# Section 2
# Ambler Mining District Industrial Access Project
# Corridor SF299 Supplemental Narrative

**Prepared on behalf of:**

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**7. Project Description (describe in detail): (a) Type of system or facility, *(e.g., canal, pipeline, road);* (b) related structures and facilities; (c) physical specifications *(length, width, grading, etc.);* (d) term of years needed; (e) time of year of use or operation; (f) Volume or amount of product to be transported; (g) duration and timing of construction; and (h) temporary work areas needed for construction.**

(a) Proposed Facility.

The project would construct a new 211-mile roadway along the southern flanks of the Brooks Range, extending west from the Dalton Highway to the south bank of the Ambler River (Appendix 2A: Figure 2-1). The road is being designed as an industrial access road to provide ingress to the Ambler Mining District (the District). The road would provide surface transportation access to the mining district to allow for expanded exploration, mine development, and mine operations at mineral prospects throughout the District. Access to the road would be controlled and primarily limited to mining-related industrial uses, although some commercial uses may be allowed under a permit process.

The Alaska Industrial Development and Export Authority (AIDEA) is requesting a right-of-way (ROW) for the industrial access road as well as material sites and access roads to reach water sources and material sites. The ROW requested is 250 feet wide in most areas, although in a few areas, with bridge crossings and steep terrain, the ROW width may need to be up to 400 feet wide. Potential measures to reduce the footprint in these areas could be evaluated in more detailed design stages. Some of the areas used as material sites may also be developed into maintenance areas to house staff and equipment to operate and maintain the road.

AIDEA would hold the ROW granted and the road, but may procure road design, construction, maintenance and operation services through third-parties. This is a proven AIDEA business model and was successfully used to construct the Delong Mountain Transportation System (DMTS) which provides access to the Red Dog Mine in northwest Alaska. AIDEA owns the DMTS but it was constructed and is operated and maintained by private parties under contract to AIDEA.

The project corridor extends along the south side of the Brooks Range, following a series of stream and river valleys oriented roughly east-west, separating the Schwatka Mountains of the Brooks Range 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.

The National Park Service (NPS) has requested AIDEA evaluate an alternative corridor through Gates of the Arctic National Park and Preserve (GAAR) that is south of the proposed (preferred) alignment and crosses through the narrowest portion of GAAR. The alternative alignment through GAAR is shown on Figure 2-2 in Appendix 2A.

Table 1 summarizes the major project elements and their typical size or dimensions. Table 2 provides information on the overall project footprint and the footprint of each of the major project elements for the preferred corridor. The footprint is based on the daylight limits for the project elements plus a 10-foot buffer around the daylight limits for construction access, clearing and other temporary effects. Temporary and permanent effects on wetlands and streams are addressed in more detail in the U.S. Army Corps of Engineers (USACE) permit application included in this document as Section 5: Tables 4-6.

**Table 1: Summary of Major Project Elements**

| Project Element | Description | Quantity | Typical Size/ Dimensions |
|---|---|---|---|
| Industrial Access Road Lanes | Industrial Access Road Travel Lanes | 211 miles | 32 ft wide |
| Industrial Access Road Embankment | Two-lane Gravel-Surfaced Road with Full-Depth Embankment | 211 miles | 80 ft wide |
| Vehicle Turnouts | Gravel-Surfaced Turnouts | 20 | 20 ft wide x 250 ft long |
| Material Sites | Borrow Locations | 41[1] | Varies |
| Access Roads Lanes | Travel Lanes for Access Roads | 48 | 32 ft wide x varied lengths |
| Access Road Embankments | Access Road with Embankment | 48 | 80 ft wide x varied lengths |
| Bridges | Water Crossings Greater than 20 ft wide | 29 | 23 ft wide x varied lengths |
| Minor Culverts | Water Crossings Up to 3 ft wide | 2,869 | Varied Lengths |
| Moderate Culverts | Water Crossings 4 to 10 ft wide | 15 | Varied Lengths |
| Major Culverts | Water Crossings 10 to 20 ft wide | 19 | Varied Lengths |
| Maintenance Stations[2] | Material and Crew Facilities | 3 | 12 Acres |
| Air Strip[2] | Landing Surface | 3 | 150 ft wide x 3,000 ft long |
| Air Strip[2] | Airstrip Footprint | 3 | 550 ft wide x 6,400 ft long |

[1]*This is a conservatively large number for preliminary design level analysis.*
[2]*These facilities would be co-located with material sites.*

Table 2: Proposed Project Footprint: Preferred and Alternative Corridors [1]

| **Project Elements** | **Quantity** | |
|---|---|---|
| | **Preferred Corridor** | **Alternative Corridor** |
| Overall Project Footprint (*Acres*) | 4,471 | 5,074 |
| Industrial Access Road Length (*Miles*) | 211 | 228 |
| Industrial Access Road (IAR) Footprint (*Acres*) | 2,318 | 2,551 |
| Support Access Road (SAR) Footprint (*Acres*) | 137 | 214 |
| Airstrip Footprint (*Acres*) | 153 | 153 |
| Material Sites Footprint (*Acres*) | 1,863 | 2,155 |
| Material Sites (*No.*) | 41 | 46 |
| Bridges (*No.*) – Small (<50 feet) | 3 | 3 |
| Bridges (*No.*) – Medium (50 – 140 feet) | 15 | 12 |
| Bridges (*No.*) – Large (>140 feet) | 11 | 11 |
| Culvert (*No.*) – Minor (3 feet) | 2,869 | 3,155 |
| Culvert (*No.*) – Moderate (4 – 10 feet) | 15 | 12 |
| Culvert (*No.*) –Major (>10 feet) | 19 | 12 |

[1]*A more detailed breakout of the footprint for each project element is included in Appendix 2A: Table 2A-2.*

(b) Related Structures and Facilities along the entire road corridor, including water crossings.

The project would require the construction of numerous support structures including: bridges, culverts, maintenance stations, turnouts, material sites, material site access roads, maintenance stations, and airstrips as listed in Tables 1 and 2. Figure 2-3 of Appendix 2A illustrates the project elements along the entire proposed project corridor from the Dalton Highway to Ambler Mining District.

Table 3 provides definitions and quantities of the proposed water crossing structures for the full length of the preferred and alternative alignments. A list of water crossings along the proposed corridor is included in Appendix 2A: Table 2A-1. Proposed locations of bridges and culverts for the proposed corridor are shown on the maps submitted as part of the USACE permit application included in this submittal (Section 5: Appendix 5B).

**Table 3: Summary of Water Crossing Structures**
**Preferred and Alternative Alignments**

| Crossing Classification | Definition (*Diameter or Span*) | Quantity | |
|---|---|---|---|
| | | Preferred Alignment | Alternative Alignment |
| Culverts | | | |
| Minor Culverts | 3 Feet | 2,869 | 3,155 |
| Moderate Culverts | 4 to 10 Feet | 15 | 12 |
| Major Culverts | 11 to 20 Feet | 19 | 12 |
| Bridges | | | |
| Small Bridges | < 50 Feet | 3 | 3 |
| Medium Bridges | 50 to 140 Feet | 15 | 12 |
| Large Bridges | > 140 Feet | 11 | 11 |

Where possible, crossings were located where floodplains are narrow to reduce floodplain impacts. Approach terrain was also evaluated to minimize necessary cut and grading during construction; locations with high terraces and bluffs along the stream channel were avoided when possible. Bridge and culvert spans were dictated by bankfull width; all perennial streams were assumed to support anadromous and/or resident fish populations and structures sizes were selected to span at a minimum the bankfull width.

AIDEA is not proposing to install fiber optic cables as part of this project; however, AIDEA believes that communications companies may be interested in installing communications cables in the future and that this should be considered as a reasonably foreseeable project in the environmental review process.

(c) Physical Specifications.

The proposed road would be built and used in phases (see Appendix 2A: Figures 2-4 to 2-6).

Phase I of the project would construct a single-lane, gravel-surfaced pioneer road, typically 16 feet wide (including two-foot-wide shoulders) on a shallow embankment, 30 to 72 inches deep, depending on subsurface. The embankment would have two horizontal to one vertical (2:1) side slopes in wetland areas and up to 4:1 side slopes in upland areas. This phase would result in a seasonal road, with restricted access during spring break-up to minimize roadway damage and use of a pilot car to manage traffic on the one-lane road. All proposed bridges would be constructed as one-lane bridges in Phase I and would remain as one-lane bridges through all construction and operational phases.

Phase II would construct a single-lane, gravel-surfaced roadway, typically 20 feet wide, over a full embankment, which would range from 36 to 96 inches deep depending on subsurface conditions. The embankment side slopes would range from two horizontal to one vertical (2:1) to four to one (4:1). This phase would result in year-round access but would likely be operated in one direction at a time with guided conveys of trucks traveling east during certain hours and going west during other hours.

Phase III would construct a two-lane, gravel-surfaced roadway, typically 32 feet wide, over the existing Phase II footprint. Embankment depth and side slopes would be the same as those in Phase II. The Phase III road would be an all-season roadway designed to support mining exploration, development, and operations, including the hauling of ore loads for export.

At its final stage, the road would be a two-lane, gravel-surfaced roadway, typically 32 feet wide. The design speed for the road is 50 mph but it is anticipated that sections may be posted for lower speeds. Actual operating speeds are likely to be lower, particular in phases with a one-lane road that would require pilot cars to guide traffic.

The maximum road grade proposed is ten percent. Figure 2-7 in Appendix 2A shows typical fill sections for the Phase III (full buildout) two-lane road fill sections in areas with good soil conditions, moderate soil conditions, and poor soil conditions. Deeper embankments are used in areas of poorer soil conditions while shallower embankments may be used in areas with better soil conditions. For the portion of the preferred corridor within GAAR, an estimated 80% of the corridor has poor soils and would require embankments of greater than 96 inches and the remainder of the corridor has moderate soils and would require embankments of 72 to 96 inches. The alternative alignment through GAAR is estimated at 85% poor soils and 15% moderate soils. The embankment would have two horizontal to one vertical (2:1) side slopes in wetland areas and up to 4:1 side slopes in upland areas.

Typical sections for other the main road, access roads, turnarounds, turnouts, maintenance sites and airstrips are included in the USACE permit application included in this submittal (Section 5: Appendix 5C). Appendix 5C (Map Set 2: Sheets 1 to 16) includes typical fill sections for various soil conditions (Sheet 1), a typical section for an area where a cut would be required for the road (Sheet 2) and a figure showing cut and fill sections for turnout areas (Sheet 3).

Amount of gravel used.

Construction of Phase III (full build out) of the entire corridor from the Dalton Highway to the Ambler Mining District will require an estimated 12.3 million cubic yards (cy) of fill. Roadway borrow material for embankments would likely be Type C Selected Material, a clean fill material low in organics and frozen matter. It is anticipated structural fill would be made up of Type A or Type B Selected Material and the surface course would be constructed with either D-1 or E-surface material. Riprap needs are estimated at 100,000 cy. Maintenance needs are estimated at 2 inches of material over the entire road each year for the 50-year road life. A total of 41 potential material sites have been identified along the corridor. These sites have an estimated capacity of 10.25 million cy of riprap and 42.23 million cy of gravel, so the sites have sufficient resources for the project.

(d) Term of years needed.

The roadway corridor is expected to be in operation for up to 50 years. The life span of the roadway corridor is dependent upon the success of exploration and extraction efforts within the Ambler Mining District. AIDEA is requesting a 250-foot wide ROW generally, with a wider ROW requested in certain areas on NPS (See Section 3, NPS Supplemental Narrative) and State lands. AIDEA is also seeking a ROW or permits for material sites and water sources, and for maintenance sites and airstrips. ROWs and permits would be requested for a 50-year term.

(e) Time of year of use or operation.

Use of the Phase I pioneer road would occur from August through April, with use in the spring/early summer months restricted due to the shallow embankment construction and spring break up conditions. Following the completion of Phase II, which is a single-lane road, the roadway would be operational year round.

(f) Volume or amount of product to be transported.

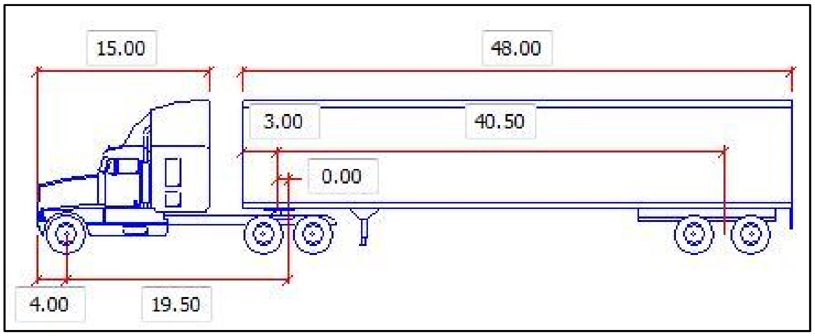
The roadway is designed to support mineral exploration, and mine development, construction, operations and ore transportation. The Ambler Mining District contains a variety of mineral resources including copper, lead, zinc, silver and gold. The road is designed to support the entire mining district, which has the potential to develop several mines, including Bornite owned by NANA Regional Corporation and Arctic owned by NovaCopper.

At present, the best estimate of the volume to be transported over the first ten years is based on the Preliminary Economic Assessment (PEA) on Nova Copper's Arctic Deposit (Tetra Tech, 2013). The PEA assumes there would be 33 50-ton trucks per day hauling ore concentrate during the peak year of production. Total traffic, including fuel and other supplies, would be up to 80 trucks per day (40 round trips) during production activities. Other exploration activities are expected to occur simultaneously with operation of the Arctic Deposit, but traffic associated with initial exploration activities would be much lower, likely less than 10-15 trucks per week from May 1 to October 15. All trucks hauling ore concentrates would be covered or sealed to prevent the release of ore concentrate. AIDEA would incorporate the abatement and wildlife interaction protocols used on the Delong Mountain Transportation System into operation of this road.

Other permitted traffic at times could include commercial deliveries of goods for local communities or commercial transport for local residents and emergency response authorized through access permits. Only commercially licensed drivers would be allowed on the road. The traffic level for these local community and emergency response operations would likely total less than one truck or bus per week. No additional work outside the approved ROW would occur to accommodate this.

The level of traffic associated with road maintenance and operations on the road is difficult to estimate, but it is likely that two to four vehicles or pieces of equipment would be on portions of the road on a daily basis.

The primary vehicles using the roadway during operations would include trucks hauling mineral exploration and development equipment, supplies, including fuel, and trucks hauling ore concentrate. The design vehicle for the proposed roadway is the AASHTO WB-62, specifically with a 22,000 pound per standard axle loading and a street-legal maximum width of 8 feet, 6 inches.




**Typical WB-62 dimensions**

(g) Duration and timing of construction.

Project construction is anticipated to begin in 2019 and to occur in three phases over the life of the mining district. The transition from one phase of the road to another would occur over time and would only proceed as needed based on activity levels in the district and the number of mines in production or being developed, which determines the demand for transportation capacity. The seasonal pioneer road is expected to be sufficient for continuing exploration and initial mine development. Once mine operations reach a level that requires ore shipments and year-round access, construction of Phase II would commence. Phase III would be constructed once traffic volumes on the road justify upgrading to two lanes. Drainage structures installed in Phase I construction will be designed to accommodate expansion of the road to full buildout (Phase III) in later construction phases in order to allow for a single installation program for drainage infrastructure.

The Phase I pioneer road would be constructed over two 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 on the pioneer road would likely take place year round, other than possible restrictions during spring breakup or bird nesting periods in compliance with the Migratory Bird Treaty Act. The seasonal pioneer road is expected to be sufficient for continuing exploration and new mine exploration efforts together with initial mine development. Once mine operations reach a level that would benefit from year-round access, construction of Phase II would commence.

Construction of the Phase II single-lane full-embankment road would take one to two years to complete. It is likely the Phase II, as a single-lane road, would be sufficient for the first 10 years of mining operations. Phase III would be constructed once traffic volumes on the road justified upgrading the roadway to two lanes.

Expansion of the Phase II single-lane, full-embankment road to a Phase III two-lane, full-embankment road would take one to two years to complete.

(h) Temporary work areas needed for construction.

A total of 41 potential material sites have been preliminarily identified to provide gravel and riprap for the entire preferred alignment; 46 potential material site locations have been tentatively identified to meet the needs of the alternative alignment. These areas are shown on Appendix 2A: Figure 2-3 Project Elements. Three of the material sites along the industrial access road alignment would be expected to be developed into long-term roadway maintenance facilities. These are identified as areas with landing strips on Appendix 2A: Figure 2-3. Most material sites would require access roadways of varying lengths to connect the borrow location to the proposed roadway. Additionally, access roads would be constructed to provide access to water sources for construction and maintenance activities.

