnorum*	C	B	N/A	N/A	N/A	N/A	N/A	1140	Alaska Center for Conservation Science Web Mapper
Passerines	Hammond's flycatcher	*Empidonax hammondii*	U	B	N/A	N/A	N/A	N/A	N/A	1144	Alaska Center for Conservation Science Web Mapper
Passerines	Say's phoebe	*Sayornis saya*	U	B	N/A	N/A	N/A	N/A	N/A	1155	Alaska Center for Conservation Science Web Mapper
Passerines	Northern shrike	*Lanius excubitor*	U	B	N/A	N/A	N/A	N/A	N/A	1156	Alaska Center for Conservation Science Web Mapper
Passerines	Black-billed magpie	*Pica hudsonia*	C	B	N/A	N/A	N/A	N/A	N/A	1293	Alaska Center for Conservation Science Web Mapper
Passerines	Common raven	*Corvus corax*	C	B	N/A	N/A	N/A	N/A	N/A	1307	DeGroot and McMillan
Passerines	Horned lark	*Eremophila alpestris*	U	B	N/A	N/A	AR	N/A	N/A	1310	Alaska Center for Conservation Science Web Mapper
Passerines	Tree swallow	*Tachycineta bicolor*	U	B	N/A	N/A	AR	N/A	N/A	1318	Alaska Center for Conservation Science Web Mapper
Passerines	Violet-green swallow	*Tachycineta thalassina*	U	B	N/A	N/A	N/A	RL	N/A	1321	Alaska Center for Conservation Science Web Mapper
Passerines	Bank swallow	*Riparia riparia*	U	B	N/A	W	AR	RL	N/A	1328	DeGroot and McMillan
Passerines	Cliff swallow	*Petrochelidon pyrrhonota*	U	B	N/A	N/A	N/A	N/A	N/A	1329	DeGroot and McMillan
Passerines	Black-capped chickadee	*Poecile atricapillus*	U	R	N/A	N/A	N/A	N/A	N/A	1334	Alaska Center for Conservation Science Web Mapper
Passerines	Boreal chickadee	*Poecile hudsonicus*	C	RE	N/A	N/A	AR	N/A	N/A	1338	DeGroot and McMillan
Passerines	Gray-headed chickadee	*Poecile cinctus*	U	RE	N/A	S	N/A	RL	N/A	1339	DeGroot and McMillan
Passerines	American dipper	*Cinclus mexicanus*	U	RE	N/A	N/A	N/A	N/A	N/A	1399	Alaska Center for Conservation Science Web Mapper
Passerines	Ruby-crowned kinglet	*Regulus calendula*	C	B	N/A	N/A	N/A	N/A	N/A	1403	Alaska Center for Conservation Science Web Mapper
Passerines	Arctic warbler	*Phylloscopus borealis*	U	B	N/A	N/A	N/A	N/A	N/A	1412	DeGroot and McMillan
Passerines	Bluethroat	*Cyanecula svecica*	U	B	N/A	N/A	N/A	N/A	N/A	1425	Alaska Center for Conservation Science Web Mapper
Passerines	Northern wheatear	*Oenanthe oenanthe*	U	B	N/A	N/A	N/A	N/A	N/A	1426	Alaska Center for Conservation Science Web Mapper
Passerines	Mountain bluebird	*Sialia currucoides*	U	B	N/A	N/A	N/A	N/A	N/A	1430	Alaska Center for Conservation Science Web Mapper
Passerines	Townsend's solitaire	*Myadestes townsendii*	R	B	N/A	N/A	N/A	N/A	N/A	1431	Kanuti NWR
Passerines	Gray-cheeked thrush	*Catharus minimus*	C	B	N/A	N/A	N/A	N/A	N/A	1451	DeGroot and McMillan
Passerines	Swainson's thrush	*Catharus ustulatus*	U	B	N/A	N/A	AR	N/A	N/A	1453	Alaska Center for Conservation Science Web Mapper
Passerines	Hermit thrush	*Catharus guttatus*	U	B	N/A	N/A	N/A	N/A	N/A	1454	Alaska Center for Conservation Science Web Mapper
Passerines	American robin	*Turdus migratorius*	C	B	N/A	N/A	N/A	N/A	N/A	1472	DeGroot and McMillan
Passerines	Varied thrush	*Ixoreus naevius*	C	B	N/A	N/A	AR	N/A	N/A	1478	Alaska Center for Conservation Science Web Mapper
Passerines	Eastern yellow wagtail	*Motacilla tschutschensis*	R	V	N/A	N/A	N/A	N/A	N/A	1513	Kanuti NWR
Passerines	American pipit	*Anthus rubescens*	U	B	N/A	N/A	AR	N/A	N/A	1521	Alaska Center for Conservation Science Web Mapper
Passerines	Bohemian waxwing	*Bombycilla garrulus*	C	B	N/A	N/A	N/A	N/A	N/A	1524	Alaska Center for Conservation Science Web Mapper
Passerines	Orange-crowned warbler	*Oreothlypis celata*	C	B	N/A	N/A	AR	RL	N/A	1536	DeGroot and McMillan
Passerines	Yellow warbler	*Setophaga petechia*	C	B	N/A	N/A	AR	YL	N/A	1545	Alaska Center for Conservation Science Web Mapper
Passerines	Yellow-rumped warbler	*Setophaga coronata*	C	B	N/A	N/A	N/A	N/A	N/A	1550	Alaska Center for Conservation Science Web Mapper
Passerines	Townsend's warbler	*Setophaga townsendi*	U	B	N/A	W	N/A	N/A	N/A	1554	Alaska Center for Conservation Science Web Mapper
Passerines	Blackpoll warbler	*Setophaga striata*	U	B	N/A	W	AR	RL	N/A	1569	Alaska Center for Conservation Science Web Mapper

Species group	Common name	Scientific name[a]	Species relative abundance in the project area	Species occurrence	BCC[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]	AOU No.	Reference
Passerines	Northern waterthrush	*Parkesia noveboracensis*	C	B	N/A	N/A	N/A	N/A	N/A	1581	Alaska Center for Conservation Science Web Mapper
Passerines	Wilson's warbler	*Cardellina pusilla*	C	B	N/A	N/A	AR	N/A	N/A	1601	Alaska Center for Conservation Science Web Mapper
Passerines	American tree sparrow	*Spizelloides arborea*	C	B	N/A	N/A	AR	N/A	N/A	1704	DeGroot and McMillan
Passerines	Savannah sparrow	*Passerculus sandwichensis*	U	B	N/A	N/A	AR	N/A	N/A	1715	DeGroot and McMillan
Passerines	Fox sparrow	*Passerella iliaca*	C	B	N/A	N/A	AR	N/A	N/A	1721	DeGroot and McMillan
Passerines	Lincoln's sparrow	*Melospiza lincolnii*	C	B	N/A	N/A	N/A	N/A	N/A	1723	Alaska Center for Conservation Science Web Mapper
Passerines	White-crowned sparrow	*Zonotrichia leucophrys*	C	B	N/A	N/A	AR	N/A	N/A	1728	Degroot-McMillan
Passerines	Golden-crowned sparrow	*Zonotrichia atricapilla*	U	B	N/A	N/A	N/A	N/A	N/A	1729	Alaska Center for Conservation Science Web Mapper
Passerines	Dark-eyed Junco	*Junco hyemalis*	C	B	N/A	N/A	N/A	N/A	N/A	1730	Alaska Center for Conservation Science Web Mapper
Passerines	Lapland longspur	*Calcarius lapponicus*	U	B	N/A	N/A	N/A	N/A	N/A	1733	Alaska Center for Conservation Science Web Mapper
Passerines	Snow bunting	*Plectrophenax nivalis*	U	B	N/A	N/A	AR	N/A	N/A	1744	Alaska Center for Conservation Science Web Mapper
Passerines	Red-winged blackbird	*Agelaius phoeniceus*	U	B	N/A	N/A	N/A	N/A	N/A	1772	Alaska Center for Conservation Science Web Mapper
Passerines	Rusty blackbird	*Euphagus carolinus*	U	B	CC	S	AR	N/A	VU	1784	DeGroot and McMillan
Passerines	Gray-crowned rosy-finch	*Leucosticte tephrocotis*	C	B	N/A	N/A	N/A	N/A	N/A	1846	Alaska Center for Conservation Science Web Mapper
Passerines	Pine grosbeak	*Pinicola enucleator*	C	B	N/A	N/A	N/A	N/A	N/A	1849	Alaska Center for Conservation Science Web Mapper
Passerines	White-winged crossbill	*Loxia leucoptera*	C	RE	N/A	N/A	N/A	N/A	N/A	1856	Alaska Center for Conservation Science Web Mapper
Passerines	Common redpoll	*Acanthis flammea*	C	B	N/A	N/A	AR	N/A	N/A	1857	DeGroot and McMillan
Passerines	Hoary redpoll	*Acanthis hornemanni*	U	RE	N/A	N/A	N/A	N/A	N/A	1858	DeGroot and McMillan
Passerines	Gray jay	*Perisoreus canadensis*	C	B	N/A	N/A	N/A	N/A	N/A	1978	Alaska Center for Conservation Science Web Mapper