Material sites would be used to provide temporary staging areas for construction activities where possible. Five construction camps are proposed, as shown in Appendix 2A: Figure 2-3 Project Elements. Camps are estimated at 5 acres each, with room for helicopter landing, equipment and material storage, and employee facilities (housing, food service, etc). Construction would occur in both directions from these camp areas, with equipment staged along the corridor via the ice road (or the pioneer road for future phases).

Additional temporary staging and construction areas would likely be required for bridges. The size and location of these temporary staging and construction areas has been estimated conservatively as a buffer around each bridge location, upstream and downstream of the river crossing parallel to the abutment locations. For small bridges, a buffer of 100 feet was used; for medium bridges, a 200-foot buffer was used. For large bridges, specific buffers were created and ranged from 200 feet to the length of the bridge. Actual staging and construction areas would be further defined during detailed design depending on the topography of a given waterway crossing. The majority of bridge construction activities would take place in the winter when rivers are frozen, facilitating the crossings required during construction. Staging areas would typically be less than one acre in size and would be located within the requested ROW area when they are required outside of material sites.

Detailed proposed cut and fill limits for work on the preferred alignment as well as temporary areas affected by construction activities are illustrated on the maps submitted as part of the USACE permit application attached to this submittal as Section 5: Appendix 5B.

Reclamation

Stabilization and restoration of sites disturbed during construction activities would occur in a timely manner as work is completed. Disturbed soils would be stabilized and revegetated with native plant materials to reduce visual impacts and the potential for soil erosion and sediment discharge. Reclamation of the industrial access road and support facilities are proposed once material exploration and mine operations in the Ambler Mining District are completed and when a surface transportation corridor to the region is no longer necessary. This would be expected to occur 50 years after road construction is completed, or when mineral exploration and development activities in the District conclude. Reclamation measures would include removal of embankments, culverts, and bridges; re-grading of the roadway to establish more natural ground contours and drainage patterns; and re-vegetation of the area through seeding or planting of native vegetation. Appropriate native plant materials would be identified in cooperation with the Alaska Plant Materials Center and with each landowner. Since reclamation methods are likely to improve between now and the end of the road's useful life, it should be anticipated a detailed reclamation plan would be developed closer to road closure.

**8. Attach a map covering the area and show location of project proposal.**

Maps of the entire proposed corridor are provided in Appendix 2B: Map Sets 2B-1 and 2B-2. Aerial photography and LIDAR imagery has been provided to the National Park Service and Bureau of Land Management and is available to other Federal agencies as needed.

**13a. Describe other reasonable alternative routes and modes considered.**

There is no existing access to the Ambler Mining District. Most supplies and personnel are transported to the site by aircraft. Crowley Marine Service Inc. runs barge services in Alaska and they can sometimes pilot barges up the Kobuk River to Ambler and/or Shungnak, but access is dependent on spring/summer rain and snow melt coinciding with late summer ice melt (personal communications, Randy Broh, Crowley Marine Services, May 8, 2014). Barges cannot always make it to Ambler and when they do, they often have to adjust (reduce) their fuel loads due to shallow river conditions. Barge access is not sufficient to support the loads required for mineral exploration and development, nor is it reliable enough to depend upon for commercial operations.

Air transport was considered. Air transport is very expensive compared to ground transportation and is not used exclusively by any mine operating in the country. Kensington Mine evaluated the potential for using aircraft to transport metal product in Alaska in 1998 and found the costs to be prohibitive. This analysis found costs to fly 300 tons per day to a port in Southcentral Alaska would be $325/ton in 1998 (Pacific Northern Associates, 1998). Costs for aircraft, fuel, and crews have escalated since that time and the actual cost would likely be significantly greater now. In comparison, concentrate could be hauled by truck from the Ambler Mining District, off-loaded to rail in Fairbanks, and transferred, for example, to ship in Seward, and still only cost $170 per ton (SRK Consulting, 2012). In addition to the transportation cost, air transport would require a much larger landing strip, support equipment, and fuel storage for aircraft operations. Multiple flights of large aircraft into and out of the area would also create overflight noise impacts on local communities.

Given the lack of feasible non-surface transportation options, the Alaska Department of Transportation & Public Facilities (DOT&PF) completed a reconnaissance analysis of potential route alternatives from 2010 through 2012. A Summary Report (Appendix 2C) documents the considered corridors and their evaluation (DOWL HKM, 2012). The initial corridor reconnaissance analyzed eight distinct corridors, many of which were evaluated for both roadway and rail options (Appendix 2A: Figure 2-8). Route options from the Ambler Mining District included those heading east toward the Dalton Highway and west toward either Kotzebue Sound or Norton Sound. These corridors were evaluated on eleven criteria as described under section 13b below. Once the Brooks Range East corridor was identified as the most feasible alternative, DOT&PF studied various alternative alignments along the general corridor alignment to fine tune the proposed alignment.

Within Gates of the Arctic National Preserve, two alignments were identified (see Appendix 2A: Figure 2-2). The alternative alignment is located south of the proposed corridor (preferred alignment) through the narrowest portion of GAAR.

**13b. Why were these alternatives not selected?**

Each corridor and subsequent potential alignment was evaluated on the following eleven criteria:

1. Corridor Length,
2. Federal Conservation System Units (CSUs) consistent with ANILCA,
3. Wild and Scenic Rivers,
4. Salmon/Sheefish Rivers,
5. Caribou Habitat,
6. Threatened and Endangered Species/Critical Habitat Areas,

7. Availability of Material Sites,
8. Large Bridges,
9. Construction Cost,
10. Maintenance Cost, and
11. Special Considerations.

Each of the criteria was scored for the specific corridor and transportation mode being examined. The scoring was used to create a hierarchy of preferred alternatives. Many corridors were determined to be unfeasible based on overall costs, environmental impacts, and lack of materials. Railway options were not considered after the initial reconnaissance level study due to the extremely high construction and operation costs when compared to roadway alternatives. Please see the DOT&PF Summary Report (Appendix 2C) and Table 4 for the evaluation of each alternative corridor on the eleven criteria listed above. (*Note: the Brooks East corridor alignment has been refined and shortened since the reconnaissance studies.*)

As documented in the DOT&PF Summary Report (Appendix 2C), routes to the west from the Ambler Mining District would have greater impacts on the Western Arctic Caribou Herd core habitat areas, greater potential to affect special status species (spectacled eider, yellow-billed loon, and polar bears), and require crossing more streams and wetlands than corridors heading east from the Ambler Mining District. Routes to the west would need to cross conservation system units (Appendix 2A: Figure 2-9). Routes to the west also had poorer availability of material sites, many more large bridges, and would require construction of a new port or substantial improvements to an existing port, making the cost of these alternatives unfeasible.

The other roadway corridors to the east included the Kanuti Flats Corridor and the Elliott Highway Corridor.

The Kanuti Flats Corridor evaluated as part of the Reconnaissance Study that was designed to avoid the Kanuti Flats Wildlife Refuge, a federal conservation system unit. However, this corridor crosses more rivers and streams, requires more large bridges, and has more potential for greater impacts to wetlands than the Brooks East Corridor. Additionally, the corridor has less material site availability and would be more expensive than the Brooks East Corridor alternatives. Further review of the corridor following completion of the Reconnaissance Study found it would not be possible to completely avoid the Kanuti National Wildlife Refuge along this corridor alternative. Therefore, this alternative was not selected as the proposed alignment.

The Elliott Highway Corridor is longer than the Brooks East Corridor, crosses twice as many rivers and streams, has more potential to impact wetlands, and has less material sites available to support construction and maintenance. Importantly, the Elliott Highway stops at the Yukon River and this route would require a large bridge to cross the Yukon River.

Construction costs for this corridor would be more than double the Brooks East Corridor and the maintenance costs on this corridor would be 60% higher than the Brooks East Corridor.

**Table 4: Criterion and Scoring for DOT&PF Initial Corridor Alternatives**

| Criterion | Brooks East | Kanuti Flats | Elliot Highway | Parks Highway RR[5] | DMTS Port[6] | Cape Blossom[6] | Selawik Flats[6] | Cape Darby[6] |
|---|---|---|---|---|---|---|---|---|
| 1. Corridor Length (*miles*) | 220[1] | 240 | 370 | 430 | 260 | 250 | 330 | 340 |
| 2. Federal CSUs | 1[2] | 0 | 0 | 1 | 3 | 1 | 1 | 1 |
| 3. Wild and Scenic Rivers | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 4. Salmon/Sheefish River Total | 26 | 55 | 56 | 71 | 76 | 85 | 71 | 77 |
| 4a. Mapped Anadromous | 5 | 14 | 8 | 8 | 13 | 2 | 23 | 26 |
| 4b. Assumed Anadromous | 21 | 41 | 48 | 63 | 63 | 83 | 48 | 51 |
| 5. Caribou Habitat | Less | Less | Less | Less | More | More | More | More |
| 6. Threatened or Endangered Species/Critical Habitat | 0 | 0 | 0 | 0 | 3 | 2 | 1 | 3 |
| 7. Material Site Availability[3] | 100% | 75% | 84% | 96% | 70% | 10% | 57% | 58% |
| 8. Total Large Bridges | 13 | 14 | 12 | 13 | 19 | 24 | 21 | 25 |
| 8a. Bridges Over 1,500' | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 9. Construction Cost[4] (*in millions*) | $430 | $510 | $990 | $1,880 | $720 | $860 | $960 | $950 |
| 10. Annual Maintenance Cost (*in millions*) | $8.5 | $9.1 | $13.5 | $17.3 | $9.5 | $9.2 | $12.8 | $13.1 |
| 11. Wetland Habitats (*miles*) | 82 | 115 | 88 | 151 | 40 | 144 | 78 | 98 |
| **Ranking** | **1** | **2** | **3** | **4** | **5** | **8** | **6** | **7** |
| **Dismissed** | **No** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |

*1. The proposed corridor alignment has been refined from the original Brooks East Corridor and is now 211 miles.*
*2. Access through Gates of the Arctic Preserve was recognized in ANILCA.*
*3. Percent of corridor with material site within 10 miles.*
*4. Costs rounded to tens of millions. Does not include port construction or expansion costs.*
*5. Only railroad corridor A, the highest scoring alternative of the four railroad corridors is presented.*
*6. These alternatives were evaluated for road and rail options. Only road options information is shown, as road options for each ranked higher than rail options due to the high costs of rail.*

Table 5 presents the, length, modes, and costing estimates evaluated for each of the initial corridors. (*Note: Cost estimates for the Brooks East Corridor have been reduced as the route has been further refined and shortened since the initial reconnaissance studies.*)

The NPS requested that two alignments be evaluated through GAAR. Using the northern option through GAAR, the proposed industrial access road alignment from the Dalton Highway to the mining district totals 211 miles, with 26 miles within the boundaries of GAAR. The southern option through GAAR increases the total length of the proposed corridor from the Dalton Highway to the mining district to 224 miles, of which 17.8 miles are within the boundary of GAAR. The northern option was identified as the preferred option, based on engineering feasibility factors and feedback from Upper Kobuk River communities (DOT&PF, 2012). From an engineering perspective, the northern option has better subsurface conditions, requiring less embankment material per mile, and gravel and riprap material sources are more readily available along this option. Finally, residents, elders, and subsistence advisors from the upper Kobuk communities provided feedback that a more southerly option would have substantially greater impacts to important cultural and subsistence areas (DOT&PF, 2012).

**Table 5: Reconnaissance Study Cost Estimates for Alternative Corridors**

| **Corridor** | **Length (*miles*)** | **Mode** | **Construction Cost (*in millions*)** |
|---|---|---|---|
| Brooks East | 220 | Roadway | $430[2] |
| Kanuti Flats | 240 | Roadway | $510 |
| Elliott Highway | 370 | Roadway | $990 |
| Parks Highway | 430 | Railway | $1,880-$2,010 |
| DMTS Port[1] | 260 | Roadway | $720 |
| DMTS Port[1] | 260 | Railway | $1,250 |
| Cape Blossom[1] | 250 | Roadway | $860 |
| Cape Blossom[1] | 250 | Railway | $1,330 |
| Selawik Flats[1] | 330 | Roadway | $960 |
| Selawik Flats[1] | 330 | Railway | $1,560 |
| Cape Darby[1] | 340 | Roadway | $950 |
| Cape Darby[1] | 340 | Railway | $1,570 |

[1]*These cost estimates do not include the costs to construct or upgrade port facilities.*
[2]*The proposed corridor has been refined since the reconnaissance study, resulting in a shorter corridor and lower cost; however, the relative cost relationships between corridors remain the same.*

**13c. Give an explanation as to why it is necessary to cross Federal Lands.**

The Ambler Mining District is located in an area with several conservation system units to the north, south, east, and west (see Figure 2-9 in Appendix 2A). The only possible corridor to avoid all conservation system units would be a corridor from the Ambler Mining District to the south and southeast which would cross through the Pah River Valley to the Elliott Highway outside Tanana. A corridor following this alignment (Elliott Highway Corridor) was evaluated as one of the alternatives considered in initial reconnaissance studies. This corridor is longer than the Brooks East Corridor, crosses twice as many rivers and streams, has a potential to impact more wetlands, has less material sites available to support construction and maintenance, and requires a much larger bridge as it would cross the Yukon River. Construction costs for this corridor would be more than double the Brooks East Corridor and the maintenance costs on this corridor would be 60% higher than the Brooks East Corridor. Consultations with the communities in the Upper Kobuk area also identified substantial concerns about any corridor that would cross through the Pah River Valley. All other corridor alternatives would pass through at least one conservation system unit. [Although the initial reconnaissance studies identified a Kanuti Flats corridor passing through the Pah River Valley and then east and north of Kanuti Flats, further alignment studies found that the corridor could not avoid Kanuti Flats due to the terrain near the northeast boundary of the Kanuti Flats National Wildlife Refuge.]

Based on the evaluation of potential corridors, the most feasible access to the Ambler Mining District is a corridor from the Dalton Highway to the Ambler Mining District along the southern flank of the Brooks Range. The need for this corridor through the Gates of the Arctic National Preserve was specifically documented in the Alaska National Interest Land Conservation Act (ANILCA) in Section 201 (H.R. 39—96th Congress: Alaska National Interest Lands Conservation Act, 1979) which states:

> *Congress finds that there is a need for access for surface transportation purposes across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve (from the Ambler Mining District to the Alaska Pipeline Haul Road) and the Secretary shall permit such access in accordance with the provisions of this subsection.*

The selected alignment is the most environmentally and economically feasible option and has the lowest potential for adverse impacts to natural, physical, and social environments.

**14. List authorizations and pending applications filed for similar projects which may provide information to the authorizing agency.**

State and local agency permits have not yet been submitted; submission is pending upon approval of a corridor by Federal agencies.

Table 7 summarizes potential permits, consultations, or other activities which may require approval from Federal or State agencies.