Sources: ABR 2014b; ACCS, UAA 2019b; ADF&G 2015; Banks et al. 2000, 2002, 2003; BLM 2019; DeGroot and McMillan 2012; IUCN 2019; USFWS 2008; Warnock 2017a, 2017b
Notes: ADF&G = Alaska Department of Fish and Game; AOU No. = American Ornithological Society Checklist Number; AUD = Audubon Alaska; B = Breeding; BCC = Birds of Conservation Concern; BLM = U.S. Bureau of Land Management; C = Common; IUCN = International Union for Conservation of Nature; M = Migration; N/A = Not applicable; NT = Near Threatened; NWR = National Wildlife Refuge; R = Rare; RE = Resident; RL = Red List of Declining Bird Populations; S = Sensitive; U = Uncommon; V = Vagrant; VU = Vulnerable; W = WatchList; YL = Yellow List of Vulnerable Species
[a] Scientific names from List of the 2,031 Bird Species (with Scientific and English Names) Known from the American Ornithological Society Checklist Area (AOS n.d.). The list incorporates changes made in the 42nd, 43rd, and 44th supplements to the checklist, as published in The Auk 117: 847−858 (2000); 119:897-906 (2002); 120:923-932 (2003) (Banks et al. 2000, 2002, 2003).
[b] CC = U.S. Fish and Wildlife Service Birds of Conservation Concern, Regions 2, 3, or 4 (USFWS 2008)
[c] BLM Sensitive Species List (BLM 2019)
[d] At -Risk" Species; Source: ADF&G Wildlife Action Plan (ADF&G 2015)
[e],Audubon Alaska, Alaska WatchList (Warnock 2017a, 2017b)
[f] IUCN Red List (IUCN 2019)

1.4. Mammals

1.4.1 Affected Environment

Table 19 lists mammal species in the project area, including common and scientific names, abundance, and special status designations.

Table 19. Mammal species in the project area

Type	Common name	Scientific name	Abundance	BLM	ADF&G
Large Herbivores	Caribou	*Rangifer tarandus*	Common	N/A	N/A
Large Herbivores	Moose	*Alces alces*	Common	N/A	N/A
Large Herbivores	Dall sheep	*Ovis dalli dalli*	Rare	N/A	N/A
Large Herbivores	Muskoxen	*Ovibos moschatus*	Rare	N/A	N/A
Large Carnivores	Black bear	*Ursus americanus*	Common	N/A	N/A
Large Carnivores	Coyote	*Canis latrans*	Rare	N/A	N/A
Large Carnivores	Gray wolf	*Canis lupus*	Common	N/A	N/A
Large Carnivores	Grizzly (brown) bear	*Ursus arctos*	Uncommon	N/A	N/A
Large Carnivores	Lynx	*Lynx canadensis*	Uncommon	N/A	N/A
Large Carnivores	Red fox	*Vulpes vulpes*	Common	N/A	N/A
Large Carnivores	Wolverine	*Gulo gulo*	Uncommon	N/A	N/A
Small Mammals	Alaska marmot	*Marmota broweri*	Common	N/A	N/A
Small Mammals	Alaska tiny shrew	*Sorex yukonicus*	Rare	N/A	N/A
Small Mammals	American beaver	*Castor canadensis*	Common	N/A	N/A
Small Mammals	American marten	*Martes americana*	Uncommon	N/A	N/A
Small Mammals	American pigmy shrew	*Sorex hoyi*	Uncommon	N/A	N/A
Small Mammals	Arctic ground squirrel	*Spermophilus parryii*	Common	WL	N/A
Small Mammals	Cinereus shrew	*Sorex cinereus*	Common	N/A	N/A
Small Mammals	Collared pika	*Ochotona collaris*	Uncommon	N/A	N/A
Small Mammals	Dusky (montane) shrew	*Sorex monticolus*	Common	N/A	N/A
Small Mammals	Ermine	*Mustela erminea*	Common	N/A	N/A
Small Mammals	Least weasel	*Mustela nivalis*	Common	N/A	N/A
Small Mammals	Little brown bat (myotis)	*Myotis lucifugus*	Rare	WL	N/A
Small Mammals	Meadow vole	*Microtus pennsylvanicus*	Common	N/A	SGCN
Small Mammals	Mink	*Mustela vison*	Common	N/A	N/A
Small Mammals	Muskrat	*Ondatra zibethicus*	Common	N/A	N/A
Small Mammals	Neararctic brown lemming	*Lemmus trimucronatus*	Common	N/A	SGCN
Small Mammals	Neararctic collared lemming	*Discrostonyx groelandicus*	Uncommon	N/A	N/A
Small Mammals	North American river otter	*Lontra canadensis*	Common	N/A	N/A
Small Mammals	Northern bog lemming	*Synaptomys borealis*	Common	N/A	SGCN
Small Mammals	Northern flying squirrel	*Glaucomys sabrinus*	Rare	N/A	SGCN

Type	Common name	Scientific name	Abundance	BLM	ADF&G
Small Mammals	Northern red-backed vole	*Myodes rutilus*	Common	N/A	SGCN
Small Mammals	Porcupine	*Erethizon dorsatum*	Common	N/A	N/A
Small Mammals	Red squirrel	*Tamiasciurus hudsonicus*	Uncommon	N/A	SGCN
Small Mammals	Root vole (tundra vole)	*Microtus oeconomus*	Common	N/A	SGCN
Small Mammals	Singing vole	*Microtus miurus*	Common	N/A	SGCN
Small Mammals	Snowshoe hare	*Lepus americanus*	Common	N/A	SGCN
Small Mammals	Tundra shrew	*Sorex tundrensis*	Common	N/A	SGCN
Small Mammals	Yellow-cheeked (taiga) vole	*Microtus xanthognathus*	Common	N/A	SGCN

Source: ADF&G 2015; BLM 2019; NPS 2019; UAA 2019
Notes: ADF&G = Alaska Department of Fish and Game; BLM = U.S. Bureau of Land Management; N/A = Not applicable; SGCN = State of Alaska Species of Greatest Conservation Need; WL = BLM Watch List Species

Table 20 includes habitat loss within the 95 percent contours for both fall and winter for each alternative.

Table 20. Loss of caribou habitat (in acres) by herd and range type for each action alternative

Herd/Range	Alternative A	Alternative B	Alternative C
WAH migratory[a]	1,287	1,347	419
WAH winter[a]	1,128	1,128	1,615
WAH peripheral[a]	1,745	2,300	2,086
WAH total[a]	4,161	4,775	4,120
WAH fall 95% utilization distribution 2009–2019[b]	1,127	1,127	810
WAH winter 95% utilization distribution 2009–2019[b]	388	164	512
RMH summer[a]	0	0	1,329
RMH total[a, c]	0	0	1,964

Notes: WAH = Western Arctic Caribou Herd; RMH = Ray Mountains Herd; fall: September 1 – November 30; winter: December 1 – March 31.
[a] ADF&G 2017
[b] Joly, K., personal communication.
[c] RMH total is entire known range, including summer range

1.4.2 Environmental Consequences

Table 21 provides a summary of potential impacts to terrestrial mammals from the road.

Table 21. Potential impacts to terrestrial mammals

Project component	Effect type	Potential effect	Extent	Duration
Construction	Habitat loss and alteration	Habitat loss from vegetation removal and gravel fill placement	Site-specific	Long-term
Construction and operation	Habitat loss and alteration	Habitat alteration due to gravel spray, fugitive dust, thermokarst, drifted snow, and contamination of soils or water	Local	Long-term
Construction and operation	Habitat loss and alteration	Early snowmelt due to deposition of fugitive dust	Local	Long-term

Project component	Effect type	Potential effect	Extent	Duration
Construction and operation	Disturbance and displacement	Displacement of terrestrial mammals away from construction activity, air traffic, and truck traffic	Project area-wide	Long-term
Construction and operation	Disturbance and displacement	Avoidance of high-quality habitat and critical range due to displacement	Project area-wide	Long-term
Construction and operation	Disturbance and displacement	Attraction to human infrastructure when scavenging for food, as a movement corridor, or as escape from insect harassment	Local	Long-term
Construction and operation	Disturbance and displacement	Disturbance and altered behavior due to noise pollution, light pollution, and human activities associated with construction and operation	Local	Long-term
Construction and operation	Disturbance and displacement	Alteration of movement patterns including delays and deflections to the road and human activity	Project area-wide	Long-term
Construction and operation	Injury and mortality	Injury or mortality of terrestrial mammals due to vehicle or aircraft strikes	Site-specific	Long-term
Construction and operation	Injury and mortality	Contamination of roadside forage due to dust or other contaminants	Local	Long-term
Construction and operation	Injury and mortality	Increase in predator efficiency by using roadway for access to resources.	Local	Long-term

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Appendix F:

Chapter 3 Social Systems Tables and Supplemental Information

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Table of Contents

Tables

1. Affected Environment and Environmental Consequences – Social Systems

1.1. Land Ownership, Use, Management, and Special Designations

1.1.1 Affected Environment

Table 1 lists the communities by class within 50 miles of a project alternative, as well as their Alaska Department of Commerce, Community, and Economic Development (ADCCED) classifications. Volume 4, Maps, Map 3-31 depicts the locations of these communities.