**Table 7: Summary of Potential Permits, Consultations, or Activities Requiring Review or Approval from Federal and State Agencies**

| Responsible Agency | Permits, Consultations, and Activities | Authority |
|---|---|---|
| State of Alaska Department of Fish and Game | Title 16 Fish Habitat Permit | *Fishway Act: AS 16.05.841 through .861, Fish Passage; Anadromous Fish Act: AS 16.05.871 through .901, Anadromous Fishes* |
| State of Alaska Department of Natural Resources (DNR) | Temporary Water Use/Water Rights | *AS 46.15; 11 AAC 93* |
| DNR | Right-of-Way Permit | *AS 38.35.050; AS 38.05.550-565* |
| DNR | Material Sales Permit | *AS 38.05.810(a)* |
| All Federal Agencies | Destruction or modifications of wetlands (Wetlands Protection Considerations) | *Executive Order 11990 (Protection of Wetlands) May 24, 1977* |
| All Federal Agencies | Essential Fish Habitat (EFH) | *Magnuson-Stevens Fishery Conservation and Management Act of 1976* |

| Responsible Agency | Permits, Consultations, and Activities | Authority |
|---|---|---|
| All Federal Agencies | Actions causing disproportionately high and adverse human health or environmental effects on minority or low-income populations | *Executive Order 12898 (Environmental Justice)* |
| All Federal Agencies | Actions that cause occupancy and modification of floodplains | *Executive Order 11988: Floodplain Management* |
| State of Alaska Department of Environmental Conservation (DEC) | Wastewater discharges to waterways via stormwater | *Section 402, Federal Water Pollution Control Act of 1972 (Clean Water Act) (33 USC 1251)* |
| DEC | State of Alaska 401 Certification | *Pursuant to Section 401 of the Clean Water Act* |
| DEC | Wastewater discharge into all waters of the state (Wastewater Disposal Permit) | *AS 46.03.020, .100, .110, 18 AAC 15, 70, and 72.010* |
| United States Department of the Interior (DOI) | Conversion of property purchased or improved with funds from the Land and Water Conservation Fund | *Section 6(f), Land and Water Conservation Fund Act of 1965 (36 CFR 59)* |
| DOI and official(s) with jurisdiction over the Section 4(f) resource | Development possibly affecting publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites | *Section 4(f) of the Department of Transportation Act of 1966 (49 USC 1653(f))* |
| DOI and U.S. Fish and Wildlife Services (USFWS) | Actions that could adversely affect threatened and endangered species or their critical habitat | *Endangered Species Act of 1973 (16 USC 1531)* |
| DOI and USFWS | Actions that could cause takes of protected birds | *Migratory Bird Treaty Act (16 USC 703-711); Bald and Golden Eagle Protection Acts (16 USC 668-668d) and Executive Order 13186* |
| National Park Service (NPS) and DOI | Application for Transportation and Utility Systems and Facilities on Federal Lands (SF-299) | *Alaska National Interest Lands Conservation Act (ANILCA) Section 201* |
| NPS and DOI | Wild and Scenic River Section 7(a) evaluation | *Wild and Scenic Rivers Act (Public Law 90-542; U.S.C. 12371 et seq.)* |
| NPS | Wetland Statement of Findings | *NPS Director's Order #77-1* |
| NPS | Floodplain Statement of Findings | *NPS Director's Order #77-2* |
| State of Alaska Office of History and Archaeology | Development possibly affecting historic or archaeological sites | *NHPA of 1966, as amended (16 USC 470); As 41.35.010 to .240, Alaska Historic Preservation Act* |
| Advisory Council on Historic Preservation | Development possibly affecting historical or archaeological sites (Review and Comment) | *National Historic Preservation Act (NHPA) of 1966, as amended (16 USC 470)* |
| U.S. Army Corps of Engineers (USACE) | Discharge of dredged or fill material into U.S. waters, including wetlands (USACE permit) | *Section 404, Federal Water Pollution Control Act of 1972, as amended in 1977 (Clean Water Act) (33 USC 1344)* |
| USACE | Construction in or over any navigable water, or 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 | *Section 10 of the Rivers and Harbors Act of 1899* |
| U.S. Coast Guard | Development of a bridge or causeway over any navigable river or navigable water of the U.S. | *Section 10 of the Rivers and Harbors Act of 1899, as defined in 33 CFR 329* |
| Northwest Arctic Borough | Land use permit | *Title 9 of Home Rule Charter of the Northwest Arctic Borough* |
| Bureau of Land Management (BLM) | Application for Transportation and Utility Systems and Facilities on Federal Lands (SF-299) | *ANILCA Title XI* |

**15. Provide statement of need for project, including the economic feasibility of items such as (a) cost of proposal (construction, operation, and maintenance); (b) estimated cost of next best alternative; and (c) expected public benefits.**

AIDEA is proposing this project to increase job opportunities and encourage the economic growth of the state. Specifically, the purpose of this project is to support mineral resource exploration and development in the Ambler Mining District in northwest Alaska.

Although AIDEA was established in 1967, the findings that led to the establishment of AIDEA are still true today. AIDEA was established by the State of Alaska to increase job opportunities and encourage the economic growth of the state, and specifically to support development of natural resources. In establishing AIDEA, the State found there were areas of the state with high unemployment rates and that unemployment posed a risk to the health, safety, and general welfare of state residents. The statutes note that the state lacks key facilities necessary to permit adequate development of its natural resources to support the balanced growth of its economy and the expansion of export trade is vital to the health and growth of the state economy.

Natural resource development is a critical component of the Alaska economy, with the minerals industry accounting for over $4 billion of activity in 2012 (Bloomberg BNA, 2014). In 2013, mining provided 9,100 direct and indirect jobs in Alaska. Mining employs residents from more than 80 communities throughout the state and mining wages are some of the highest in the state. State revenues from mining were almost $150 million, including royalties, rents, taxes, and payments to state entities such as the Alaska Railroad.

As important as mining is currently, it has the potential to become even more critical to the state economy in the future. Alaska has enormous potential for natural resource development. The state currently ranks fifth in the country in terms of mineral production value. But Alaska is still relatively underexplored and underdeveloped. Alaska's mineral resource potential is typically listed in the top ten mining jurisdictions worldwide based on its mineral resource potential (Fraser Institute, 2013). However, when it comes to infrastructure, Alaska slips to the lowest ranking in the country and falls well below all other developed countries (Fraser Institute, 2013). As pointed out repeatedly by the Alaska Minerals Commission in their annual reports, infrastructure is vitally important to supporting growth in the mining industry in remote areas of Alaska (Alaska Minerals Commission, 2013). Mineral site development in these remote areas, where living costs are very high and economic development opportunities are lacking, provides opportunities for workforce training and development and employment.

The Ambler Mining District in northwest Alaska is one of the areas of highest mineral potential in Alaska. This area has been explored for decades, but the lack of transportation access has made it challenging to bring these high value resource areas into production. The importance of transportation access has been recognized not just by the state but by Congress in ANILCA. ANILCA Section 201 states:

> *Congress finds that there is a need for access for surface transportation purposes across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve (from the Ambler Mining District to the Alaska Pipeline Haul Road) and the Secretary shall permit such access in accordance with the provisions of this subsection.*

(a) The cost of the proposed construction, operation, and maintenance.

The estimated cost of construction for the full buildout of a two-lane road from the Dalton Highway to the Ambler River (Phase III) is $350 million. Construction of Phase I is estimated to be $271 million; construction of phases II and III is estimated to be $29 million and $50 million respectively. Operations and maintenance costs are expected to range from $8 to 10 million per year.

(b) The estimated cost of the next best alternative.

Only one potential alternative completely avoids conservation system units as discussed in section 13c above. The cost for this alternative, the Elliott Highway Corridor, is $990 million, over twice the cost of the proposed alignment. The reasons this alternative was not considered to be feasible are listed in section 13c above.

(c) The expected public benefits of the proposed project.

The purpose of this project is to provide transportation access to the Ambler Mining District to support and encourage mineral exploration and development in this highly mineralized area. As described above, mining is a major industry in Alaska and has the potential to continue its strong growth in employment, wages, and income to the State, local governments, and Native Corporations.

As stated by the Alaska Department of Labor and Workforce Development in the May 2013 Alaska Economic Trends publication (Abrahamson, 2013):

> *"Alaska's mining industry has been a standout over the last decade for its job and wage growth…"*

The public benefits from the project would include:

- Direct employment and wages related to road construction and operation and maintenance activities;
- Indirect employment and wages related to mineral exploration and development activities in the Ambler Mining District,
- Revenues to local and State government from mineral exploration and development activities in the District;
- Revenues to Alaska Native Corporations and their shareholders from mineral exploration and development activities in the District; and
- Opportunities for rural residents to continue to live in their communities while having the ability to generate income and the possibly to create new economic opportunities based on proximity to road access.

Employment in the mining industry has more than doubled over the last ten years. Mining has high average wages and allows workers to live where they prefer and commute to the work site on a rotating schedule. This is especially important for residents of small, rural communities having few local employment opportunities.

In addition to the employment and wages generated, mining in Alaska paid $17 million to local governments through taxes or payments in lieu of taxes; $150 million to the State through rents, royalties, fees, and taxes; and $144 million in payments to Alaska Native corporations.

The operation of Red Dog Mine in northwest Alaska provides insight into the importance of mining in rural Alaska areas. The Red Dog Mine has provided over $1 billion to NANA Regional Corporation (NANA) over its life and it is the largest source of revenue for the Northwest Arctic Borough. The revenues to NANA and the borough are spread throughout the region and the State as NANA revenues are shared with other Native corporations. Further, NANA and borough revenues are used to support social services throughout the borough.

Although the proposed road would have controlled access, local communities would have the potential to hire commercial transportation providers to deliver fuel or freight to staging areas where the communities could access it, probably in the winter. Alternatively, local residents could instead form their own companies to provide these services. These opportunities have been discussed with residents in the study area and while not a direct benefit of the project, they are indirect and long-lasting benefits to local communities.

**16. Describe probable effects on the population in the area, including the social and economic aspects, and the rural lifestyles.**

Describe the probable effects of a road through Gates of the Arctic National Preserve on human uses of the area; include effects on recreational, subsistence and other economic uses, and effects on rural and traditional lifestyles.

The proposed road would not directly connect to any existing communities. The proposed alignment is closest to the City of Bettles and the unincorporated community of Evansville. Table 8 documents the other communities in the vicinity of the alignment and the straight line distance between the roadway alignment and each community.

**Table 8: Distance from Community to Road Alignment**

| Community | Straight Line Distance to Proposed Alignment |
|---|---|
| Bettles/Evansville | 8 miles |
| Alatna/Allakaket | 33 miles |
| Ambler | 22 miles |
| Shungnak | 15 miles |
| Kobuk | 9 miles |
| Hughes | 67 miles |
| Huslia | 91 miles |

Overall, the road is expected to provide several benefits to residents of the region, as describe above and listed below.

- Increased employment and income opportunities in the short term and long term in these areas where few employment opportunities exist. These opportunities are associated with road construction and operations as well as in mineral exploration and development.

- Potential for communities to develop businesses to support the road construction and operation and to support mineral exploration and development.
- Potential for communities to use the road to reduce fuel and freight transportation costs to reduce the high cost of living in these rural areas.
- Indirect benefits from increased revenues to the Northwest Arctic Borough and NANA Regional Corporation, which are used to support many social services in the region.

Studies over the last several years have looked at outward migration from rural communities into Alaskan's urban centers and the factors that contribute to strong healthy communities with lower suicide rates. A 2010 study by the Institute for Social and Economic Research noted people were moving out of rural areas and into urban areas for employment opportunities and due to the rising costs of living in rural areas (Lowe, 2010). A more recent study looking at risk factors for youth suicide in rural Alaska found the combination of a strong cash economy (higher median incomes) and the presence of traditional elders that provide role models for integration of the traditional and more modern cultures provided some protection against young Native male suicide (Berman, 2014). Healthy communities need both strong traditional cultures and cash incomes to help offset the high cost of living and to provide financial support for continuing traditional ways.

The potential social and economic effects on the population in the area would vary from community to community. Due to the proximity to the road, the effects would be most noticeable in Bettles and Evansville. Communities further away, such as Hughes and Huslia, would see much smaller effects. The potential effects on human uses for each area are described below.

**Bettles/Evansville**

Socioeconomic Effects.

The City of Bettles and the community of Evansville currently have very low year-round populations. The Alaska Department of Labor and Workforce Development (ADLWD) population estimates for 2013 listed the population in Bettles at 14 and Evansville at 2 (ADLWD, 2014). Employment opportunities and local services are very limited in these communities. The cost of living in these communities is high, but the City of Bettles constructs an ice road from the Dalton Highway to the City each winter to allow local residents and businesses to drive between Fairbanks and Bettles to obtain supplies. This helps to somewhat moderate the cost of living in these communities.

The proposed road alignment is approximately 8 miles north of the communities. No connection from the road to the communities is proposed. Construction and operation of the proposed road could provide new employment opportunities for local residents.

Recreation Effects.

Residents of this area and visitors use the surrounding areas for recreation. The proposed road would not result in a change in recreation use but could affect the recreation experience. Recreation uses on the Koyukuk, Alatna, Wild and John Rivers may be affected in the quality of the recreation experience where the proposed road would cross these rivers, but the ability to use the rivers for recreation would not be affected. Local residents would continue to have extensive undeveloped areas in the vicinity to continue to support their recreation activities. The proposed road would not enter or cross designated wilderness areas and would not affect the ability of people to access these areas for recreation.

Subsistence Effects.

Residents of Bettles and Evansville use areas in the vicinity of the communities for gathering subsistence resources. In particular, ADF&G has identified areas along the Alatna, John, and Koyukuk Rivers as subsistence use areas for these communities (Braund & Associates, 2012). The proposed road may affect subsistence harvests in the immediate vicinity of the road. Overall impacts on subsistence resources (fish, wildlife, etc.) however are expected to be low and only in close proximity to the road itself, affecting only a small area compared to the overall availability of areas usable for subsistence harvests.

Rural and Traditional Lifestyles.

The location of the road near these communities would potentially change the character of the rural and/or traditional lifestyle currently enjoyed by local residents. However, lifestyles in rural areas are dynamic and have been changing over the past several decades. Very few communities support completely traditional lifestyles; most communities now depend on wage employment as well as continued subsistence lifestyles. Given the decrease in population in these communities over the last few decades, the communities may not be sustainable without some increase in economic activity in the area.

**Upper Kobuk Communities**

Socioeconomic Effects.

The populations of the Upper Kobuk communities (Kobuk, Shungnak, and Ambler) are estimated at 159, 294, and 264 respectively for 2013 (ADLWD, 2014). Although these communities have few employment opportunities locally, many people from these communities are or have been employed in mineral exploration activities occurring in the Ambler Mining District. There are more services available in these Northwest Arctic Borough communities, as the Borough supports services in the communities.

These communities would continue to benefit from increased employment in the Ambler Mining District and have the potential to use the proposed road to lower the cost of fuel and freight deliveries into the communities. Almost all freight and fuel is currently delivered by air to these communities. This results in very high costs for fuel and basic commodities.

Kobuk currently has a road from the community to the mineral exploration site at Bornite and the support area at Dahl Creek. Kobuk has the most potential to benefit from the road in terms of having fuel and/or freight delivered to Bornite to then be transported to Kobuk. Shungnak is several miles away from Kobuk, but has expressed interest in constructing a road to provide access to the Bornite mine area. Ambler is approximately 30 miles from Kobuk, but has the potential to access the proposed endpoint of the road at the Ambler River.

Recreation Effects.

Residents of this area and visitors use the surrounding areas for recreation. The proposed road would result in a change in recreation use along the corridor. Recreation uses on the rivers in the vicinity of these communities may be affected in the quality of the recreation experience where the proposed road would cross these rivers, but the ability to use the rivers for recreation would not be affected. Local residents would continue to have extensive undeveloped areas in the vicinity to continue to support their recreation activities. Many visitors to the area are visiting nearby Gates of the Arctic National Park and Preserve and the wilderness areas within the park. The proposed road does not enter into or cross designated wilderness areas and would not affect the ability of people to access these areas for recreation. Similarly, visitors that desire fishing opportunities on the Ambler or other rivers would continue to have these opportunities.

Subsistence Effects.

Residents of Ambler, Shungnak, and Kobuk gather subsistence resources from a very wide area from near the western coast to the Alatna River in the east, up through the Brooks Range, and south toward the Koyukuk River (Braund & Associates, 2012). The proposed road may affect subsistence harvests in the immediate vicinity of the road. Overall impacts on subsistence resources (fish, wildlife, etc.) however are expected to be low and only in close proximity to the road itself, affecting only a small area compared to the overall availability of areas usable for subsistence harvests.

Rural and Traditional Lifestyles.

The proposed road would potentially change the character of the rural and/or traditional lifestyle currently enjoyed by local residents. However, lifestyles in rural areas are dynamic and have been changing over the past several decades. Very few communities support completely traditional lifestyles; most communities now depend on wage employment as well as continued subsistence lifestyles. Residents of the Upper Kobuk area have benefited from mining activity in their region through direct employment at the Red Dog Mine and exploration activities in the Ambler Mining District, as well as indirectly through social services and corporation dividends funded by mining activities.

**Lower Koyukuk River Communities**.

Socioeconomic Effects.

The populations of the Lower Koyukuk River communities (Hughes, Huslia, Alatna, and Allakaket) vary significantly. Alatna is the smallest community with an estimated 26 residents in 2013. Allakaket, located across the river from Alatna, is estimated at 108 residents (ADLWD, 2014). Hughes' population in 2013 was estimated at 88 and Huslia had the largest population at 322 (ADLWD, 2014). The populations of Hughes and Huslia have been growing, while the population in Allakaket has been steady and the population of Alatna has been decreasing. Employment opportunities in these communities are also limited, with most employment associated with local, tribal, or regional public sector agencies.

The cost of living in these communities remains high with most goods and supplies delivered by air. Although these communities have historically been able to receive some goods on river barges, river transportation becomes less feasible the further up the river one travels.

The Lower Koyukuk River communities are farther from the proposed road corridor and have less potential for lowering fuel and freight costs associated with construction of the road. The construction, operation, and maintenance of the road, as well as increased mineral exploration and development within the Ambler Mining District, would provide wage employment opportunities for these communities.

Recreation Effects.

Residents of this area and visitors use the surrounding areas for recreation. Since these communities are located 30 to 90 miles from the proposed road corridor, the effects on recreation would be less than the other communities discussed above. Recreation uses on the Koyukuk, Alatna, and John rivers may be affected in the quality of the recreation experience where the proposed road would cross these rivers, but the ability to use the rivers for recreation would not be affected. Local residents have extensive undeveloped areas in the vicinity to continue to support other recreation activities.

Subsistence Effects.

Residents of Alatna and Allakaket gather subsistence resources from a very wide area including the lower Koyukuk valley and particularly up the Alatna River. The proposed road may affect subsistence harvests in the immediate vicinity of the road. Overall impacts on subsistence resources (fish, wildlife, etc.) however are expected to be low and only in close proximity to the road itself, affecting only a small area compared to the overall availability of areas usable for subsistence harvests.

Documented traditional use areas for subsistence harvest for Hughes are south of the proposed road corridor and minimal effects on the community's subsistence use are anticipated. Huslia is located 90 miles from the road corridor and minimal effects from the road are anticipated on the community's subsistence uses.

Rural and Traditional Lifestyles.

The proposed road would potentially change the character of the rural and/or traditional lifestyle currently enjoyed by local residents. However, lifestyles in rural areas are dynamic and have been changing over the past several decades. Very few communities support completely traditional lifestyles; most communities now depend on wage employment as well as continued subsistence lifestyles. Given the distance from the road to these communities, effects on their rural and/or traditional lifestyles are anticipated to be low.

**Federally recognized tribes and ANCSA Corporations**

Effects on federally recognized tribes would be expected to be low. Effects on tribal members are described in the sections above. Initiation of the Title XI review process would result in formal government-to-government consultation with the federally recognized tribes and allow any potential issues to be identified and addressed in the environmental review process.

Effects on ANCSA corporations are expected to be positive. Native corporations have the potential to gain revenues from land leases, material sales, and by providing goods and services associated with road construction and operations. NANA Regional Corporations would also benefit indirectly from mining-related revenues generated in the Ambler Mining District and Native corporations in the region could benefit from providing goods and services to the mining companies conducting exploration and operations in the District.

**17. Describe likely environmental effects that the proposed project will have on: (a) air quality; (b) visual impact; (c) surface and ground water quality and quantity; (d) the control or structural change on any stream or other body of water; (e) existing noise levels; and (f) the surface of the land, including vegetation, permafrost, soil, and soil stability.**

(a) Provide an estimate of the quantity and type of air emissions (point source and fugitive dust) that will occur during the construction and operation of the proposed road and project changes that these emissions will have on local and general air quality.

Existing air quality in the study area is expected to be very good due to the limited development and activity in most of the area. Adverse impacts to air quality within the region from the proposed road are expected to be low and limited to the immediate vicinity of the roadway. The roadway is anticipated to have less than 400 vehicles per day at peak usage following the full build-out of the Phase III roadway. Vehicular traffic would result in emissions of nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide ($SO_2$), volatile organic compounds (VOCs), and particulate matter (PM). Given the low levels of air pollutants present in the area and the relatively low level of vehicular emissions expected, overall air quality in the Preserve would not be anticipated to change substantively from pre-road conditions, but the levels of criteria pollutants in the areas near the road would be higher than baseline levels. In particular, unpaved roads in Alaska are known to produce substantial dust. The University of Alaska Fairbanks (UAF) Alaska University Transportation Center has been studying dust palliatives for several years and this project would incorporate the latest technologies for dust minimization and mitigation based on UAF studies.

Construction impacts to air quality would be temporary. The two greatest sources of airborne pollutants would be from dust generated from earthwork activities and combustion exhausts from construction vehicles and equipment. Emissions from construction equipment would be similar to those described above for vehicles and rates would vary depending on the type of equipment, the type of activity, and the duration of the use. Construction emissions would be minimized through use of standard best management practices (BMPs) related to dust suppression, equipment maintenance, and other factors.

Describe patterns of NOx, SOx, ozone, and PM in the Preserve after road construction and operation, compared to baseline levels.

As discussed above, vehicle emissions would result in higher levels of NOx, SOx, ozone, and PM in the immediate vicinity of the road. Overall air quality in the Preserve would not be anticipated to change substantively from pre-road conditions, but the levels of criteria pollutants in the areas near the road would be higher than baseline levels. Again, PM emissions are likely to be of the most concern and would be addressed through use of BMPs for dust suppression, such as dust paliatives.

Describe dust palliative application plan to be used during operation to control crustal and fugitive dusts.

The proposed road would have a gravel surface resulting in the potential for fugitive dust emissions. The distance that dust would be carried from the road depends on traffic levels, gravel properties, road moisture content, use of dust palliatives, and other factors. Dust loads typically decrease logarithmically with distance from the road (Myers-Smith, Arnesen, Thompson & Chapin, 2006). As an example, most dust impacts occur within 30 meters (100 feet) of the road (Myers-Smith et al., 2006). Since the road would be capped in snow and ice for more than half the year, overall levels of fugitive dust emissions would be minimized. In addition, there are a number of possible dust palliatives that may be applied to gravel roads to reduce dust emissions. The effectiveness of palliatives depends on the soil conditions and typical weather conditions. The Alaska University Transportation Center at UAF continues to study dust control methods and would be consulted to determine the most effective palliatives for the proposed road once a corridor is approved.

Project levels of asbestos to be found in road dust.

Some materials used for road construction in the western portion of the corridor may contain low levels (up to 1%) naturally occurring asbestos (NOA). AIDEA is proposing to avoid the use of NOA materials unless no other suitable materials are available. In the event NOA materials are the only feasible option for road construction, use of NOA materials may be proposed. If NOA materials are used, AIDEA would follow DOT&PF's interim guidance and standards for NOA material use (Appendix 2D). The interim guidance and standards call for development of a site specific plan that identifies asbestos and dust control measures to minimize the potential for the dispersion of asbestos during construction and road maintenance and operations. Measures to control dust and asbestos dispersion include covering NOA materials with non-NOA materials, using dust palliatives, and other measures. Avoiding the use of NOA materials and following the interim guidance and standards in those areas where NOA materials must be used would be expected to result in a very low potential for asbestos in road dust.

Provide an estimate of the reduction in visibility (i.e., increase in haze) that will occur from road dust and exhaust during operation of the road.

An increase in PM emissions and fugitive dust could result in a reduction of visibility or increase in haze near the road corridor. Measures to reduce the potential for PM emissions and/or fugitive dust would be implemented to reduce the potential for haze as discussed under the air quality discussion above.

(b) Describe effects on visual and scenic qualities of the landscape of proposed road.

Evaluating the effect on the visual environment requires consideration of the visual character and quality of the area, viewer exposure to the area, and viewer sensitivity. The proposed road alignment crosses primarily through undeveloped areas with high scenic quality. The presence of a roadway, associated facilities, and vehicular traffic would affect the visual character and visual qualities of the area by introducing a man-made structure into an undeveloped area. Viewer exposure to the road may occur at any point along the road corridor, but the number of viewers at any one point is expected to be low.

Within GAAR, most visitors to this area would be expected to be at Walker Lake or on the Kobuk River. GAAR visitors are estimated at 795 to 910 visitors per year with the vast majority visiting between May and October (NPS, 2011). Walker Lake is the sixth most popular visitor entry location with a total of 232 visitors entering there from 2000 to 2007, with annual numbers ranging from 4 to 63. Nutuvuki accounted for 24 entries from 2000 to 2007, with annual numbers ranging from 0 (in four years) to 13. Given GAAR’s size and the relatively low number of visitors, the number of visitors likely to be affected by views of the road is anticipated to be fairly low.

It is likely visitors to the Preserve would be fairly sensitive to the scenic quality of the area. The magnitude of the effects on the visual and scenic qualities would be expected to be most noticeable at and near the areas where the proposed road crosses the Kobuk River. Effects would be less when the road corridor is visible in the middle or background of the view. Re-vegetation of fill slopes with native seed, trees and/or shrubs on topsoil could be used as a mitigation technique to reduce the contrast between the gravel road and the existing forest.

A visual analysis was conducted in GAAR, at the NPS’s request. That analysis is discussed in the NPS Supplemental Narrative (Section 3) and Appendix 3C.

(c) Provide current water quality data on major wetlands and water bodies.

The proposed road alignment crosses major tributaries and forks of the Kobuk, Alatna, and Koyukuk rivers, as well as the John, Reed, and Mauneluk rivers. This hydrologic network is comprised of streams encompassing a wide range of forms, including perennial and intermittent mountain headwater streams, glacial-fed streams, meandering clear-water tundra streams, and large braided rivers. Lakes and ponds are widespread throughout the project area in lowlands, with several deep lakes near the proposed road, including Iniakuk Lake, Walker Lake, Nutuvukti Lake, Norvak Lake, and Avaraart Lake.

Despite the diversity of waterbodies, the average sediment load in many streams and rivers is low and they typically run clear. Some tributaries to the Reed and Alatna Rivers are fed by spring streams which may not freeze solid during winter and provide important habitat for overwintering resident and anadromous fish species.

No comprehensive assessment of baseline water quality has been conducted to date for the waterbodies crossed by the proposed corridor. With the sheer number of waterbodies within the proposed corridor, no comprehensive baseline data exists that could be correlated with other data collection efforts. The corridor crosses no waters listed as impaired waterbodies (Section 303(d) of the Clean Water Act) (Alaska Department of Environmental Conservation [DEC], 2010); the nearest impaired waterbody is the Hogatza River, last reported in 2002 (Environmental Protection Agency [EPA], 2014). The EPA did not identify the source(s) of impairment, but the American Water Resources Association notes “placer mining operations” with its inclusion of the Hogatza River on the Alaska Clean Water Actions Waters Priority List.

Available baseline information on waterbodies within the southern Brooks Range is primarily from NPS reports as part of the Arctic Network Inventory and Monitoring Program or earlier study efforts. Some lakes in the Noatak watershed and the northern portion of GAAR were assessed for baseline data in 1991 (Swanson, 1992). Results from the study show the surface water conductivity, alkalinity, and hardness were elevated from the electrical conductivity due to high dissolved ions in the water from the carbonate geology prevalent in that area of the Noatak watershed. A 2005 study on aquatic biodiversity, community composition, and ecosystem processes in the upper Noatak River basin, found that algal and macroinvertebrate biomass were low and consistent with expectations for oligotrophic rivers (Bowden et al., 2009). In addition, it noted that tributary streams appeared to have few fish. Data was also collected from 29 shallow lakes in Kobuk Valley National Park in 2009 including specific conductivity, total nitrogen, total phosphorus, alkalinity, nitrate, ammonia, orthophosphate, sulfate, calcium, magnesium, potassium, sodium, chloride, dissolved organic carbon, and silica (Larsen and Kristenson, 2010).

The U.S. Fish and Wildlife Service (USFWS) has also conducted a few studies evaluating metal and metalloid contaminants in water and sediments in National Wildlife Refuges in interior and western Alaska (Mueller, Snyder-Conn & Scannell, 1995; Mueller, Snyder-Conn & Scannell, 1996; Mueller & Matz, 2002). Known mineral deposits (including, but not limited to, antimony, arsenic, bismuth, copper, lead, gold, molybdenum, nickel, silver, tin, thorium, tungsten, uranium, and zinc) occur throughout the region south of the Brooks Range. Placer gold mines have existed throughout the region since the late 1800s. These studies examined the effects of historic placer mining operations in and around wildlife refuges and provided baseline data for potential future mining activities which may occur adjacent to refuges or headwaters for rivers traversing the refuges.

The USFWS studies described the rivers and streams as clear, with soft water, calcium and magnesium bicarbonate-dominated, and with mostly neutral pH. Waters analysis routinely found a variety of metals and metalloids present, but primarily at levels typically considered within the normal background range for interior Alaska. Contaminants were identified in waterway sediments throughout the region, but again levels were primarily within ranges considered to be typical of naturally occurring background levels for interior Alaska. Concentrations of most metals were found to be at levels characterized as uncontaminated sediments. Mercury was rarely found in sediments, and when found, was typically near the limit of detection. Typical copper and nickel concentrations were found to exceed to typical background limits. Generally, samples from streams where mining activity had previously occurred did not have a higher concentration of metals in sediments than those from streams located in areas where mining activity has not occurred.

AIDEA's project team collected basic water chemistry data at dozens of potential bridge crossing sites along the proposed corridor while completing anadromous fish surveys in 2012 and 2013 (Appendix 2E). Locations included Ulaneak Creek, Shungnak River, Ruby Creek, East Fork Sozhekla Creek, Bedrock Creek, Hogatza River, Helpmejack Creek, Kogoluktuk River, Canyon Creek, and Riley Creek. Data was also collected from the unnamed tributaries to the following rivers and creeks: Kogoluktuk, Alatna, Malamute Fork of the Alatna River, Mauneluk; Kobuk, South Fork of Koyukuk River, Reed River, Beaver Creek, Kichaiakalea Creek, Hogatza River, Tobuk Creek, Bedrock Creek, Helpmejack River, and Narvak Lake.

Describe potential consequences to surface seasonal water flow, including quality and quantity from construction and operation of road.

Road construction has the potential for short-term water quality effects resulting from sediment runoff from disturbed areas and from the potential releases of hazardous materials such as oils and fuel. A stormwater pollution prevention plan would be developed for construction and would identify BMPs to be implemented to reduce the potential for water quality impacts. Measures would include barriers to capture and filter stormwater at construction area boundaries, stabilization of disturbed areas as quickly as feasible, and designation of specific areas for fueling and maintaining equipment to reduce the potential for unintentional releases. BMPs would also be developed for road operation and maintenance activities to minimize potential impacts on water quality.

Potential effects to seasonal surface water flow from road operation include altering existing drainage patterns, increasing sediment loads, and bisecting wetland areas. Snow drifting and snow storage from plowing operations may increase the duration of snowmelt-fed runoff in the immediate vicinity of the road. Collection and conveyance of surface runoff in roadside ditches can result in localized changes (i.e., increases and decreases) in water flow quantities as runoff is diverted to adjacent drainageways. The collection of upstream runoff in ditches would be minimized to reduce the effects of diverting surface waters to adjacent drainageways, maintain existing flow patterns and quantities, and reduce the potential for permafrost degradation. Effects to surface water flows would be minimized by placing an adequate number of culverts and/or bridges to maintain hydrologic continuity and existing drainage patterns within wetland complexes, ephemeral channels, and perennial stream channels. Roadway culverts would be placed at identified surface water drainages and in wetland complexes to minimize disruption to the existing hydrologic regimes and minimize the need for runoff to flow along roadside ditches or alter existing flow patterns.

Constricting surface water flows may lead to increased velocities and erosion with potential detrimental effects on downstream water quality; therefore, culverts and bridges would be sized to adequately span the bankfull width to minimize changes to stream flow velocities during base and flood flows. Stream banks would be stabilized at road crossings to minimize the potential for erosion and downstream sedimentation.

All culverts judged necessary to maintain hydrologic connectivity during full buildout of the project (Phase III) would be installed during construction of Phase I. Culverts installed during Phase I would be of the ultimate length required for the Phase III two-lane road, eliminating the need to extend culverts during subsequent phases of the project. Culvert lengths will be determined from the necessary daylight fill limits for the two-lane road. Installing the total culvert length required during Phase I reduces impacts to the existing stream channel and water quality by minimizing handling of stream flows, limiting exposure of unstabilized soils, and eliminating the need to divert flows and excavate in the channel during subsequent phases. During Phase I and Phase II, fill slopes at culverts will be flattened to provide sufficient burial cover over the culverts to protect the pipes. The flatter fill slopes and more gradual transition from the roadway embankment to existing ground will also help reduce permafrost degradation at the stream crossings.