Table 1. Communities by class within 50 miles of a project alternative

Community name	Class	Distance from Alternative A (miles)	Distance from Alternative B (miles)	Distance from Alternative C (miles)
Alatna	Unincorporated	35	35	37
Evansville	Unincorporated	8	8	78
Coldfoot	Unincorporated	13	13	92
Manley Hot Springs	Unincorporated	139	139	41
Tanana	First Class City	128	126	28
Rampart	Unincorporated	105	105	18
Bettles	Second Class City	8	8	77
Allakaket	Second Class City	34	34	39
Ambler	Second Class City	22	22	22
Shungnak	Second Class City	15	15	5
Kobuk	Second Class City	9	9	2
Huslia	Second Class City	92	92	47
Hughes	Second Class City	68	55	3
Wiseman	Unincorporated	24	24	102

Source: ADCCED 2019

Table 2 summarizes 17(b) easements within 5 miles of proposed project alternatives.

Table 2. 17(b) easements within 5 miles of a project alternative

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
9 L	50900613	Doyon, Limited	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
19a C5	50950471	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
4 C5	5020120013	Doyon	Proposed trail up to 50 feet	No restrictions	Reserved	N/A
17, C5, D3, D9, L	5020120013	Doyon, Limited	Existing trail up to 25 feet	No restrictions	Reserved	N/A
30 C5	50950467	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Existing trail up to 25 feet	Other	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 25 feet	Winter only	Reserved	Alternative A, Alternative B, Alternative C
78 D9	N/A	N/A	N/A	N/A	Nominated	N/A
6 C5	5020110115	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 50 feet	Other	Reserved	N/A
2 D1	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	No restrictions	Reserved	N/A
7 L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 50 feet	Other	Reserved	Alternative C
15 L	5020110113	NANA Regional Corporation, Inc.	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
9 C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
10b C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
10a C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
10 C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
11 C5	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	Winter only	Reserved	N/A
16 L	5020090323	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
16 L	5020090323	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
50 C5	N/A	N/A	N/A	N/A	Nominated	N/A
9 L	50950689	Doyon, Limited	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
23 C5	5020050403	Doyon, Limited	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
38 E	50950471	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
30 C5	50950469	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Existing trail up to 25 feet	Other	Reserved	N/A
30 C5	50950469	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Existing trail up to 25 feet	Other	Reserved	N/A
52 C5	N/A	N/A	N/A	N/A	Nominated	N/A
34 C5	50900615	Doyon, Limited	Proposed trail up to 50 feet	No restrictions	Reserved	N/A
1 C3, C5, D9, L	50900615	Doyon, Limited	Existing trail up to 50 feet	Other	Reserved	Alternative A, Alternative B
1 C3, C5, D9, L	5020140025	Evansville, Inc.	Existing trail up to 50 feet	Other	Reserved	N/A
1 C3, C5, D9, L	5020120199	Evansville, Inc.	Existing trail up to 50 feet	Other	Reserved	N/A
6 C5	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 50 feet	Other	Reserved	N/A
6 C5	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	Other	Reserved	N/A
8 L	5020110113	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
7 L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 50 feet	Other	Reserved	N/A
7 L	5020090323	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing Trail up to 50 feet	Other	Reserved	Alternative A
7 L	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	Other	Reserved	Alternative C

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
15 L	5020090323	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
15 L	5020110113	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
15 L	N/A	N/A	Proposed trail up to 25 feet	N/A	Nominated	N/A
15 L	5020110115	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
9 C3, D9, L	5020000260	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
9 C3, D9, L	5020000260	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
9 C3, D9, L	5020000260	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
2 D1	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Existing trail up to 50 feet	No restrictions	Reserved	N/A
2 D1	5020000260	NANA Regional Corporation, Inc.	Proposed trail up to 50 feet	No restrictions	Reserved	N/A
2 D1	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	No restrictions	Reserved	N/A
1 C5, D1	5020110041	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110041	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110041	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	Winter only	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	Winter only	Reserved	N/A
10a C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
10a C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
10 C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
4 C5, D1, L	5020110041	NANA Corporation, Successor in Interest to Isingnakmeut Incorporated	Existing trail up to 25 feet	No restrictions	Reserved	N/A
4 C5, D1, L	5020110041	NANA Corporation, Successor in Interest to Isingnakmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
11 C5	5020110039	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	Winter only	Reserved	N/A
16 L	N/A	N/A	Proposed trail up to 25 feet	N/A	Nominated	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
15 L	5020090323	NANA Corporation, Successor in Interest to Koovukmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
15a C5	N/A	N/A	Proposed trail up to 25 feet	N/A	Nominated	Alternative A, Alternative B
4 C5, D1, L	5020110109	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	No restrictions	Reserved	N/A

Note: N/A = Not Applicable

Table 3 summarizes RS2477 trails within 5 miles of proposed project alternatives.

Table 3. RS2477 trails within 5 miles of a project alternative

ADNR Casefile number	Name	Qualifies as RS2477 right-of-way	Alternative intersected
RST 18	Bettles-Wild Lake River Trail	Yes	Alternative A, Alternative B
RST 38	Tramway Bar	Yes	Alternative A, Alternative B
RST 105	Alatna-Shungnak	Yes	Alternative C
RST 209	Bettles-Coldfoot	Yes	Alternative A, Alternative B
RST 289	Tanana-Allakaket	Yes	Alternative C
RST 308	Hughes-Mile 70	Yes	Alternative C
RST 412	Slate Creek	Yes	Alternative A, Alternative B
RST 450	Hickel Highway	Yes	Alternative A, Alternative B
RST 1611	Bergman-Castle Mountain	Yes	Alternative A, Alternative B
RST 1718	Kobuk-Dahl Creek Trail	Yes	N/A
RST 1719	Wesley Creek Trail	Yes	Alternative C
RST 1720	Dahl Creek-Wesley Creek Trail	Yes	Alternative C
RST 1741	California Creek Trail	Yes	N/A
RST 1742	Kobuk River-California Creek Mine	Yes	N/A
RST 1744	Kobuk River-Junction	Yes	Alternative C
RST 1745	Kobuk-Dahl Creek Landing Field	Yes	N/A
RST 1913	Pah River Portage	Yes	Alternative C

Source: ADNR 2019
Note: ADNR = Alaska Department of Natural Resources; RST = Revised Statute Trail; N/A = Not Applicable.

Table 4 shows the Bureau of Land Management (BLM) Areas of Critical Environmental Concern (ACEC) and Research Natural Areas (RNA) near the project, including their size and reason for ACEC/RNA designation. Volume 4, Map 3-26 depicts the locations of areas.

Table 4. BLM Areas of Critical Environmental Concern and Research Natural Areas in the project vicinity

Plan	ACEC or RNA name	Size (acres)	Reason for designation
CY	Hogatza River Tributaries ACEC	5,200	Crucial salmon spawning habitat
CY	Indian River ACEC	158,000	Crucial salmon spawning habitat
CY	Ishtalitna Creek Hot Springs RNA	1,000	Low-gradient hot springs system
UC	Kanuti Hot Springs ACEC	40	Hot springs system
CY	Lake Todatonten Pingos RNA	660	Geologic features: open system pingos
CY	McQuesten Creek RNA	3,900	Low-gradient hot springs system; geologic features: stone stripes and surface slumps
CY	South Todatonten Summit RNA	660	Geologic features: open system pingos
CY	Spooky Valley RNA	10,100	Geologic, physiographic, vegetation, and scenic
CY	Tozitna River ACEC	843,000	Crucial salmon spawning habitat
CY	Tozitna Subunit North ACEC	129,000	Crucial caribou calving habitat
CY	Tozitna Subunit South ACEC	62,600	Crucial caribou calving habitat

Sources: BLM 1991, 2012
Notes: ACEC = Areas of Critical Environmental Concern; CY = Central Yukon; RNA = Research Natural Area; UC = Utility Corridor

1.1.2 Environmental Consequences

Table 5 shows the amount of land by owner that would be within the project right-of-way for each of the three alternatives.