Minimum burial cover during Phase I will be provided in accordance with E80 railway loading (America Railway Engineering and Maintenance-of-Way Association (AREMA, 2011)) to make sure the culverts have sufficient burial depth to handle construction and mining loads; E80 minimum cover is one foot for minor culverts, up to 2.5 feet for moderate culverts, and up to 4 feet for major culverts. If sufficient burial depth isn't obtainable, culvert gauge (wall thickness) can be increased to accommodate more shallow cover depths.

During Phase III of the project, fill slopes will be steepened in accordance with typical sections (4:1 to 2:1 fill slopes) as the road surface is widened to maintain the toe of the slope at the ends of the previously installed culverts (i.e., the daylight fill limits at the culvert ends will be held constant). Riprap will be placed around the culvert ends at all phases of construction to protect and stabilize the slope of the embankment, reducing erosion of embankment material and minimizing the risk of embankment failure at the crossing during flood events.

Corrugated steel culverts would be sufficient to provide drainage across the road for the project design life. In areas where abrasion is a concern (e.g., steep streams with high bed load) culvert wall thickness would be increased to accommodate the abrasion and extend the structure's design life. Likewise, in areas where corrosion is a concern (e.g., corrosive soils or waters), culvert gauge can be increased or corrugate aluminum culverts could be substituted to provide increased corrosion resistance. Providing culvert structures with sufficient design life to match the project life of the road through all three phases will minimize the need to replace structures and effect surface water flows.

Road operations would be anticipated to have minimal adverse effects on water quality. Although the road is proposed to have a gravel surface, dust palliatives would be applied to reduce the potential for dust. Although there would be the potential for accidents along the road resulting in spills, the low volume of truck traffic expected would result in a very low potential for these events.

Operation of the Delong Mountain Transportation System (DMTS) between the Red Dog Mine and the DMTS port site provides evidence of the ability to construct and operate an industrial road with low impact on surrounding waters. The DMTS has been in operation for over 20 years and surface water sampling conducted at creeks along the DMTS have shown little to no impact from road operations (Exponent, 2002). Most parameters tested for were below analytical detection limits and none exceeded state water quality criteria.

The proposed road is expected to have minor effects on existing groundwater patterns and is not expected to have substantial effects on groundwater quality. Minimization of disturbances to groundwater flow has been considered in both corridor selection and roadway design. The planned construction of the road would primarily use fill techniques with minimal cutting of native soils, so the likelihood of subsurface construction intercepting and altering groundwater flows is small.

Placement of fill for the road embankment would result in consolidation of near-surface existing soils beneath the embankment; the rate of consolidation would be greatest in the first few years following construction of each phase of the road, particularly Phase II and Phase III when the embankment would be constructed to the full design thickness, and decrease over time. Subsurface consolidation would decrease the permeability of the underlying soils, which may decrease the rate of groundwater flow (transmissivity) across the road corridor, depending on soil characteristics and the gradient driving the groundwater flows. While the transmissivity may be temporarily decreased immediately beneath the road embankment, overall groundwater patterns are not anticipated to change. Consolidation of the subsurface will be greatest at the existing ground surface and decrease with depth. Because loads dissipate rapidly in the existing ground beneath roadway embankments, significant effects on subsurface permeability is limited to near-surface soils, generally within 10 feet of the existing ground surface.

Should consolidation result in groundwater flows being forced to the surface following construction of the road, culverts could be installed to convey the water across the road prism, where water could infiltrate back into the unconsolidated soils on the other side of the road. Modifications to the road embankment, such as installation of porous rock into the road subbase, could also be implemented as part of maintenance activities to better facilitate groundwater flow beneath the road embankment. As collected surface water increases the likelihood of permafrost degradation at the roadway embankment, there is strong impetus to keep groundwater flows subsurface.

Where permafrost or bedrock results in shallow groundwater flows, there is a greater likelihood that construction of the roadway embankment would impede groundwater; where these conditions are identified during future phases of the project design, options for maintaining groundwater connectivity would be explored and implemented as practical. Design techniques such as installing multiple culverts in parallel or the installation of a subsurface layer of porous, rocky substrate are two options for facilitating shallow groundwater flow beneath the roadway embankment. Subsurface drains/pipes could also be incorporated into the roadway design to better facility groundwater transport beneath the road embankment.

Where cut (excavation) is necessary, there is potential for exposing groundwater flows. Cut areas have been minimized along the proposed alignment and generally limited to upland areas where sand and gravel soils can generally be expected to be fairly free draining. Cut areas will be examined further during future design phases to evaluate the risk of intercepting groundwater flows; high risk areas will be mitigated by adjusting the roadway profile to reduce or eliminate the required cut or by incorporating appropriate drainage measures to collect and convey the exposed water. Should groundwater seeps be observed during excavation for the roadway, cut slopes will be stabilized with angular rock (riprap) and subsurface drain rock and/or culverts will be incorporated into the roadway design to provide sufficient drainage across the roadway prism; flows will be conveyed to native soils where water can infiltrate back into the subsurface or to the nearest stream channel as practical. Cut slopes exposing ice-rich permafrost are particularly susceptible is erosion and would be stabilized using a mat of riprap or porous, granular material placed on a geotextile fabric; the porous rock material and geotextile fabric would cover the exposed ice-rich soils and extend to the toe of the embankment slope, allowing water to flow through the subsurface soils beneath the roadway embankment.

(d) The control or structural change on any stream or other body of water.

The proposed road would have minimal effect on existing hydrologic patterns. Bridges and culverts would be sized to span (at a minimum) the bankfull width of the natural channel, maintaining natural channel functions such as sediment/debris transport and wildlife passage. Bankfull width and depth is the maximum channel flow and depth before water flows out of the channel into the adjacent floodplain (i.e., the incipient point of flooding) and typically has a recurrence interval of 1.4 to 1.6 years (Rosgen, 1996). The bankfull event is the "channel-forming" event typically moving the most sediment, debris, and ice over time.

Bridges and culverts would be installed at all identified drainage crossings, including rills and ephemeral channels, to maintain hydrologic connectivity, minimize changes to watershed basin areas, and reduce the likelihood of water impoundment degrading permafrost.

Culvert and bridge spans would be increased as needed, and/or overflow culverts would be installed to improve floodplain connectivity and accommodate stream characteristics to reduce the likelihood of damming or erosion. Key factors influencing the decision to install overflow culverts and/or upsize culverts and bridges include potential for lateral channel migration, propensity for aufeis formation, sediment transport, and floodplain characteristics. Addition of overflow culverts or upsizing structures would be evaluated on a case-by-case basis during future design phases of the project, considering riverine characteristics in the immediate vicinity of the proposed crossing. Overflow culverts could also be added following Phase I construction as need arises based on observations and maintenance demands during operation of the pioneer road.

Bridges and culverts are static points which would prevent long-term lateral channel migration of streams and rivers. Structures with wider spans will be considered to better accommodate channel shifts within riverine systems prone to lateral channel migration, such as highly sinuous systems that show a recent history of substantial lateral migration (based on available aerial imagery, topographic mapping, and field observations) and strongly braided systems prone to rapid and substantial channel migration within the braided floodplain. Overflow culverts, typically set at higher elevations relative to the primary culvert, would be considered at stream crossings where aufeis formation is probable; the overflow culverts would greatly improve the ability to keep water flowing across the roadway and prevent erosion and damming should flow through the primary culvert become impeded or blocked by ice. Overflow culverts would also considered at stream crossings where there is a high likelihood of large woody debris (e.g., fallen trees) blocking culverts, based on the prevalence of timbered banks and active stream erosion upstream of the crossing. Overflow culverts would also be considered at broad, active floodplains, especially where the main stream channel is poorly defined, to better accommodate hydrologic connectivity across the floodplain.

All perennial rivers and streams are assumed to provide fish habitat and crossings would be designed to provide fish passage. Culverts would be designed and installed using stream simulation principles with embedded culverts filled with substrate to replicate natural channel characteristics and function. Crossings of well-established ephemeral channels likely to provide fish habitat during seasonal flow periods would also be designed to provide fish passage. Fish passage crossings would likely be designed to convey the 100-year peak flood (1% exceedance probability). Embedded fish passage culverts would be installed during Phase I of the project, eliminating the need to excavate in the stream channels or divert stream flows during later phases of construction and operation. Culvert lengths installed during Phase I would be sufficient to extend to the daylight fill limits of subsequent phases. Culvert shapes and gauges would be designed to withstand E80 railway loading during Phase I operation to ensure adequate burial depth until Phase II and Phase III construction is complete. During Phase I and Phase II, culverts will be buried to the culvert ends, flattening fill slopes from the road shoulder as necessary, to protect the pipe and minimize permafrost degradation.

Flooding of rivers and streams along the project corridor is typically attributed to snowmelt during spring breakup and storm events. Flood events attributed to snowmelt during spring breakup typically occur in May and are often the annual peak flow. Spring snowmelt flows are typically around bankfull in magnitude, less than the two-year recurrence interval (50% exceedance probability) and would be adequately conveyed by proposed bridges and culverts. Periodic ice jams may impound flows and temporarily raise water elevations beyond bankfull, resulting in inundation of the floodplains. Larger flood events are attributed to storm events and occur less frequently, with the severity of flooding inversely proportional to the recurrence interval. Large storm events typically occur in late summer and early fall. On average, roughly half of the project area's annual precipitation occurs between July and September (Western Regional Climate Center, 2014).

Detailed hydrologic calculations necessary to predict peak flood flows to ensure adequate hydraulic capacity at river and stream crossings have not yet been completed. Hydrologic predictions, likely using the United States Geological Survey (USGS) Regional Regression Equations, would be completed as part of later design phases. All bridges would be designed to adequately convey at a minimum the 100-year peak flood without damage to the roadway embankment or adjacent channel reaches. Scour characteristics of rivers at bridge crossings would be evaluated to minimize long-term risk to bridge abutments and piers. Culverts would be designed to convey at a minimum the 50- or 100-year peak flood depending on site characteristics and perceived risk, as determined on a case-by-case basis.

(e) Quantify changes to ambient natural soundscape due to noise from the project, including construction and operation.

Noise is generally defined as unwanted sound, and can be intermittent or continuous, steady or impulsive, stationary or transient. Noise levels heard by humans and animals are dependent on variables, including distance and ground cover between the source and receiver and atmospheric conditions. Perception of noise is affected by intensity, frequency, pitch, and duration. Noise can influence people or animals by interfering with normal activities or diminishing the quality of the environment.

The study area currently has little man-made noise and is characterized by natural sounds in most areas. The area does experience noise related to aircraft overflights and localized use of snowmachines, boats and four wheelers by subsistence users.

*Operational Noise*

Given the lack of access and development along the majority of the corridor, it can be assumed that with the exception of airplanes flying overhead, or floatplanes and helicopters landing and taking off, human-made noise is mostly absent. Noise may be concentrated at rivers stemming from boat traffic and ATVs during summer, or snowmachine traffic during the winter. Snowmachines, outboard motors, and float planes typically generate noise levels up to 85 dB(A) at 50 feet (EPA, 2009).

The estimated maximum noise level associated with an ore concentrate hauling truck or fuel truck at Red Dog Mine was 90 dB(A) at 50 feet (EPA, 2009). Although the noise level may be higher with multiple trucks, it should be noted the overall perceived noise level is not directly additive. The analysis conducted for Red Dog Mine estimated noise levels returned to background level at 2.3 miles from the noise source, assuming no noise attenuation from vegetation or topography. Although the type, number, and frequency of trucks on this road may differ from the operations scenario at Red Dog Mine, this provides an approximate indicator of likely noise levels associated with trucks hauling ore concentrate on the proposed road (EPA, 2009).

Table 9 presents an estimate of noise values from the most likely prevalent sources.

Table 9: Estimated Noise Values[1]

| Source | Sound Pressure Level [dB(A)] | Frequency/ Duration | Maximum Combined Noise [dB(A)] | Distance to Background [45 dB(A)] |
|---|---|---|---|---|
| Concentrate Truck Units | 90 @ 50 ft | ~ 1/ every 45 minutes | 93 @ 50 ft | 2.3 mi |
| Tanker/Supply Trucks | 90 @ 50 ft | ~ 1/day | 100 @ 50 ft | 5.2 mi |
| Utility/ Passenger Vehicle | 80 @ 50 ft | ~1/day | | |
| Helicopter | 102 @ 2,000 ft | ~1/week | 102 @ 50 ft | 6.8 mi |

[1]Estimated noise values are taken from analysis at Red Dog Mine (EPA, 2009).

Although braking and engine noise are the major contributor to highway noise, most highway noise is generally the result of tires hitting the ground and forcing air outwards at high rates of speed. Shrubs and trees do not act as significant noise barriers, but terrain can. Evaluating potential noise from the proposed road is a function of terrain and both the road's vertical profile and its cross-section. Looking at the highway cross section, if there is an up-hill grade on one side, the hill would act as a noise barrier reflecting highway noise. If on another side the grade is down-hill, the noise propagation would follow the grade.

The maximum haul road gradient is limited to 10% and gradients over 8% were avoided when practical. The longest stretch of 10% gradient is no longer than one-half mile. In these areas, noise would not reach as far if one side of the road contains a steep grade.

In all areas, ground surface type affects the amount of noise reflected by the ground. Vegetated ground reflects less noise that paved ground. It is expected that the native tundra would reflect very little noise, and reduce the overall propagation of noise within the corridor.

A noise study was conducted in GAAR at NPS's request. A summary of the noise study results in included in the NPS Supplemental Narrative (Section 3) and Appendix 3D.

*Construction Noise*

Road construction may cause localized, intermittent, short-duration noise impacts that would increase the overall noise levels in the area. Construction noise would vary by construction phase, types of equipment used, and distance between activities and a listener location.

In addition to the vehicle traffic noise described for operations, construction noise would also include the following:

1. Blasting from material site development and road embankment cuts; and
2. Increased air traffic, including landings and takeoffs, at maintenance area airstrips.

*Noise Mitigation*

Options for reducing the truck traffic noise along the road are limited and include reducing the speed of the traffic, barriers, and using quieter trucks.

Reducing traffic speed can reduce Lmax noise levels of a truck pass-by and the Leq(h) noise levels for multiple trucks during 1-hour of time. Traffic noise levels are reduced by approximately 1 to 2 dBA for every 5 mph reduction in speed, and therefore, a 10 to 20 mph reduction in speed would be needed to make a clearly noticeable reduction in noise. However, lower speed also means it would take longer for trucks to complete a route from the mining district to Fairbanks, and the truck noise at any specific location would be present for longer periods of time.

Barriers, such as man-made walls or earthen berms along the side of a road, are only effective for noise mitigation when they are tall enough and long enough to completely block the direct line-of-sight between the entire truck and the listener location. Therefore, barriers would not be practical for noise-sensitive locations at considerably higher elevation than the road. Also, barriers are most effective when the listener is located within a few hundred feet of the road. Listeners located more than 0.1 miles away from the road would receive little, if any, benefit from a barrier.

Noise from heavy trucks is predominantly from the engine and exhaust system. Therefore, high-grade mufflers would be installed on all trucks using the road to reduce vehicle noise.

During construction, contractors could use the following techniques to reduce construction noise:

1. Place stationary noise sources away from noise-sensitive locations.
2. Turn idling equipment off.
3. Drive equipment forward instead of backward; lift instead of drag materials; and avoid scraping or banging activities.
4. Use quieter equipment with properly sized and maintained mufflers, engine intake silencers, less obtrusive backup alarms (such as manually adjustable, self-adjusting, or broadband sound alarms instead of traditional “beep-beep-beep” alarms), engine enclosures, or noise blankets.
5. Purchase and use new equipment rather than using older equipment. New equipment tends to be quieter than older equipment due to new technology, improvements in mechanical efficiency, improved casing and enclosures, etc. Also implement a regular maintenance and lubrication schedule to ensure that equipment is operating properly.

Provide a description of the grades on the route alignments and their effects on noise from operation of vehicles the proposed road.

Although braking and engine noise are the major contributor to highway noise, most highway noise is generally the result of tires hitting the ground and forcing air outwards at high rates of speed. Shrubs and trees do not act as significant noise barriers, but terrain can. Evaluating potential noise from the proposed road is a function of terrain and both the road’s vertical profile and its cross-section. Looking at the highway cross section, if there is an up-hill grade on one side, the hill would act as a noise barrier reflecting highway noise. If on another side the grade is down-hill, the noise propagation would follow the grade.

The maximum haul road gradient is limited to 10% and gradients over 8% were avoided when practical. The longest stretch of 10% gradient is no longer than one-half mile. In these areas, noise would not reach as far if one side of the road contains a steep grade.

In all areas, ground surface type affects the amount of noise reflected by the ground. Vegetated ground reflects less noise that paved ground. It is expected that the native tundra would reflect very little noise, and reduce the overall propagation of noise within the corridor.

(f) The surface of the land, including vegetation, permafrost, soil, and soil stability.

In order to complete the project, cut and fills would be required to create a suitable base for the new roadway. Some wetland areas would need to be filled. Permafrost is a primary design consideration for the roadway foundation as the thawing of permafrost layers can cause undue settling of the roadbed.

Water accumulation along the embankment, both in roadside ditches and at culverts, could result in potential heat sinks contributing to thermal degradation of permafrost along or underneath the road embankment. Design measures are being incorporated based on geologic and hydrologic studies to freely convey surface water across the road surface and minimize impacts on groundwater flows. As additional studies are completed during future design phases to identify areas with high risk of permafrost degradation, additional design measures would be incorporated as discussed in subsections (c) and (d) above. New embankment fill would be stabilized with soil and topsoil to establish a vegetative mat to minimize erosion. Additional soil stability and erosion measures, such as riprap armoring and installation of erosion control matting, would be incorporated as part of future design phases where conditions suggest erosion may be an issue. Geotextile fabric would be placed beneath the riprap as appropriate to prevent migration of fines out of the underlying soils into surface water flows.

**Wetlands and Vegetation**

Provide mapping by vegetation type. Species of particular concern include lichen and T&E species.

Vegetation mapping for the majority of the corridor, and particularly the portion of the corridor within GAAR, is provided in the Preliminary Wetland Delineation Report attached to this application (excerpts are included in Appendix 2F; the complete report was provided on a DVD in the back of the SF299 Consolidated Application binder submitted in November 2015).

Provide plan for obtaining native plant seed and/or cuttings for reclamation and restoration after spills.

AIDEA would work with the Alaska Plant Material Center and the NPS to develop a plan for obtaining native plant seed and/or cuttings to be used for restoration and reclamation needs.

Provide wetlands delineation using the Cowardin Classification of Wetlands and Deepwater Habitats by a qualified wetland professional.

A wetland delineation has been performed and the Preliminary Wetland Delineation Report (Appendix 2F) was provided as an attachment to the November 2015 SF299 Consolidated Application. The USACE approved the Preliminary Wetland Delineation on September 9, 2014 with minor revisions (See Appendix 2F).

The eastern 50 miles of the proposed corridor ("the eastern portion of the corridor") has changed since the wetland field work was conducted. Consequently, a desktop wetland analysis (Appendix 2G) has been completed for this portion of the corridor, based on guidance in the USACE 1987 Wetland Delineation Manual. The study area for the eastern portion of the corridor was based on a 1,000-foot-wide corridor from the Dalton Highway to a connection with the existing corridor just west of the John River. This study area contains 6,528 acres and contained 3,753 acres of wetland (about 57% of the study area). The desktop delineation identified boundaries between wetland and upland areas but did not identify the Cowardin classifications for the areas. Additional field verification may be completed on these areas following completion of scoping.

Quantify the amount of wetlands crossed, and describe consequences to hydrology and wetland functions.

The proposed corridor traverses two relatively undisturbed ecological sub-regions: Interior Forested Lowlands and Uplands (IFLU) and Interior Highlands (IH). The IFLU are located in broad U-shaped valleys containing large rivers where floodplains and the presence of permafrost contribute to poorly drained soils and large wetland complexes. Uplands within the IFLU are located in elevated areas containing better-drained soils. The IFLU transitions from wet, broad U-shaped valleys into the IH with dry, well-drained soils of low mountains and rugged peaks south of the Brooks Range. Wetlands in the IH are located on ridge tops or along hillsides in drainage ways.

The preliminary wetland delineation study evaluated a 2,000-foot-wide corridor extending 204 miles from the Dalton Highway to the Ambler River (the study area), crossing seven watershed (8-digit hydrologic unit code [HUC]) boundaries. The area mapped includes areas proposed for material sites, maintenance stations, air strips, and access roads to reach material sites and water sources.

Wetlands consist of waters of the U.S. (lakes, ponds, and rivers) and "areas that are inundated or saturated…at a frequency and duration sufficient to support…vegetation typically adapted for life in saturated soil conditions" (forested, scrub-shrub, and emergent wetlands). The 68,067 acre study area contained up to 39,949 acres of jurisdictional wetlands and 1,115 acres of jurisdictional Waters of the U.S (lakes, ponds, and waterways). Wetlands and Waters of the U.S. constituted 60 percent of the total study area. A Preliminary Wetland Delineation (PWD) report was completed and submitted to the USACE in July 2014 and the delineated boundaries were approved with minor revisions in a preliminary jurisdictional determination issued by USACE in September 2014.

Table 10 provides a comparison of the overall size of the individual watersheds crossed by the preferred project alignment and the impacts from project development. The impacts listed in this table include all impacted wetlands, Waters of the U.S., and upland areas. Table 11 provides a comparison of the overall size of the individual watersheds crossed by the alternative project alignment and the resulting impacts.

**Table 10: Comparison of Watershed Sizes and Total Impact Areas for the Preferred Alignment**

| Hydrologic Unit Code[1] | HUC Name | Size[1] (*Acres*) | Potential Impacts (*Acres*) | Impact Percentage of HUC |
|---|---|---|---|---|
| 19050302 | Upper Kobuk River | 2,987,287 | 1,950 | 0.065 |
| 19050303 | Middle Kobuk River | 3,082,959 | 350 | 0.011 |
| 19090101 | Upper Koyukuk River | 4,436,234 | 999 | 0.023 |
| 19090108 | South Fork Koyukuk River | 1,477,876 | 119 | 0.008 |
| 19090103 | Alatna River | 2,240,661 | 827 | 0.037 |
| 19090105 | Allakaket-Koyukuk River | 1,103,242 | 226 | 0.020 |
| | **Total** | **15,328,259** | **4,471** | **N/A** |

[1]*USGS, 2014*

**Table 11: Comparison of Watershed Sizes and Total Impact Areas for the Alternative Alignment**

| Hydrologic Unit Code[1] | HUC Name | Size[1] (*Acres*) | Potential Impacts[2] (*Acres*) | Impact Percentage of HUC |
|---|---|---|---|---|
| 19050302 | Upper Kobuk River | 2,987,287 | 2,034 | 0.068 |
| 19050303 | Middle Kobuk River | 3,082,959 | 350 | 0.011 |
| 19090101 | Upper Koyukuk River | 4,436,234 | 999 | 0.023 |
| 19090102 | South Fork Koyukuk River | 1,477,876 | 119 | 0.008 |
| 19090103 | Alatna River | 2,240,661 | 1,057 | 0.047 |
| 19090105 | Allakaket-Koyukuk River | 1,103,242 | 225 | 0.020 |
| 19090108 | Koyukuk Flats- Koyukuk River | 4,234,909 | 290 | 0.007 |
| | **Total** | **19,563,168** | **5,074** | **N/A** |

[1]*USGS, 2014*

The project footprint affects less than 0.07 percent of any one watershed. This loss would have minimal impacts and not affect the overall physical, biological, and chemical processes of the habitats, including wetlands contained in each watershed.

Table 2A-2 in Appendix 2A provides information on the footprint for major elements and the amount of wetland, open water and upland affected by each element for the corridor from the Dalton Highway to the Amber Mining District. More detailed information on wetland and stream impacts is provided in the USACE wetland permit application, included as Section 5 of this submittal. A summary of impacts from the overall project footprint is provided in Table 12.

**Table 12: Summary of Project Footprint on Wetlands and Other Waters of the U.S.**

| Project Element | Preferred Corridor (acres) [1] | Alternative Corridor (acres) [1] |
|---|---|---|
| Overall Project Footprint | 4,471 | 5,074 |
| Wetland Impacts | 1,899 | 2,231 |
| Open Water Impacts[2] | 8 | 8 |
| Upland Impacts | 2,564 | 2,836 |

[1] *Differences due to rounding.*
[2] *Includes fill in ponds and riprap in streams at bridge crossings.*

Direct wetland impacts from construction of the proposed roadway and ancillary facilities would be limited to the project footprint where ground disturbing activities would occur. Anticipated direct impacts to wetlands and Waters of the U.S. throughout the preferred project corridor are 1,899 acres (43 percent) of the overall design footprint. The impacted habitat types throughout the project corridor (for both the preferred and alternative alignments) are described in Table 13. All directly impacted wetland would require a Section 404 Permit from the USACE for the dredge and fill of wetlands prior to the beginning of construction activities.

**Table 13: Habitat Types Directly Impacted by Preferred and Alternative Corridors (Dalton Highway to Ambler Mining District)**

| Habitat Type (Cowardin, 1979) | Habitat (Viereck et al, 1992) | Preferred Alignment | | Alternative Alignment | |
|---|---|---|---|---|---|
| | | Impacts (Acres) | Impacts (Percent) | Impacts (Acres) | Impacts (Percent) |
| Emergent Wetlands | Mesic and Wet Graminoid Herbaceous | 91 | 2.04% | 93 | 1.83% |
| Forested Wetlands | Closed Needle-leaved and Mixed Forests; Open Needle-leaved and Mixed Forests, Needle-leaved and Mixed Woodlands | 566 | 12.67% | 822 | 16.20% |
| Scrub-shrub Wetlands | Closed Dwarf Tree, Tall, and Low Scrub; Dwarf Tree Scrub Woodland; Open Dwarf Tree, Tall and Open Low Scrub | 681 | 15.23% | 755 | 14.88% |
| Other Wetland[1] | N/A[1] | 561 | 12.55% | 561 | 11.05% |
| Pond/Riverine | Water | 8 | 0.18% | 8 | 0.16% |
| Upland[2] | Varies | 2,564 | 57.35% | 2,836 | 55.88% |
| | **Total** | 4,471 | 100% | 5,075[3] | 100% |

[1] *Impact areas on the eastern portion of the corridor were not classified into Cowardin or Viereck habitat classes.*
[2] *Uplands areas are not distinguished in Cowardin.*
[3] *Total acreage off by 1 acre due to rounding.*

Indirect impacts to wetlands occur from bisecting habitats or changing hydrological surface flow patterns. Design efforts to minimize impacts to wetlands and streams included traversing upland habitats with less than ten percent longitudinal grades; avoiding sloughs, ponds, and lakes, typically by a minimum of 50 feet; and, locating river crossings at straight sections, avoiding braided or multiple channels, and crossing rivers at the narrowest point where feasible. Other design minimization measures included shifting of the alignment to impact lower value wetlands and following existing roads or trails where possible.

Wetland habitats are rated on the physical, biological, and chemical process they perform, and are assigned a corresponding value (low, moderate, or high). Wetland habitats rated as high value regardless of their locality include ponds, lakes, and river habitats, while the value ratings for scrub-shrub, forested, and emergent wetlands vary dependent on their abundance within a watershed. For instance, as a result of scarcity within six watersheds, emergent wetlands were considered high value in all watersheds but one where they were rated as moderate due to a greater prevalence. The functional rating of each wetland type is summarized in Table 14.

**Table 14: Functional Rating of Wetlands by Watershed and Type**

| Watershed | Wetland Type | | | |
|---|---|---|---|---|
| | Emergent | Forested | Scrub-Shrub | Ponded, Lake, or River |
| Upper Kobuk River | High | Moderate | Moderate | High |
| Middle Kobuk River | Moderate | High | Low | High |
| Upper Koyukuk River | High | Low | High | High |
| South Fork Koyukuk River | High | Low | Moderate | High |
| Alatna River | High | Low | High | High |
| Allakaket-Koyukuk River | High | Low | High | High |
| Koyukuk Flats-Koyukuk River | High | Low | Moderate | High |

As part of the design process, rivers, rills, and swales were identified through both desktop analysis and field survey efforts. The project design has incorporated efforts to maintain hydrologic connectivity, such as using the bankfull widths of defined channels to determine culvert and bridge sizes. Areas where the proposed roadway footprint requires the fill of wetlands and does not contain a defined channel, minor culverts (less than three-foot diameter) would be installed approximately every 150 feet. These efforts would maintain hydrologic connectivity between bisected wetlands and minimize impacts to the physical, biological, and chemical processes from the construction of the proposed roadway.

Additional information regarding wetland functions and hydrology may be found in the Preliminary Wetland Delineation Report which is included on the attached CD.

Consequences to hydrology and wetland functions.

The primary consequence to area hydrology and wetlands which would result from the construction includes: alterations to surface flows from the construction of embankments and thousands of stream crossings; the bisecting of wetland habitats, and the filling of 1,907 acres of wetlands and Waters of the

U.S. Impacts from construction would alter the saturation or inundation of a small portion (less than 0.01 percent) of each watershed, causing minimal effects to the overall wetland physical, chemical, and biological functions. All impacts to wetlands are anticipated to be localized in nature. Design elements such as the placement of porous material within embankments and the use of culverts would be employed to minimize local impacts to hydrology (surface and sub-surface) resulting from the construction of the proposed roadway. Refer to subsections (c) and (d) above for more information on proposed drainage measures to maintain hydrologic connectivity across the roadway embankment throughout all phases.

Lichen

Lichen make up a substantial portion of the vegetation in GAAR and serve an important role as a major food source for caribou migrating through the area (Neitlich and Hasselback, 1998). Lichens also create community infrastructure and nesting material for insects, birds, and small mammals. Additionally, some lichen species fix nitrogen, which is important in nutrient-poor systems. Steep and rocky alpine sites tend to favor lichen over vascular plants, which need more soil and moisture to thrive.

A number of lichen surveys have been conducted in GAAR over the years with a 1998 report noting that a total of 260 macrolichens were known or reported in GAAR (Neitlich and Hasselback, 1998). A more recent survey of lichen in Arctic National Parks identified 491 unique species, including 351 macrolichens, 138 microlichens and 2 basidiolichens (Holt and Neitlich, 2010). This survey effort identified 24 lichen species unique to GAAR. GAAR sample sites included in this survey were all in the Park portion of GAAR, north of the proposed corridor.

Threatened and Endangered Plant Species

There are no known occurrences of plant species listed as threatened or endangered under the Endangered Species Act in the study area.

Provide map and description of existing permafrost in the project area. Describe actions that will be taken to stabilize permafrost overlain by a road.

Most of the project corridor is assumed to traverse areas of continuous permafrost based on existing available information and the limited geotechnical studies conducted to date (Appendix 2A: Figure 2-10). There are several options to mitigate the impacts to areas susceptible to permafrost degradation. The primary adverse effects on permafrost result from creation of heat sinks, typically at the embankment's toe of slope or from poor drainage along the embankment. Therefore, the key issues for minimizing effects on permafrost include decreasing the side slopes of the embankment and providing for adequate drainage along the embankment to prevent ponding.

Gravel road surfaces increase the magnitude of the temperature swing caused by solar radiation and cold air, thereby increasing the thaw depth compared to the original soil surface. Providing adequate embankment thickness can be used to raise the thaw depth (i.e., active layer) above the original permafrost layer and prevent or minimize permafrost degradation. Embankment thicknesses are increased where permafrost is likely and cut sections are avoided to the greatest extent practical to minimize permafrost exposure. Since permafrost degradation typically begins at the toe of the fill slope and spreads under the embankment, ideally fill slopes should be as flat as possible (constructing benched berms alongside the embankment is a common approach); obviously flattening the fill slopes has to be weighed against the increased footprint of the roadway. The typical sections depicted in Section 5: Appendix 5C illustrate examples of incorporation of these measures into the proposed project design with side slopes extended to 4:1 (horizontal: vertical) and an embankment up to 96 inches deep to account for permafrost conditions.

The alignment itself was selected to avoid areas with a high potential for aufeis formation, which can lead to ponding of surface runoff that acts as a heat sink and degrades permafrost. Culverts are the typical measure used to preserve hydrological function for surface water flow, with importance placed on providing adequate culverts to maintain existing drainage patterns (including small and ephemeral drainages). A sufficient number of culverts would be used to minimize surface water accumulation. Roadside ditches would only be used in limited cut areas with permafrost presence is unlikely. The elevated (fill) aspect of the road would avoid impacts to shallow groundwater sources; if there are site-specific concerns about damming shallow groundwater or wetting of the embankment, coarse materials could be placed at the lowest levels of the embankment to facilitate groundwater movement across the system. These design considerations are in line with recommendations listed in Cold Regions Pavement Engineering by Guy Dore and Hannele Zubeck, a leading reference on engineering in permafrost environments.