Table 5. Acreage of land by owner within the right-of-way by alternative

Land Owner	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Department of the Interior	3,498	3,082	19,089
State government	8,635	10,147	426
Local government	261	592	0
Native Allotment	Less than 1	Less than 1	12
Alaska Native lands patented or interim conveyed	2,439	2,437	3,389
Private	0	0	152
Undetermined	42	45	73
Total	14,873	16,305	23,142

Note: The right-of-way is generally 250 feet wide, centered on the road centerline, except where the toe-of-slope is outside that limit. In those locations, the right-of-way boundary is considered to be 10 feet beyond the toe-of-slope limit.

To give a sense of how much each action alternative affects land areas with special management designations, Table 6 provides the linear miles of each alignment within such designated areas.

Table 6. Mileage of each alternative within affected special designation areas

Designation area	Alternative A (miles)	Alternative B (miles)	Alternative C (miles)
BLM Utility Corridor Special Recreation Management Area	3.1	3.1	3.1
National Wilderness Preservation System	0	0	0
National Park System (GAAR)	26.1	17.8	0
National Wildlife Refuge System	0	0	0
Wild and Scenic River System[a] (Kobuk River)	River crossed	River crossed	River not crossed
Tozitna River ACEC (BLM)	0	0	77.2
Indian River ACEC (BLM)	0	0	24.4
Other Lands (not specially designated)	182.0	207.5	227.6

Notes: BLM = Bureau of Land Management; GAAR = Gates of the Arctic National Park and Preserve; ACEC = Area of Critical Environmental Concern
[a] Wild and Scenic Rivers within GAAR do not have a separate land area designation or width; therefore, this table indicates whether an alternative crosses or does not cross the Kobuk Wild and Scenic River, but it does not show mileage.

1.2. Transportation and Access

1.2.1 Affected Environment

Table 7 provides information on transportation facilities within the study area by community, including details on road accessibility and barge service, as well as the closest airport. Volume 4, Map 3-27 depicts the locations of these community transportation facilities.

Table 7. Community-based transportation facilities within the transportation study area

Community name	Connected to road system?	Closest airport	Commercial barge service[a]
Alatna	No	Allakaket Airport	No
Evansville	Seasonal	Bettles Airport	No
Coldfoot	Yes	Coldfoot Airport	No
Manley Hot Springs	Yes	Manley Hot Springs	Yes
Tanana	Seasonal	Tanana Ralph M Calhoun Airport	Yes
Rampart	Seasonal	Rampart Airport	Yes
Bettles	Seasonal	Bettles Airport	No
Allakaket	No	Allakaket Airport	No
Ambler	No	Ambler Airport	Not consistent service
Shungnak	No	Shungnak Airport	Not consistent service
Kobuk	No	Kobuk Airport	Not consistent service
Huslia	No	Huslia Airport	Yes
Hughes	No	Hughes Airport	Not consistent service
Wiseman	Yes	Wiseman Airport[b]	No

Source: ADCCED 2019
[a] Under typical conditions
[b] Not consistently maintained

1.2.2 Environmental Consequences

No additional tables or supplemental information.

1.3. Recreation and Tourism

1.3.1 Affected Environment

Table 8 presents the rivers commonly used for float trips that could be affected by the project. It also includes the common float lengths, typical craft used, put-in and take-out locations, and details on the lands crossed. Volume 4, Map 3-26 depicts the locations of these river float routes.

Table 8. Potentially affected common river float routes[a]

River name (common float length)	Typical craft	Typical put-in location[b]	Typical take-out location	Lands crossed
Alatna River (135 miles)	Inflatable kayak, small raft	Circle Lake	Allakaket (Koyuk confluence), Malamute Fork (gravel bar), Helpmejack Creek	GAAR (WSR), state, BLM, Native corporation
Ambler River (75 miles)	Canoe, kayak	Gravel bars near headwaters	Ambler Village	GAAR, state, BLM, Native corporation
John River (100 miles)	Canoe, kayak, raft	Hunt Fork Lake	Bettles/Koyukuk confluence	GAAR (WSR), state, Native corporation
Kobuk River (115 miles)	Kayak, raft	Walker Lake	Kobuk	GAAR (WSR), state, Native corporation, BLM
North Fork Koyukuk River (90 miles)	Kayak, raft	Kuchona Creek, Redstar Creek	Bettles	GAAR (WSR), Native corporation, state
Selawik River (160 miles)	Canoe, kayak	Lake near headwaters	Selawik River (floatplane) below Tagagawik River	Selawik NWR (WSR)

Sources: Alaska.org (No date); U.S. Fish and Wildlife Service (No date); American Packrafting Association (No date)
Notes: BLM = U.S. Bureau of Land Management; GAAR = Gates of the Arctic National Park and Preserve; NWR = National Wildlife Refuge; State = State of Alaska; WSR = Wild and Scenic River
[a] Many other streams may be floated, particularly by single-person packraft in conjunction with hiking, and some of them could be affected.
[b] Typical access to put-in location is by small plane from Bettles or Coldfoot or direct from Fairbanks.

1.3.2 Environmental Consequences

See Table 8.

1.4. Visual Resources

1.4.1 Affected Environment

No tables or supplemental information.

1.4.2 Environmental Consequences

Table 9 presents the mileage of each action alternative within BLM Visual Recreation Management (VRM) classifications. BLM has only designated VRM classifications near the Dalton Highway corridor.

Table 9. Mileage of each action alternative within BLM's Visual Resource Management classes

BLM VRM class	Alternative A (miles)[a]	Alternative B (miles)[a]	Alternative C (miles)[a]
Class I/II	0	0	0
Class III	16.9	16.9	7.9
Class IV	1.9	1.9	4.4

Source: BLM data accessed 2019; analysis by HDR
Notes: BLM = Bureau of Land Management; VRM = Visual Recreation Management
[a] Mileages are short compared to the overall lengths of the alternatives because BLM VRM classes exist only near the Dalton Highway. Mileage given is on the centerline of each alternative and does not include proposed access roads to material sites, maintenance camps, or other associated facilities.

Table 10 presents the mileage of each action alternative with BLM Visual Resource Inventory (VRI) classifications. These occur more broadly, including some areas not managed by the BLM, but are a tool for inventorying the importance of the visual environment on BLM lands and do not indicate management intent.

Table 10. Mileage of each alternative within BLM's Visual Resource Inventory classes

BLM VRI class	Alternative A (miles)	Alternative B (miles)	Alternative C (miles)
Class I	0	0	0
Class II	107.3	119.3	75.5
Class III	0	0	64.4
Class IV	21.5	25.7	168.7
Unclassified (GAAR[a])	26.1	17.8	0
Unclassified (other[a])	56.4	65.6	23.9

Source: BLM data accessed 2019, analysis by HDR.
Notes: BLM= Bureau of Land Management; VRI = Visual Resources Inventory; GAAR = Gates of the Arctic National Park and Preserve
[a] BLM has classified broad areas of similar topography and vegetation regardless of land ownership but has not classified the entire project area. Gates of the Arctic National Park and Preserve is assumed to be the equivalent of Class I or II based primarily on management intent. Based on surrounding classifications (See Volume 4, Map 3-30), the other unclassified portions would likely be a combination of classes II, III, and IV, with more Class II near the Brooks Range and more Class IV farther south. Mileage given is on the centerline of each alternative and does not include proposed access roads to material sites, maintenance camps, or other facilities that may occur.

1.5. Socioeconomics and Communities

1.5.1 Affected Environment

Table 11 presents a snapshot of the resident workforce of the Northwest Arctic Borough (NAB) and Yukon-Koyukuk Census Area (YKCA) by industry over the 2014–2016 period, based on data provided by the Alaska Department of Labor and Workforce Development (ADOLWD 2019). Government jobs constitute the largest public sector for employment in the NAB and YKCA. Volume 4, Map 3-31 depicts the boundaries of these analysis areas.

Table 11. Northwest Arctic Borough and Yukon-Koyukuk Census Area annual average resident employment by industry, 2014–2016[a]

Industry	NAB 2014	NAB 2015	NAB 2016	YKCA 2014	YKCA 2015	YKCA 2016
Natural resources and mining	129	176	178	99	95	81
Construction	121	116	111	149	160	146
Manufacturing	17	22	21	27	15	7
Goods producing	267	314	310	275	270	234
Trade, transportation, and utilities	350	327	318	259	252	257
Information	60	52	48	35	36	34
Financial activities	99	95	72	8	7	7
Professional and business services	406	422	367	113	102	105
Educational and health services	474	523	549	261	254	241
Leisure and hospitality	71	87	87	143	142	127
Service providing	1,460	1,506	1,441	819	793	771
State government	89	88	70	80	76	78
Local government	1,187	1,144	1,183	1,554	1,496	1,484
Government	1,276	1,232	1,253	1,634	1,572	1,562
Other	25	29	24	121	125	120
Unknown	0	0	1	2	0	0
Total	**3,003**	**3,052**	**3,004**	**2,728**	**2,635**	**2,567**

Source: ADOLWD 2019
Notes: NAB = Northwest Arctic Borough; YKCA = Yukon-Kuskokwim Census Area
[a] Data are by place of residence. All employed residents age 16 and over who live in the borough/census area are counted whether or not they work in the borough/census area. The ADOLWD database captures data for workers in private sector, state, and local government covered by unemployment insurance within Alaska. Federal workers, military, and the self-employed are not included.

Table 12 presents the costs of heating oil and gasoline per gallon within select study area communities in 2017 and 2018. Table 12 also includes electricity rates in 2017, with and without the State of Alaska's Power Cost Equalization (PCE) program. Volume 4, Map 3-31 depicts the locations of these communities.

Table 12. Heating oil, gasoline, and electricity prices in study area communities

Community	2018 residential rate for No. 1 fuel oil (per gal.)	2018 price for gasoline (per gal.)	2017 residential rate without PCE (per kWh)	2017 residential rate with PCE (per kWh)
Alatna	$6.25	$7.00	$0.75	$0.32
Allakaket	$6.25	N/A	$0.75	$0.32
Bettles	$4.00	N/A	$0.69	$0.32
Evansville	$3.91	N/A	$0.69	$0.32
Hughes	$9.00	$8.42	$0.71	$0.19
Huslia	$5.70	$6.58	$0.52	$0.22
Rampart	$5.00	N/A	$0.82	$0.35

Community	2018 residential rate for No. 1 fuel oil (per gal.)	2018 price for gasoline (per gal.)	2017 residential rate without PCE (per kWh)	2017 residential rate with PCE (per kWh)
Ambler	N/A	N/A	$0.54	$0.22
Kobuk	$9.44	N/A	$0.55	$0.22
Shungnak	$8.33	N/A	$0.55	$0.22

Source: Alaska Energy Data Gateway 2019; ADCCED 2019
Notes: gal. = gallon; kWh = kilowatt hour; N/A = Not available; No. = Number; PCE = Power Cost Equalization

1.5.2 Environmental Consequences

No additional tables or supplemental information.

1.6. Environmental Justice

1.6.1 Affected Environment

President William J. Clinton issued Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, in 1994. Its purpose is to focus federal attention on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities. The EO directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations to the greatest extent practicable and permitted by law.

When determining whether effects are disproportionately high and adverse, EO 12898 directs agencies to consider the following:

1. Whether there is, or will be, an effect on the natural or physical environment that significantly (as employed by the National Environmental Policy Act [NEPA]) and adversely affects a minority or low-income population or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority or low-income communities or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment;

2. Whether environmental effects are significant (as employed by NEPA) and are, or may be, having an adverse impact on minority or low-income populations or Indian tribes that appreciably exceeds, or is likely to appreciably exceed, those on the general population or other appropriate comparison group; and

3. Whether the environmental effects occur, or would occur, in a minority or low-income population or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

This analysis identified minority and low-income populations in study area communities using the 2017 American Community Survey 5-year data provided by the U.S. Census Bureau (2019). The analysis based minority status determinations on identifying individuals who are non-white, or who are white but have Hispanic ethnicity. The analysis based low-income status determinations on identifying individuals living in poverty in the previous 12 months.

This analysis identified a study area community as an area of potential environmental justice concern if (1) the minority population exceeds 50 percent or (2) the minority or low-income population is meaningfully greater than the minority or low-income population percentage in a reference population. For the purposes of this analysis, the reference population is the population of Alaska. The decision threshold when there is a "meaningfully greater" percentage of minority or low-income individuals than in the reference population is based on the following equation:

> (minority or low-income population in study area community/total population in study area community)
>
> divided by
>
> (minority or low-income population in reference area/total population in reference area).

If the equation results in a number greater than 1, there is a greater proportion of minority or low-income individuals residing in the study area community than in the reference population.

Table 13 presents population, minority, and low-income characteristics of study area communities and other geographic extents such as relevant boroughs and Alaska as a whole. The communities that did not meet the environmental justice criteria include Fairbanks, Wiseman, and Bettles. Volume 4, Map 3-31 depicts the locations of these census areas and communities.

1.6.2 Environmental Consequences

See Table 13.

Table 13. Population and environmental justice metrics in study area communities

Geographic location	Associated with Alaska Native tribe	Total population	Minority population metric: White (%)a	Minority population metric: Black or African American (%)b	Minority population metric: American Indian or Alaska Native (%)b	Minority population metric: Asian (%)b	Minority population metric: Pacific Islander (%)b	Minority population metric: Other (%)b	Minority population metric: Hispanic or Latino (%)c	Minority population metric: minority (%)d	Minority population metric: EJ community?	Low-Income population metric: unemployment rate (%)	Low-Income population metric: median household income ($)	Low-Income population metric: individuals below poverty level (%)	Low-Income population metric: EJ community?
State of Alaska	N/A	738,565	61.5	4.9	19.6	8.1	1.9	1.9	6.8	38.5	N/A	7.7	76,114	10.2	N/A
Fairbanks North Star Borough	N/A	100,031	83.8	6.7	11.5	4.8	0.9	1.2	7.7	28.9	N/A	8.0	76,250	7.7	N/A
Fairbanks[e]	No	31,853	57.5	12.7	13.7	6.6	1.6	2.0	11.9	42.5	No	9.4	60,658	11.9	No
Nome Census Area	N/A	9,869	23.1	1.4	80.6	2.1	0.5	0.1	2.4	85.1	N/A	16.6	53,821	24.9	N/A
Brevig Mission	Yes	421	0.7	1.4	99.3	0.0	0.0	0.0	0.0	99.3	Yes	30.8	33,750	59.3	Yes
Elim	Yes	296	1.7	0.0	98.3	0.0	0.0	0.0	0.7	98.3	Yes	25.5	39,375	25.5	Yes
Golovin (Cheenik)	Yes	123	4.9	0.0	94.3	0.0	0.0	0.8	0.8	95.1	Yes	11.5	50,000	19.5	Yes
Koyuk	Yes	248	2.0	0.0	97.6	1.2	0.0	0.0	0.0	98.0	Yes	36.0	36,429	41.1	Yes
Nome	Yes	3,793	27.3	3.3	64.1	2.2	1.1	0.3	5.8	72.7	Yes	9.6	81,389	11.8	Yes
St. Michael	Yes	441	1.1	0.2	98.9	0.0	0.5	0.0	0.0	98.9	Yes	21.3	42,813	23.3	Yes
Shaktoolik	Yes	282	1.1	0.0	98.9	1.1	0.0	0.0	0.0	98.9	Yes	20.5	56,875	16.0	Yes
Shishmaref	Yes	522	6.5	0.6	92.7	0.2	0.0	0.0	0.0	93.5	Yes	18.8	34,583	37.3	Yes
Stebbins	Yes	500	2.2	0.0	97.8	0.0	1.2	0.0	0.0	97.8	Yes	23.9	37,679	33.9	Yes
Teller	Yes	184	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	Yes	15.0	33,750	37.5	Yes
Unalakleet	Yes	685	11.7	0.7	75.2	14.0	0.0	0.0	0.1	88.3	Yes	12.0	61,250	13.5	Yes
Wales	Yes	159	0.6	0.0	99.4	0.0	0.0	0.0	0.0	99.4	Yes	12.0	31,250	41.4	Yes
White Mountain	Yes	173	9.2	0.0	90.8	0.0	0.0	0.0	0.0	90.8	Yes	21.2	38,125	30.6	Yes
North Slope Borough	N/A	9,757	36.4	2.1	57.6	6.5	3.1	1.6	4.1	68.7	N/A	9.5	77,266	10.2	N/A
Anaktuvuk Pass	Yes	290	11.7	1.0	87.2	0.0	0.0	0.0	1.7	88.3	Yes	50.4	56,667	33.6	Yes
Atqasuk	Yes	172	1.7	0.0	98.3	0.0	0.0	0.0	0.0	98.3	Yes	11.6	61,250	19.2	Yes
Utqiaġvik	Yes	4,383	13.0	2.9	68.6	12.8	6.5	1.6	4.6	87.0	Yes	14.2	82,964	11.2	Yes
Nuiqsut	Yes	395	7.8	0.0	90.9	0.0	1.5	0.0	0.0	92.2	Yes	23.1	82,813	9.3	No
Point Hope	Yes	629	3.8	2.2	94.1	1.4	0.0	2.9	6.0	96.2	Yes	32.3	60,417	20.0	Yes
Point Lay	Yes	273	4.4	0.0	92.7	0.0	1.5	0.0	4.8	95.6	Yes	22.4	58,750	20.2	Yes
Wainwright	Yes	513	6.2	0.2	93.8	0.0	0.0	0.0	2.3	93.8	Yes	15.9	71,250	13.5	Yes
Northwest Arctic Borough	N/A	7,715	15.1	1.0	85.0	1.8	0.5	1.0	2.5	88.9	N/A	20.1	61,533	25.3	N/A
Ambler	Yes	299	3.3	0.0	96.3	0.0	1.0	0.0	0.0	96.7	Yes	22.2	44,500	27.8	Yes
Buckland	Yes	627	1.8	0.0	97.4	0.2	0.0	0.6	0.6	98.2	Yes	42.2	41,932	22.5	Yes
Deering	Yes	152	1.3	0.0	92.1	6.6	0.0	0.0	0.0	98.7	Yes	14.3	44,375	13.2	Yes
Kiana	Yes	284	3.5	0.0	95.4	1.1	1.4	0.0	0.0	96.5	Yes	31.0	42,813	37.5	Yes