In addition to these key design measures, there are additional measures that can be incorporated if needed in key areas. Any additional measures would be implemented for specific areas to be identified and designed during future detailed design phases. Methods for reducing permafrost degradation generally function by reducing the thermal conductivity near the surface or improving heat extraction through conduction, condensation, evaporation, and/or convection. Potential methods for addressing permafrost concerns include embankment insulation, air convention embankment, thermosyphons, sunsheds, snowsheds, or air ducts.

As described in subsections (c) and (d) above, all culverts installed during Phase I of the project would be of the full length required for the full-embankment, two lane (Phase III) road. This will be done to minimize disturbance and to ensure the culverts will work for all phases of the project. Embankment slopes would be flattened and sloped at culverts to provide sufficient cover over the culverts to the pipe ends. Because permafrost degradation is often initiated at the toe of the embankment slopes, the widened, flattened slopes at culvert crossings would be beneficial to reducing effects on underlying permafrost. If cut slopes expose ice-rich permafrost, the exposed soils would be stabilized with a mat of porous rock (riprap or coarse, granular material) placed on a geotextile fabric.

Proper maintenance activities are also beneficial to reducing effects on underlying permafrost. Snow piles can trap heat within the roadway embankment and extend the depth of the active thaw layer, especially early in winter. Plowing snow off of the road shoulders and embankment slopes better facilitates dissipation of heat out of the roadway embankment and reduces the likelihood of permafrost degradation. The fill slopes of 3:1 and flatter included in the design would accommodate maintenance vehicles and allow for plowing of snow off of the embankment slopes. Routine maintenance of the roadway would include plowing the road surface to the edge of the shoulders, maximizing heat extraction from the road surface, and extending plowing down the embankment slopes as can be practically accommodated.

Current permafrost mapping is highly generalized and the extent and depth to permafrost is widely unknown. It is too early in the design process to determine where more site-specific approaches, such as those described above, might be needed and would be practical to implement to minimize permafrost degradation. Determining the best method to control permafrost thawing in specific areas would require more detailed thermal modeling along the selected alignment. Improving the accuracy of thermal modeling requires a detailed understanding of the soil profiles, as subsurface materials have varying thermal conductivities. More geotechnical field studies and detailed thermal modeling would be completed and more specific measures to be incorporated in specific areas would be identified during final design after the alignment has received approval from the appropriate Federal and State agencies.

Table 15 presents descriptions and quantities of permafrost encountered along the proposed alignment from the Dalton Highway to the mining district and if the alternative alignment through GAAR is selected.

**Table 15: Permafrost along the Corridor from Dalton Highway to Ambler Mining District**

| Permafrost | Preferred Alignment | | Alternative Alignment | |
|---|---|---|---|---|
| | Miles of Corridor | Percentage | Miles of Corridor | Percentage |
| Mountainous Area Underlain by Continuous Permafrost | 172 | 82 | 172 | 75 |
| Lowland and Upland Area Underlain by Moderately Thick to Thin Permafrost | 23 | 11 | 37 | 16 |
| Lowland and Upland Area Underlain by Discontinuous Permafrost | 16 | 7 | 20 | 9 |
| **Total** | **211** | **100** | **228** | **100** |

Describe the soil types to be encountered in road construction and maintenance. Describe any expected issues with soil stability and the measures to be taken to address these issues.

Assessing and quantifying soils is an ongoing process, however a general description of the project corridor soils is provided here. The alignment from the Dalton Highway to the Koyukuk River is characterized by shallow slopes, poor exposure of soil facies and the occurrence of thaw lakes. Much of the foundation soils below the proposed alignment are glacial lacustrine deposits. The section from the Koyukuk River to Gates of the Arctic National Park and Preserve traverses glacial landforms composed of lateral and terminal moraines, undifferentiated drift, and minor glacial lacustrine deposits. The portion of the alignment through the Preserve traverses primarily glacial landforms and piedmont gravel deposits and their associated foundation soils. The proposed alignment from GAAR to the Ambler Lowlands crosses piedmont gravels, glacial drift, and polygenetic sand and silt. The amount of sand increases in the western portion, particularly south of Avaraat Lake, where re-transported glacial lacustrine sands and silt appear to blanket much of the region. Much of the surficial soils in the Ambler Lowlands section of the corridor appear to consist of frozen sands, based on the prevalence of polygonal surface features, thaw lakes and small streams. At one time the Ambler Lowlands were a sand dune field and much of that material remains in place.

Initial mapping has been completed however; additional field work is needed to determine all of the soil characteristics needed for final design of the road. Additional studies would be performed to delineate soil characteristics related to soil stratigraphy and gradation, erosion potential, frost heave potential, thaw settlement potential, bearing strength, slope stability, and borrow source suitability. These studies would allow the design team to propose measures to deal with the specific soil issues in each area.

Kobuk Wild River: Describe potential changes to free-flowing nature, water quality and outstandingly remarkable values (ORVs) of the Kobuk Wild River (per Wild and Scenic Rivers Act). Present measures to minimize effects on the Kobuk Wild River.

The free-flowing Kobuk Wild River consists of a combination of both flat and white waters spanning the Upper and Lower Kobuk Canyon in GAAR. The proposed project would require a 430-foot span bridge across the Kobuk River just south of the wilderness boundary near the confluence of the Walker Lake outlet into the Kobuk River. The bridge would likely consist of three 130-foot spans supported by piers; three piers would be constructed within the river channel between the bridge abutments. Piers are anticipated to be constructed using steel piles with concrete caps. Bridge abutments would likely be protected with riprap mats placed along the river banks.

Impacts on the hydrologic processes associated with the river would be limited to the immediate vicinity of the bridge. The proposed crossing location is along a fairly straight portion of the river where the river is against a bluff that has blocked it from migrating further to the west. The proposed bridge is not anticipated to impact the active channel location, geometry, slope, or form. There may be minor effects on channel width and roughness in the immediate vicinity of the crossing. No effects are anticipated on existing flow patterns (amount or timing), surface and subsurface flow characteristics, or aggradation/degradation of the channel. Overall impacts on the floodplain would be minor and localized to the immediate vicinity of the bridge. Impacts to adjacent uplands, soils, and riparian vegetation would occur due to construction of the bridge approaches, abutments, and any stabilization required on the bank at the river crossing.

Although the project would result in some work in the bed and on the banks of the river, the bridge would be designed to minimize impacts on river flow and to allow continued navigation on the river by riverboats and rafts. Since the free-flowing classification associated with the Wild and Scenic Rivers Act refers to the lack of impoundments on the river, the proposed addition of a bridge would not be considered to change the free-flowing designation on the river.

Table 16 documents ORVs for the Kobuk Wild River, existing conditions, and potential effects.

Construction of the proposed project would likely result in short-term effects on water quality during the construction period, but these would be mitigated through appropriate sediment and erosion control measures, such as stabilizing disturbed areas as quickly as possible and completing in water construction during winter months when river flows are at a minimum. Construction would also result in short term effects on fish habitat from disturbance of the river bed and banks. Long-term effects on water quality and fish habitat in the river would be expected to be minor.

Potential mitigation/minimization measures for the proposed road and bridge crossing would include: designing the Kobuk River bridge to minimize effects on water flow and fish migration; use of clean temporary diversion structures (e.g., Super Sack containers) during construction activities, working in low-water conditions when the need for diversion and dewatering requirements are lessened, minimizing use of riprap by exploring bioengineering alternatives for bank protection and stabilization, placement of pilings to allow for unimpeded river traffic; and restricting in-water construction during critical migration and spawning movements. These measures would minimize potential negative impacts on soils, habitat, wildlife, subsistence, and recreation.

**Table 16: Summary of ORV Existing Conditions and Potential Effects of the Proposed Project**

| ORV | ORV Description[1] | Potential Effects |
|---|---|---|
| Scenic Quality | Wide valley with sweeping vistas of nearby hills and low mountains, Walker Lake, two canyons.<br><br>There are currently no man-made structures or facilities within the viewshed. | The majority of the length of the river would be unaffected. Scenic values would change substantially in the vicinity of the road crossing as a man-made structure would be visible. Other views of the road corridor may be visible in the mid-ground and background from some view points along the river. |
| Recreational Opportunities | Exceptional float river, a few short stretches of extremely rugged rapids (up to class V), good opportunities for sport hunting (in preserve only), wildlife observation, and backpacking.<br><br>The Kobuk River corridor supports numerous recreational activities from motorized and non-motorized river travel, subsistence and sport hunting, wildlife observation and backpacking. Most use in the vicinity of the proposed road corridor is along the Kobuk River and at Walker Lake. | The proposed project would have little effects on recreational opportunities along the Kobuk River. Recreational activities would be limited and/or restricted during construction, but impacts are anticipated to be short-term and temporary. The recreation experience may be changed in the vicinity of the road crossing as the bridge and road would be visible for some distance on the river as you approach the crossing area. |
| Geologic Features | Endicott Mountains of central Brooks Range, upper and lower Kobuk canyons. The geologic features are as they were at designation of the river. | The proposed road would have little impact on these geologic features. |
| Fish, Wildlife and Plants | Variety of fish and wildlife, one of largest concentrations of sheefish, wintering grounds for western arctic caribou herd, one of the largest continuous spruce forest areas in the Brooks Range.<br><br>According to the ADF&G information on the seasonal ranges for the Western Arctic Caribou Herd, the Preserve is within the Migratory Area and Outer Range for this caribou herd (Appendix 2A: Figure 2-11). | The proposed project may have an adverse effect on individual fish, animals, and plants during construction and during operation. Negative effects from construction on fish and wildlife would be expected to be temporary. Effects on migrating caribou are not anticipated to occur at a population level, although there may be some effects on individual caribou during migration. The loss of plants and habitat along the proposed corridor would be expected to have minor effects due to the size of the area affected compared to the extent of habitat available. |
| Cultural Resources | Highly significant potential for archeology because of continuous occupation and links between inland Eskimo people.<br><br>The cultural resources are as they were at designation of the river. | Proposed project construction and operation would comply with Section 106 of the National Historic Preservation Act. Project development would include consultation with NPS, the State Historic Preservation Office and Native entities with ties to the area to identify potential effects and, if required, stipulations to address these effects. |

*[1]ORV descriptions are from the General Management Plan/Land Protection Plan/Wilderness Suitability Review (NPS, 1986).*

**Spills**

Provide an estimate of the probability of fuel, chemical, and ore spills including frequency and magnitude. Provide a plan(s) of action for dealing with fuel spills, ore spills and other contaminant spills during road construction and operation, including response capability.

Experience at Red Dog Mine indicates fuel spills are rare; only one fuel spill was reported on DMTS from 2000 to 2007 (EPA, 2009). Concentrate spills on the DMTS have also occurred, although the design of concentrate containers has improved during the time of the DMTS operations reducing the loss of concentrates during transport accidents. Restrictions on road use would require concentrate haulers to use sealed concentrate containers to minimize the loss of concentrate during transport.

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. AIDEA would also require a concentrate recovery plan similar to that developed at the Red Dog Mine to address concentrate spills.

**Cultural features**

A 2013 field survey by Northern Land Use Research Alaska, LLC. (NLURA) used Light Detection and Ranging (LiDAR) data to identify Locations of Interest (LOIs) within the project corridor which were the focus of the work (NLURA, 2013). Using helicopter and pedestrian surveys, NLURA recorded two new sites in 2013, both near the western end of the proposed route. One site is located between the Shungnak and Ambler rivers and the other is located southeast of the Kogoluktuk River. Both sites contain prehistoric and historic components.

Prior to 2013 field survey, 118 sites were identified in the Alaska Heritage Resources Survey (AHRS) within one mile of the corridor centerline. Of these, 70 are prehistoric sites, 46 historic, one is a protohistoric site, and one is a modern site. The sites are generally clustered in two areas: near Bettles and within and adjacent to GAAR. However, this distribution should not be considered representative of historic habitation patterns, but rather the history of cultural resource surveys in the area.

Many of the known sites are near Bettles and related to the Old Bettles Historic District, consisting of a trading post, associated cabin sites, a store, and various outbuildings. The known prehistoric sites, predominantly recorded in and near GAAR, are typically small lithic scatters and isolates that have been interpreted as short-term camps (NLURA, 2014).

Recent modifications to the proposed corridor move it farther from the sites near Bettles. The eastern end of the proposed corridor near the Dalton Highway has not been evaluated for cultural features. Refinement of the corridor through GAAR after the initial cultural resource studies were complete resulted in some alignment adjustments. This resulted in some of the proposed alignment being outside the corridor evaluated during initial cultural resource surveys. Therefore, it is anticipated that additional cultural resource field work would be conducted on the east end of the corridor and in GAAR upon completion of the scoping process.

**<u>Wilderness</u>**

<u>Describe changes to wilderness characteristics from the project, including construction and operation.</u>

Wilderness areas are those areas designated by Congress as part of the National Wilderness Preservation System. The proposed road corridor does not cross through any federally-designated wilderness areas. ANILCA specifically set the wilderness boundary north of the Preserve and provided for a transportation access through the Preserve.

The term wilderness is often used more generally to describe areas that are natural in appearance, lack man-made alterations to the landscape, and provide opportunities for solitude or primitive and unconfined recreation. Construction and operation of the project would add a man-made feature into the area and would introduce human noise and activity in the area. Those areas affected by the sight and sound of the road would have diminished or reduced wilderness characteristics. The majority of the Preserve, excluding the vicinity of the road, would continue to have wilderness characteristics and provide opportunities for solitude and unconfined recreation.

**18. Describe the probable effects that the proposed project will have on (a) populations of fish, plant life, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals.**

(a) The proposed project is anticipated to have minimal and limited effects on all wildlife within or near the project corridor, including fish, mammals, and birds. Construction of the road and subsequent traffic volumes could impact individual animals but would not be expected to have population-level effects. Impacts on plant life would be limited to the road and material site footprints and immediate vicinities. There would be no effects on marine life, threatened or endangered species, or critical habitats.

The project corridor provides habitats that support populations of migratory birds, brown and black bears, wolves, lynx, ungulates such as moose, Dall sheep, caribou, and small furbearers.

Construction and operation of the road would result in a minor loss of habitat when compared to the amount of habitat in the area. Traffic noise and activity levels may also result in localized disturbances to wildlife along the road. Vehicle collisions with wildlife may result in mortality for a limited number of individuals but would not be expected to have effects on a population level.

<u>Provide data on affected wildlife, including population, existing sex/age distribution, distribution, harvest, incidental take, T&E species. Species of particular concern are caribou (caribou winter range quality, migratory movements and stress hormone levels), grizzly and black bear, fur bearers, raptors, waterfowl, and other nesting bird species.</u>

**<u>Threatened and Endangered Species</u>**

The proposed road corridor does not cross through areas where threatened or endangered species are documented, or lands designated as critical habitat. The yellow-billed loon (*Gavia adamsii*) is being assessed as a candidate species and its breeding range may overlap the project vicinity. In October 1, 2014, the U.S. Fish and Wildlife Service determined the yellow-billed loon does not warrant listing as part of the Endangered Species Act.

**Caribou (*Rangifer tarandus*)**

The proposed road crosses the outer range and migratory areas of the Western Arctic Caribou Herd (WACH) but completely bypasses calving grounds, summer range, and is on the periphery of the winter range as shown in Appendix 2A: Figure 2-11. The WACH has been declining in population at a rate of approximately five percent annually since 2003. In 2011, the herd totaled 325,000 animals and at its peak totaled 490,000 animals. Prior to this peak, however the WACH has had as few as 75,000 animals (WACH Working Group, 2011). Caribou from other herds may occasionally be present in the project study area, but these are typically very small numbers of caribou at the edge of their range.

As the largest caribou herd in Alaska, the WACH has been extensively studied over the last twenty years. Studies range from effects of climate change on the herd, to how differing policies and plans have affected the herd. Studies have also tried to evaluate the effect of roads and development on the WACH. These have focused on the Red Dog Mine and the DMTS road as these comprise the largest non-residential development complex within the WACH range. A caribou management report by the Alaska Department of Fish and Game (ADF&G) noted the Red Dog Mine, the road, and the port site appeared to have had only limited and localized effects on movements and distribution of the herd. It further noted the success of the mine's policies developed to minimize impacts on subsistence users and caribou (Dau, 2011).