Geographic location	Associated with Alaska Native tribe	Total population	Minority population metric: White (%)a	Minority population metric: Black or African American (%)b	Minority population metric: American Indian or Alaska Native (%)b	Minority population metric: Asian (%)b	Minority population metric: Pacific Islander (%)b	Minority population metric: Other (%)b	Minority population metric: Hispanic or Latino (%)c	Minority population metric: minority (%)d	Minority population metric: EJ community?	Low-Income population metric: unemployment rate (%)	Low-Income population metric: median household income ($)	Low-Income population metric: individuals below poverty level (%)	Low-Income population metric: EJ community?
Kivalina	Yes	678	5.2	0.6	94.2	0.0	0.0	0.0	0.6	94.8	Yes	20.3	48,750	31.1	Yes
Kobuk	Yes	152	5.3	0.0	94.7	0.0	0.0	0.0	9.2	94.7	Yes	26.7	52,500	39.5	Yes
Kotzebue	Yes	3,276	20.4	1.7	73.2	2.7	0.9	1.9	4.9	79.6	Yes	11.9	88,047	16.2	Yes
Noatak	Yes	424	0.9	0.7	98.6	0.0	0.0	0.0	0.0	99.1	Yes	29.5	50,000	28.8	Yes
Noorvik	Yes	579	4.8	0.0	95.2	0.0	0.0	0.0	0.0	95.2	Yes	29.5	48,750	32.2	Yes
Selawik	Yes	813	1.4	0.0	98.6	0.0	0.0	0.0	0.0	98.6	Yes	36.1	35,625	46.6	Yes
Shungnak	Yes	280	13.2	0.7	80.0	6.8	0.0	0.0	0.0	86.8	Yes	26.4	39,688	31.9	Yes
Kusilvak Census Area	N/A	8,129	7.6	1.2	94.6	0.6	0.2	0.0	1.6	96.2	N/A	28.8	36,468	39.1	N/A
Kotlik	Yes	726	1.9	1.2	97.8	0.0	0.0	0.0	0.0	98.1	Yes	17.0	41,667	44.2	Yes
Yukon-Koyukuk Census Area	N/A	5,453	27.9	0.5	76.3	0.7	0.1	0.2	2.1	78.7	N/A	19.7	37,819	25.5	N/A
Alatna[f]	Yes	37	0	0	100.0	0	0	0	0	0	Yes	15.4	NA	NA	NA
Allakaket	Yes	186	10.2	0.0	82.8	2.2	0.0	0.0	4.8	89.8	Yes	35.8	27,250	28.8	Yes
Bettles[e, g]	No	74	68.9	0.0	31.1	0.0	0.0	0.0	0.0	31.1	No	NA	68,125[f]	0.0	No
Coldfoot	No	84	97.6	0.0	1.2	1.2	0.0	0.0	1.2	2.4	No	NA	N/A	29.8	Yes
Evansville	Yes	9	11.1	0.0	88.9	0.0	0.0	0.0	0.0	88.9	Yes	NA	33,750	NA	NA
Galena	Yes	473	32.1	0.2	63.6	1.7	0.0	0.0	2.5	67.9	Yes	11.0	74,375	10.4	Yes
Hughes	Yes	77	0.0	0.0	89.6	10.4	0.0	0.0	0.0	100.0	Yes	10.5	34,375	28.6	Yes
Huslia	Yes	397	8.1	0.0	91.9	0.0	0.0	0.0	1.8	91.9	Yes	22.6	40,000	24.2	Yes
Kaltag	Yes	165	8.5	0.0	91.5	0.0	0.0	0.0	0.0	91.5	Yes	35.4	27,500	18.8	Yes
Koyukuk	Yes	54	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	Yes	19.2	15,417	42.6	Yes
Manley Hot Springs	Yes	77	66.2	0.0	22.1	0.0	0.0	0.0	11.7	33.8	No	11.4	55,833	15.6	Yes
Nulato	Yes	276	2.9	1.4	97.1	0.0	0.0	0.0	0.0	97.1	Yes	30.2	38,333	31.4	Yes
Rampart	Yes	36	0.0	0.0	100.0	0.0	0.0	0.0	30.6	100.0	Yes	NA	50,625	N/A	NA
Tanana	Yes	243	10.7	0.4	87.7	0.0	0.0	0.0	1.2	89.3	Yes	6.5	47,778	8.4	No
Wiseman[e]	No	9	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	No	0.0	NA	0.0	No

Source: U.S. Census Bureau 2019; National Conference of State Legislatures 2018
Notes: N/A = Not applicable; EJ = Environmental Justice; NA = Not available
[a] Alone, non-Hispanic, or Latino.
[b] Alone or in combination with one or more other races.
[c] Hispanic or Latino, can be of any race.
[d] 100 percent minus "White, non-Hispanic, or Latino."
[e] Did not meet the Environmental Justice criteria.
[f] All data for Alatna are from ADCCED 2019.
[g] Median household income data for Bettles are from ADCCED 2019.

1.7. Subsistence Uses and Resources

1.7.1 Affected Environment

Table 14 lists the primary subsistence communities for the analysis.

Table 14. Ambler Road EIS subsistence and Western Arctic Caribou Herd Working Group study communities

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAH WG
1	Alatna	SUB	Yes	Yes	Yes	No
2	Beaver	SUB	No	No	Yes	No
3	Coldfoot	SUB	Yes	Yes	Yes	No
4	Evansville	SUB	Yes	Yes	Yes	No
5	Livengood	SUB	Yes	No	No	No
6	Manley Hot Springs	SUB	Yes	No	Yes	No
7	Minto	SUB	Yes	No	Yes	No
8	Nenana	SUB	No	No	Yes	No
9	Rampart	SUB	Yes	Yes	Yes	No
10	Stevens Village	SUB	Yes	Yes	Yes	No
11	Tanana	SUB	Yes	Yes	Yes	No
12	Allakaket	SUB/WAH	Yes	Yes	Yes	Yes
13	Ambler	SUB/WAH	Yes	Yes	Yes	Yes
14	Anaktuvuk Pass	SUB/WAH	No	Yes	Yes	Yes
15	Bettles	SUB/WAH	Yes	Yes	Yes	Yes
16	Buckland	SUB/WAH	No	No	Yes	Yes
17	Galena	SUB/WAH	No	Yes	Yes	Yes
18	Hughes	SUB/WAH	Yes	Yes	Yes	Yes
19	Huslia	SUB/WAH	Yes	Yes	Yes	Yes
20	Kiana	SUB/WAH	No	Yes	Yes	Yes
21	Kobuk	SUB/WAH	Yes	Yes	Yes	Yes

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAH WG
22	Kotzebue	SUB/WAH	No	No	Yes	Yes
23	Noatak	SUB/WAH	No	No	Yes	Yes
24	Noorvik	SUB/WAH	No	No	Yes	Yes
25	Selawik	SUB/WAH	No	Yes	Yes	Yes
26	Shungnak	SUB/WAH	Yes	Yes	Yes	Yes
27	Wiseman	SUB/WAH	Yes	Yes	Yes	Yes
28	Atqasuk	WAH	No	No	No	Yes
29	Brevig Mission	WAH	No	No	No	Yes
30	Deering	WAH	No	No	No	Yes
31	Elim	WAH	No	No	No	Yes
32	Fairbanks	WAH	No	No	No	Yes
33	Golovin	WAH	No	No	No	Yes
34	Kaltag	WAH	No	No	No	Yes
35	Kivalina	WAH	No	No	No	Yes
36	Kotlik	WAH	No	No	No	Yes
37	Koyuk	WAH	No	No	No	Yes
38	Koyukuk	WAH	No	No	No	Yes
39	Nome	WAH	No	No	No	Yes
40	Nuiqsut	WAH	No	No	No	Yes
41	Nulato	WAH	No	No	No	Yes
42	Point Hope	WAH	No	No	No	Yes
43	Point Lay	WAH	No	No	No	Yes
44	Shaktoolik	WAH	No	No	No	Yes
45	Shishmaref	WAH	No	No	No	Yes
46	St. Michael	WAH	No	No	No	Yes
47	Stebbins	WAH	No	No	No	Yes
48	Teller	WAH	No	No	No	Yes

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAH WG
49	Unalakleet	WAH	No	No	No	Yes
50	Utqiaġvik	WAH	No	No	No	Yes
51	Wainwright	WAH	No	No	No	Yes
52	Wales	WAH	No	No	No	Yes
53	White Mountain	WAH	No	No	No	Yes

Notes: SUB=Subsistence Study Community; WAH=Western Arctic Caribou Herd Working Group Study Community; WAH WG = Western Arctic Caribou Herd Working Group

Table 15 provides average harvest and participation data for all resources for the subsistence study communities. Note that Livengood and Nenana are not included in this table as there are no harvest data and no comprehensive study years for data, respectively.

Table 15. All resources harvest and participation data, average across available study years, subsistence study communities

Study community	% of HH using	% of HH trying to harvest	% of HH harvesting	% of HH giving	% of HH receiving	Estimated pounds harvested	Average HH pounds	Per capita pounds	Top 3 resource categories (by % of total harvest)
Alatna	100	100	100	100	100	97,760	2,274	633	Salmon (48.5) LLM (28.8) NSF (16.4)
Allakaket	100	95	90	86	100	114,651	2,349	689	Salmon (53.4) NSF (22.9) LLM (18.7)
Ambler	98	96	96	87	92	170,468	2,243	603	LLM (59.9) NSF (28.9) Salmon (5.9)
Anaktuvuk Pass	98	77	75	76	95	69,825	1,122	316	LLM (89.6) NSF (7.9) Vegetation (1.9)
Beaver	100	98	96	78	95	43,301	1,277	545	Salmon (49.8) LLM (30.7) NSF (7.3)
Bettles	100	88	88	88	100	11,010	446	186	LLM (67.2) Salmon (15.2) NSF (10.1)

Study community	% of HH using	% of HH trying to harvest	% of HH harvesting	% of HH giving	% of HH receiving	Estimated pounds harvested	Average HH pounds	Per capita pounds	Top 3 resource categories (by % of total harvest)
Buckland	99	90	90	89	82	226,074	2,569	554	LLM (44.1) NSF (17.3) Salmon (10.6)
Coldfoot	100	100	100	50	100	381	76	38	LLM (85.3) Vegetation (14.7)
Evansville	100	100	100	77	100	10,748	401	155	LLM (57.9 Salmon (18.1) NSF (11.6
Galena	96	85	87	65	86	325,368	1,628	520	Salmon (58.0) LLM (27.6) NSF (10.1)
Hughes	96	85	77	62	96	87,069	3,697	926	Salmon (60.8) LLM (24.6) NSF (10.7)
Huslia	N/A	N/A	100	N/A	N/A	208,165	3,652	1082	Salmon (51.2) LLM (35.0) NSF (8.4)
Kiana	99	92	92	N/A	N/A	133,211	1,402	347	LLM (37.7) NSF (28.7) Salmon (24.4)
Kobuk	100	100	100	90	100	50,743	1,410	309	LLM (36.1) Salmon (29.8) NSF (27.2)
Kotzebue	99	88	87	79	96	1,278,772	1,601	398	LLM (31.5) Marine Mammals (23.0) NSF (22.9)
Manley Hot Springs	100	98	98	71	93	52,438	904	426	Salmon (82.0) NSF (7.4) LLM (5.0)
Minto	98	97	95	74	93	115,196	2,312	620	Salmon (55.3) LLM (23.6) NSF (13.1)

Study community	% of HH using	% of HH trying to harvest	% of HH harvesting	% of HH giving	% of HH receiving	Estimated pounds harvested	Average HH pounds	Per capita pounds	Top 3 resource categories (by % of total harvest)
Noatak	96	95	95	91	92	96,797	88,230	412	LLM (41.9) Salmon (20.0) NSF (19.5)
Noorvik	100	94	93	75	96	353,142	2,616	603	NSF (38.5) LLM (36.8) Salmon (17.1)

Sources: See Appendix L, Subsistence Technical Report, Table 41.
Notes: HH = households; LLM = Large Land Mammal; N/A = not applicable; NSF = Non-salmon Fish
The 25 communities listed in this table, in addition to Nenana and Livengood, make up the 27 primary subsistence study communities. Comprehensive harvest data is not available for Nenana and Livengood and therefore are not included in this table.
[a] Estimated Number Harvested not available for All Resources data.

Table 16 provides average moose harvest and participation data for the for the 27 subsistence study communities.

Table 16. Moose harvest data, average across all available study years

Community	% HHs use	% HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Alatna	98	75	50	41	74	15	7,905	355	117	16.0
Allakaket	97	73	52	45	65	34	17,676	332	98	12.9
Ambler	36	21	13	14	26	10	5,231	74	20	4.5
Anaktuvuk Pass	29	10	6	9	24	4	2,230	25	7	3.2
Beaver	33	27	12	12	28	10	5,927	277	90	25.1
Bettles	88	35	24	40	62	8	3,792	193	72	51.5
Buckland	26	19	NA	15	15	13	6,787	74	15	4.0
Coldfoot	25	NA	NA	NA	25	NA	NA	NA	NA	NA
Evansville	78	33	20	39	68	7	3,201	133	55	51.4
Galena	90	64	48	34	55	106	60,907	316	108	25.6
Hughes	96	62	57	35	69	26	13,083	538	140	17.6
Huslia	99	66	58	36	52	79	44,744	608	198	28.8

Community	% HHs use	% HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Kiana	29	16	13	9	14	13	7,054	72	19	6.5
Kobuk	48	45	16	16	43	6	2,958	95	21	3.8
Kotzebue	47	23	12	16	38	105	56,591	70	18	5.4
Manley Hot Springs	59	50	11	25	49	8	4,498	123	55	4.9
Minto	90	70	39	34	74	32	18,732	309	96	22.5
Nenana	49	69	22	8	29	62	40,213	223	83	NA
Noatak	39	28	24	21	32	377	3,973	386	8	2.3
Noorvik	57	28	20	18	43	35	18,902	129	28	3.7
Rampart	86	57	57	43	86	4	4,011	309	103	27.2
Selawik	65	36	25	36	53	50	26,775	164	35	4.7
Shungnak	57	27	19	16	41	12	6,302	113	25	3.1
Stevens Village	60	56	25	14	44	31	1,630	82	24	1.5
Tanana	94	67	38	42	70	48	27,253	258	105	5.4
Wiseman	100	80	60	60	40	4	1,890	432	166	46.4
All communities	64	45	30	27	47	44	15,691	228	68	15.8

Notes: There are no harvest data for the subsistence study community of Livengood. NA = not available; HHs = households; lbs = pounds

Table 17 provides caribou use and harvest averages, across all available study years, for the caribou study communities listed in Table 14 as members of the WAH WG, as well as depicted on Volume 4, Map 3-32. Note that Fairbanks and Koyukuk are not included in Table 17 because they have no available caribou harvest data.

Table 17. Caribou harvest data, average across all available study years, Western Arctic Herd study communities

Community	% of HHs using	% of HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Allakaket	72	38	15	21	52	32	4,129	80	22	4.2
Ambler	88	74	69	56	51	489	66,473	937	255	54.6

Community	% of HHs using	% of HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Anaktuvuk Pass	92	61	49	49	68	514	65,678	784	222	86.2
Atqasuk	96	70	65	71	65	257	N/A	N/A	N/A	N/A
Bettles	62	29	18	32	32	11	1,387	106	38	14.1
Brevig Mission	47	17	11	16	40	46	6,261	93	24	0.0
Buckland	84	71	68	57	58	622	84,558	915	186	38.3
Deering	88	52	46	51	68	243	32,989	738	241	42.1
Elim	92	63	51	56	77	153	20,844	276	70	N/A
Galena	13	5	4	4	10	18	2,801	15	5	1.1
Golovin	79	30	21	22	67	57	7,707	161	32	10.3
Hughes	31	27	6	4	18	10	1,360	40	15	4.2
Huslia	75	40	33	23	38	107	13,880	182	60	3.3
Kaltag	14	6	5	5	10	6	795	13	3	N/A
Kiana	89	70	66	53	65	403	54,755	559	144	31.2
Kivalina	90	69	56	57	70	412	57,326	1,550	251	25.7
Kobuk	89	78	66	57	63	154	20,976	655	147	31.8
Kotlik	N/A	N/A	7	N/A	N/A	8	1,600	29	4	NA
Kotzebue	86	49	42	47	64	2,094	284,711	353	90	25.7
Koyuk	94	66	56	52	64	292	39,742	474	118	40.0
Noatak	88	66	60	54	67	416	44,761	12,355	124	39.6
Noorvik	95	67	67	48	60	869	118,140	818	184	32.8
Nuiqsut	96	72	67	71	75	507	63,281	746	165	29.9
Nulato	5	3	3	2	3	4	552	7	2	0.0
Point Hope	91	53	30	51	80	185	25,156	143	34	7.6
Point Lay	94	66	66	67	75	223	29,501	494	149	25.5
Selawik	97	65	59	67	82	969	131,801	810	174	20.4
Shaktoolik	84	54	51	43	67	156	21,196	361	93	N/A

Community	% of HHs using	% of HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Shishmaref	75	38	35	44	59	333	45,237	335	80	13.7
Shungnak	97	66	64	48	60	441	60,044	1,055	237	44.7
St. Michael	68	29	18	16	57	33	4,413	47	10	NA
Stebbins	7	5	1	2	5	9	1,161	9	2	0.9
Teller	34	4	3	3	32	11	2,823	20	6	NA
Unalakleet	83	42	37	32	64	481	65,468	317	93	NA
Utqiaġvik	86	52	42	67	68	3,008	370,858	242	90	24.2
Wainwright	97	64	64	62	84	971	125,271	886	231	32.7
Wales	19	3	1	5	19	1	162	3	1	0.4
White Mountain	75	41	33	32	56	81	10,985	168	54	55.8
Wiseman	80	80	60	60	20	7	890	104	40	20.9
All communities	72	46	38	39	53	352	47,201	703	98	26.5

Sources: See Appendix L, Subsistence Technical Report, Table 39.
Note: N/A = Not applicable; NA = not available; HHs = households; Lbs = pounds

1.7.2 Environmental Consequences

Table 18 provides the number of subsistence study communities with subsistence use areas that are crossed by an alternative by resource type.

Table 18. Number of communities with use areas crossing the project, by alternative and resource

Resource	Number of communities crossing Alternative A	Number of communities crossing Alternative B	Number of communities crossing Alternative C	Number of communities crossing any alternative	Alternative(s) affecting greatest number of communities
Moose	9	9	8	12	A, B
Caribou	9	9	10	12	C
Dall sheep	6	6	3	6	A, B
Bear	5	5	7	7	C

Resource	Number of communities crossing Alternative A	Number of communities crossing Alternative B	Number of communities crossing Alternative C	Number of communities crossing any alternative	Alternative(s) affecting greatest number of communities
Other large land mammals	0	0	0	0	N/A
Small land mammals	8	9	11	15	C
Marine mammals	0	0	0	0	N/A
Migratory birds	6	5	6	9	A, C
Upland game birds	4	4	3	7	A, B
Eggs	2	2	0	2	A, B
Salmon	3	3	5	6	C
Non-salmon fish	3	3	8	10	C
Marine invertebrates	0	0	0	0	N/A
Vegetation	6	7	6	10	B
Total number of communities crossed	12	12	12	16	N/A

Source: Appendix L, Maps 2 through 27
Note: N/A = Not Applicable

1.8. Cultural Resources

1.8.1 Affected Environment

Table 19 provides the generalized prehistoric chronology of the study area, including details on the type of cultural complex and representative sites and their characteristics.

Table 19. Generalized prehistoric chronology of the study area

Cultural complex	Chronology	Characteristics and representative sites
Paleo-Indian Period	11,700–8,000 BP	Lanceolate projectile points, distinctive gravers, end scrapers, blades, and debitage Mesa and Sluiceway complexes; Utukok River sites, Putu, Mesa
American Paleoarctic Tradition	10,000–7,000 BP	Core and blade technology characterized by wedge-shaped microblade cores, microblades, blades, burins, and ellipsoidal bifaces Onion Portage, Gallagher Flint Station, Lisburn Site
Northern Archaic Tradition	6,500–3,500 BP	Side-notched projectile points, some presence of microblades Kurupa Lake, Tuktu Lake, Onion Portage
Denbigh Flint Complex	4,250–2,600 BP	Well-made, tiny bifacial tools and projectile points; microblades, burins, and insets Iyatayet Site, Cape Denbigh, Onion Portage
Choris	2,800–2,200 BP	Large, finely made projectile points, ground slate tools, pottery, burin spalls, and adze blades. Large oval-shaped structures; elliptical houses and associated material culture that includes lanceolate projectile points, adze blades (for insertion into antler shafts), and flaked burins Cape Krusenstern, Choris Peninsula, Onion Portage
Norton	2,500–1,800 years ago	Greater dependence on marine resources, including fish; abundance of net sinkers; coarser material types compared to earlier periods; check-stamped pottery, deep square houses Iyatayet site
Ipiutak	1,950–1,100 BP	Elaborate burial goods carved of ivory, use of iron, Denbigh-like inset styles, uniface knives, Norton style discoid scrapers, bifaces and burins, lack of pottery, and ground slate artifacts Point Hope, Anaktuvuk Pass
Northern Maritime Tradition	1,600 BP–European Contact	Increased exploitation of marine mammals, stamped pottery, ground slate tools, flaked stone insets, ivory artifacts Cape Krusenstern, Birnirk
Arctic Woodland	800–200 BP	Caribou-oriented, interior, Eskimo culture, square house pits with entrance tunnels Kobuk River sites, Kotzebue coastal area
Athabascan Tradition	200–120 BP	Variations in semi-subterranean house structures or winter houses (*ookevik*) and variations in lithic technology; subsurface house pits and cache pits; European trade goods at later sites Lake 324 complex at Batza Tena, Onion Portage

Source: BLM 2012; Giddings and Anderson 1988; Blanchard 2014
Notes: BP = Before Present

Table 20 lists the Revised Statute 2477 (RS2477) trails found in the cultural resources study area, as well as corridors within the direct and indirect effects areas. Volume 4, Maps 3-26 and 3-29 depict the locations of the RS2477 rotes.

Table 20. RS2477 trails in the cultural resources study area

RST number	RST name	Corridors within direct impacts area	Corridors within indirect impacts area
RST 105	Alatna-Shungnak	Alternative C	Alternative A, Alternative C
RST 1611	Bergman-Cathedral Mountain	Alternative A, Alternative B	Alternative A, Alternative B
RST 1718	Kobuk-Dahl Creek Trail	No direct impacts	No indirect impacts
RST 1719	Wesley Creek Trail	Alternative A, Alternative C	Alternative A, Alternative C
RST 1720	Dahl Creek-Wesley Creek Trail	Alternative A, Alternative C	Alternative A, Alternative C
RST 1741	California Creek Trail	No direct impacts	No indirect impacts
RST 1742	Kobuk River-California Creek Mine	No direct impacts	No indirect impacts
RST 1744	Kobuk River-Junction	Alternative A, Alternative C	Alternative A, Alternative C
RST 1745	Kobuk-Dahl Creek Landing Field	No direct impacts	No indirect impacts
RST 18	Bettles-Wild Lake River Trail	Alternative A, Alternative B	Alternative A, Alternative B
RST 1913	Pah River Portage	Alternative A, Alternative C	Alternative A, Alternative C
RST 209	Bettles-Coldfoot	Alternative A, Alternative B	Alternative A, Alternative B
RST 289	Tanana-Allakaket	Alternative A, Alternative C	Alternative A, Alternative C
RST 308	Hughes-Mile 70	Alternative A, Alternative C	Alternative A, Alternative C
RST 38	Tramway Bar	Alternative A, Alternative B	Alternative A, Alternative B
RST 412	Slate Creek	Alternative A, Alternative B	Alternative A, Alternative B
RST 450	Hickel Highway	Alternative A, Alternative B	Alternative A, Alternative B

Source: ADNR (No date).
Notes: RST = Revised Statute Trail

1.8.2 Environmental Consequences

Table 21 through Table 23 summarize the results of cultural resources sensitivity modelling for each alternative. For purposes of the model, "study area" was defined as a 20-mile buffer centered on the 3 alternative routes (Sweeney and Simmons 2019).

Table 21 summarizes the results of cultural resources sensitivity modelling for Alternative A. There are a total of 2,695,857.8 model study acres for Alternative A.

Table 21. Model results, Alternative A

Model value	Model value acreage for study area (acres)	Percentage (%)
High	978,408.3	36.3
Medium	1,306,638.2	48.5
Low	410,811.3	15.2
Total	2,695,857.8	100.0

Source: Adapted from Sweeney and Simmons 2019

Table 22 summarizes the model results for Alternative B. There are a total of 2,870,235.7 total study acres for Alternative B.

Table 22. Model results, Alternative B

Model value	Model value acreage for study area (acres)	Percentage (%)
High	1,114,208.0	38.8
Medium	1,361,150.5	47.4
Low	394,877.1	13.8
Total	2,870,235.7	100.0

Source: Adapted from Sweeney and Simmons 2019

Table 23 summarizes the model results for Alternative C. There are a total of 4,971,935.4 total study acres for Alternative C.

Table 23. Model results, Alternative C

Model value	Model value acreage for study area (acres)	Percentage (%)
High	2,022,278.0	40.7
Medium	1,895,499.5	38.1
Low	962,693.0	19.4
No Value	91,464.9	1.8
Total	4,971,935.4	100.00

Source: Adapted from Sweeney and Simmons 2019

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