A number of studies have been conducted throughout the north evaluating the potential effects on caribou from industrial development and roads. The studies reach a range of conclusions with some indicating avoidance of developed infrastructure and others indicating habituation to infrastructure (Bergerud, Jakimchuk & Carruthers, 1984; Fancy, 1983; Haskell, Nielson, Ballard, Cronin & McDonald, 2006; National Research Council [NRC], 2003). In general it appears individual caribou are likely to respond to the presence of a road and road traffic, but population level effects from infrastructure development do not appear to be evident. The Central Arctic Herd provides useful information as it has been studied to assess the impact of the Dalton Highway on migratory and calving patterns. While the Central Arctic Herd has experienced an increase in population, the caribou do exhibit "some avoidance" to crossing the Dalton Highway (NRC, 2003).

Caribou migration patterns change from year to year, but general ranges have been identified by ADF&G (Appendix 2A: Figure 2-11). Caribou tend to be more closely tied to calving areas whereas winter habitats tend to be more variable. The proposed corridor is separated from the WACH calving range by the Brooks Range. The proposed corridor is primarily within the migratory area used by the herd when moving between the herd's summer and winter ranges. The proposed road may have some effect on caribou migrating through this area, however recent NPS work notes the corridor would affect less than ten percent of WACH wintering range.

Potential impacts to the WACH include vehicle collisions with individual caribou and behavioral changes in the vicinity of the road. There may also be shifts in the migratory pattern or timing as a result of some caribou who may avoid or delay crossing the road. Again, no population level effects are anticipated.

**Dall Sheep (*Ovis dalli*)**

Dall sheep are an alpine species of ungulates prevalent in Alaska. The project vicinity is the northernmost extent of their range. The NPS estimates the Gates of the Arctic, Noatak, and Kobuk Valley encompass most of the available habitat in the central and western Brooks Range. Monitoring of Dall sheep has been conducted in GAAR for many years, while the western Baird Mountains have been surveyed nearly every year since 1986. Recent data show this population has increased since a decline in the early 1990's. Dall sheep are a valued subsistence species for local residents and sport hunting is permitted within the preserve area. It is estimated approximately 10,000 Dall sheep can be found in GAAR (NPS, 2010).

**Moose (*Alces alces*)**

Moose are an important subsistence resource for the residents of Kobuk, Shugnak, and Ambler, and are considered second only to caribou in regards to their importance as a subsistence resource. They are sought primarily for recreation, producing income for hunting guides and transporters in the area, and secondarily as a food source (ADF&G, 2008). Moose habitat can be found in relatively high elevation drainages flowing out of the Brooks Range.

In 2003, one survey showed moose density in the upper Kobuk River to be relatively low at 0.21 moose per square-mile. In 2006, the Upper Kobuk drainage was surveyed for moose and a total of 219 moose were observed, leading to a total estimate of 737 animals with a density of 0.18 moose per square-mile (NPS, 2006a).

The proposed alignment predominantly traverses Alaska Game Management Unit (GMU) 23, which encompasses the Western Brooks Range and Kotzebue Sound, with a smaller portion in GMU 24B, which includes the Koyukuk River drainage above the Dulbi River.

The main stem of the Kobuk River below Kiana has the highest year-round density in GMU 23 and since the 1980's, moose hunting and harvest have declined in the Noatak drainage, but has increased in the Kobuk and Selawik drainages. Moose densities are higher in GMU 24B.

**Black Bear (*Ursus americanus*)**

The project vicinity is at the northern extent of common black bear range. Black bears have been reported from areas around the North Fork Koyukuk River and Takahula Lake within GAAR. The University of Alaska Museum of the North (USNM) has a specimen taken from the Brooks Range near the head of the John River. Although black bear are known to live in the Kobuk River drainage (Dean and Chesemore, 1974), this region still lacks specimen documentation.

**Brown Bear (*Ursus arctos*)**

Brown bears have been reported at Agiak Lake, Lake Tulilik, Lake Isiak, and Walker Lake. While brown bear populations in the project vicinity range throughout all habitats, they tend to aggregate around major streams or rivers and open alpine or tundra habitats. Specimens have been preserved from a number of locations in the park and are documented in the USNM. Brown bear density is approximately one per 100 square miles. The NPS has conducted five aerial surveys in northwest Alaska, with the nearest study occurring in the GAAR to the north of the Ambler River drainage.

**Furbearers**

Furbearer species are important to hunters and trappers in the region for their pelts, which are used to make traditional Alaska Native crafts and clothing. Trends of furbearer species have been inferred by trapping harvest reports conducted by ADF&G and are reported by GMU. The project corridor mostly lies within GMU 23. Information on known furbearers within the area is summarized below.

- Beaver (*Castor canadensis*) — The populations of beaver have remained high within the Kobuk River drainages where they occupy high and marginal habitat areas (ADF&G, 2010).
- Lynx (*Lynx canadensis*) — Lynx typically travel between one to five miles per day within home ranges which can extend anywhere from five to more than 100 miles. Lynx lifecycles are closely tied with snowshoe hare populations, with kitten survival tied to the availability of the hares. The 2010 survey report noted that snowshoe hare populations in GMU 23 were increasing and projected lynx populations would increase in response (ADF&G, 2010).
- Snowshoe Hare (*Lepus americanus*) — Snowshoe hares have a highly cyclical population distribution over a ten-year cycle, so rather than assess populations, the cycle itself is evaluated. The population builds up over several years to a peak abundance (as many as 600 hares per square mile), followed by a sudden decline to a very low level (Alaska Natural Heritage Program, 2013). Showshoe hare habitat is generally one that contains abundant understory cover (forest, shrubby woodlands, and riparian shrub thickets). In March 1997, GAAR began a long-term monitoring program of the snowshoe hare population in the eastern portion of the park (DiFolco, 1999). The study concluded snowshoe hare population dynamics is potentially confined to relatively small areas and differences in vegetation may be a key driver for the population rate increase or decrease.
- Mink (*Neovison vison*) and American Marten (*Martes americana*) — Spruce forests are prime habitat for these species and these furbearers are considered common within forested areas in GAAR (NPS, 2006b). Marten habitat is best in the upper Kobuk River drainage and the forested reaches of the Koyukuk, John, and Alatna rivers of GAAR also provide excellent habitat for this species. Little is known about mink abundance or population trends within GMU 23 (ADF&G, 2010).
- River Otter (*Lontra canadensis*) — Little data has been collected regarding the River Otter's population, distribution, or status in the project vicinity. However, a survey of trapping, harvest, and sightings indicate they are relatively abundant (ADF&G, 2010).
- Red Fox (*Vulpes vulpes*)—The Red Fox is considered abundant throughout the project corridor (ADF&G, 2010).
- Arctic (White) Fox (*Alopex lagopus*) — Arctic foxes are prevalent in treeless coastal areas, and prefer to den along sandy-soil riverbanks and hillocks, and may occur within the project corridor. Due to denning habitat preferences, if they are present within the project corridor it would likely be a rare occurrence and contained near riparian areas of the major rivers. Distribution and population trends across the entire range follow a cyclic rise and fall directly correlated with specific prey species (ADF&G, 2014b).
- Wolverine (*Gulo gulo*) — The population of wolverines is considered low within GMU 23 (ADF&G, 2010). Only one wolverine was documented in a mammal survey of the GAAR and it was near the Kobuk and Kallarichuk rivers (NPS, 2006b).
- Gray wolf (*Canis lupus*) — Wolves are social animals and usually live in varying sized packs. Wolves are carnivores and in most of mainland Alaska, moose and/or caribou are their primary food. Wolves are common over much of the State and in the GAAR area, wolf density is

approximately five per 1,000 square kilometers throughout the year (Adams, Stephenson, Dale, Ahgook & Demma, 2008).

- Coyote (*Canis latrans*) — The entire project corridor is located within the coyote's range, which includes most of Alaska's interior. However, no coyotes were observed or reported during a 2006 study within GAAR (NPS, 2006b). As excellent scavengers, coyotes respond quickly to dramatic increases and decreases of available prey.

Provide a description and schedule of wildlife data to be collected.

Although a wide variety of wildlife may be present in the study area and some may use the specific area where the road is proposed, effects on most wildlife species would not be expected to be substantial and existing data on species occurrence and habitat use would be expected to be sufficient for review of wildlife and wildlife habitat impacts from the proposed road. Species of particular concern include caribou and several fish species. Studies on the WACH and other Alaska caribou herds are extensive, as described above, and should provide sufficient information to evaluate potential effects on caribou. Fisheries studies along the corridor were conducted and are included in Appendix 2E as described below.

Describe projected changes to wildlife and wildlife habitat. Describe anticipated mitigations to wildlife impacts.

Loss of habitat due to noise and human activity is difficult, if not impossible, to quantify because species and even individuals within a singular species differ in their tolerance to noise and human activity. Potential for injury and mortality increase as interaction between animals and vehicles is increased. Vehicular use would create localized disturbances to wildlife along the road. Vehicle access would be controlled and limited to professional drivers transporting materials to and from the mine, though some use by other commercial operators may be permitted on a case-by-case basis to deliver fuel and supplies to local communities.

The greatest mitigation to wildlife impacts during operations of the road would come from the controlled access and limited use of the road. Additionally, the road design would often require slower speeds due to the gravel surface, horizontal curves, and grades. Coordination and notification to drivers of currently observed animal patterns, including migration patterns, would increase awareness of potential animal and vehicle conflicts.

Provide information on raptors, waterfowl, and other nesting bird species of concern, and projected changes due to the project.

**Migratory Birds**

Migratory bird species include landbirds, raptors, shorebirds, seabirds, and waterfowl; all categories are found within the project vicinity.

**Songbirds**

In 2005, the NPS estimated lands within GAAR supported between 150 and 200 breeding species of birds, of which only 60 to 80 percent have been adequately documented (NPS, 2006c). Within the project vicinity, 19 species were documented in 2005. GAAR contains the northernmost breeding and nesting habitat for several species, including Savannah sparrow, northern shrike, Lapland longspur, and common redpolls.

**Raptors**

Species within GAAR include four species of hawk, the northern harrier, Golden and Bald eagle, ospreys, gyrfalcon, peregrine falcon, merlin, kestrel, and seven species of owl. A 1991 raptor survey included sites on the Middle Fork of the Koyukuk, Kobuk, and Alatna Rivers, with the most active nests on the Noatak and Kobuk Rivers. Identified osprey nests were in closest proximity to the project corridor as several active and inactive nests were identified south of Walker Lake and along the Kobuk River, upstream of the Reed River.

A raptor survey was conducted in 2013 (Appendix 2H). This survey located osprey and peregrine falcon nests within the GAAR. Osprey nests were identified in spruce stands located along rivers and peregrine falcons were found to be nesting in cliff areas.

**Waterfowl**

Surveys were flown in 1997 just to the south of the project vicinity and identified an estimated 228,000 ducks, 4,000 geese, and 1,200 loons (USFWS, 1999). Other abundant species included scaup, green-winged teal, mallards, and shovelers.

Provide baseline data on concentrations of heavy metals in small mammals, lichen, particularly forage lichen species (*Cladonia*, *Cetraria*), and moss (*Hylocomium splendens*) prior to road construction.

The monitoring of voles and small-nesting birds subject to ingestion of fugitive dust near the DMTS road were tested for concentrations of heavy metals in their blood and livers. Animals captured near the road had approximately 20 times greater blood and liver lead concentrations and three times greater cadmium concentrations compared to reference sites. This study concluded the animals were not suffering from biological effects due to metals, but more monitoring was recommended (EPA, 2009).

No baseline studies of heavy metal concentrations on mammals, lichen, moss, or other vegetation species has been conducted to date within the project corridor. It is assumed the presence of any heavy metal concentrations is currently limited due to the remote and undeveloped nature of the area.

Mineral resources within the Ambler Mining District include copper, zinc, lead, gold, and silver deposits. Although mining, processing, transfer, and transport of these resources may produce dust containing minerals, fugitive dust emissions would be minimized through the implementation of best management practices on material handling, including the use of covered or sealed transport vehicles that eliminate or reduce ore concentrate losses during shipping activities.

Fish Populations

AIDEA contractors conducted anadromous fish surveys in the summers of 2012 – 2013 along the proposed corridor. Salmon and other anadromous fish have been previously documented within the project area in the Anadromous Waters Catalog (ADF&G, 2014a). These studies are attached as Appendix 2E. Additional fisheries and aquatic habitat studies were undertaken by ADF&G along the proposed corridor (ADF&G, 2015a; 2015b). The study reports are included in Appendix 2E.

While numerous tributaries to larger rivers are universally assumed to support/contain anadromous fish species, limited data is available on the exact distribution at the proposed river crossings. The 2012 and 2013 studies focused sampling efforts to examine anadromous species in sub-basins and watersheds within the corridor. The 2014 and subsequent studies will expand the knowledge of fish species present, their distribution, population dynamics, and habitat use in streams, lakes, and rivers potentially affected within the corridor.

From survey results collected in 2012 and 2013, eight species were observed within the project area including: Chinook (king) salmon (*Oncorhynchus tshawytscha*), coho (silver) salmon (*Oncorhynchus kisutch*), chum (dog) salmon (*Oncorhynchus keta*), Dolly Varden (*Salvelinus malma*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), burbot (*Lota lota*), and slimy sculpin (*Cottus cognatus*). For the purposes of these surveys, salmonids were classified as either known Pacific salmon or facultative anadromous, i.e. Dolly Varden char. Dolly Varden were assumed to be anadromous due to their potential to expand their range into marine waters.

The following is a summary of species common to northwest Alaska, and includes information collected in the 2012-2013 studies to document anadromous fish distribution within the main watersheds crossed by the proposed corridor.

General results for the 65 total surveys indicated the following prevalence of each species know to occur within the project corridor:

- Slimy Sculpin – 58%
- Arctic Grayling – 29%
- Dolly Varden – 23%
- Pacific Salmon – 22%

In total, seven sub-basins (Middle Kobuk River, Upper Kobuk River, Koyukuk Flats-Koyukuk River, Alatna River, Allakaket-Koyukuk River, Upper Koyukuk River, and the South Fork Koyukuk River) were surveyed.

**<u>Salmon</u>**:

While there are a total of five species of salmon, only Chinook (king), chum (dog), and coho (silver) were observed during fish surveys.

- Chinook Salmon
    - Juvenile salmon were observed in 3% of the surveys. The observed distribution for juveniles included Tobuk Creek, and an unnamed tributary to the Jim River.
    - Adult spawning salmon were observed in the Alatna River, as well as an unnamed tributary to the Alatna River.
- Chum Salmon
    - Juvenile salmon were observed in 6% of the surveys. The observed distribution for juveniles included the Mauneluk River, an unnamed tributary of the Mauneluk River, the Reed River, and an unnamed tributary to the Malamute Fork of the Alatna River.
    - Adult salmon were observed in 8% of the surveys. The observed distribution included an unnamed tributary of the Alatna River, an unnamed tributary to the Mauneluk River, the Reed River, the Kobuk River, and the Hogatza River.

- Coho Salmon
  - Juvenile salmon were observed in 9% of the surveys. The observed distribution for juveniles included unnamed tributaries of the Malamute Fork Alatna River, the Malamute Fork John River, Jim River, and Tobuk Creek.
  - No adult coho salmon were observed during 2012 surveys.
- Dolly Varden
  - Dolly Varden were observed in 23% of the surveys including the western portion of the survey area, with the easternmost extent in the Alatna River sub-basin in an unnamed tributary to Helpmejack Creek.
  - Juveniles were caught in 86% of the minnow traps.

**Sheefish**:

Sheefish (*Stenodus leucichthys*) are recognized as important to subsistence lifestyles in Interior Alaska and were specifically targeted for subsistence protection in ANILCA. Sheefish have been found throughout the Selawik, Kobuk, Kuskokwim, and Koyukuk Rivers. Sheefish use the Kobuk and Selawik rivers for feeding, migration, and spawning. Sheefish are also know to spawn in the Alatna River and may spawn in the Koyukuk River between Allakaket and Hughes (Alt, 1987). Most are estuarine anadromous, while a small number belong to local non-anadromous stocks.

**Grayling:**

Arctic grayling are widely distributed throughout the network of rivers and streams crossed by the proposed road. They prefer clear, fast moving tributary streams. Project studies documented grayling in several rivers along the project corridor. Grayling were identified in 2012 within tributaries of the Shungnak, Kogoluktuk, Mauneluk, Reed, Jim, Kobuk, Hogatza, Alatna, and South Fork Koyukuk Rivers, as well as Beaver and Sozhekla Creeks. Arctic Grayling prefer areas near springs and isolated deep pools in mountain streams for overwintering habitat.

**Whitefish**:

Whitefish are the most abundant group of fish north of the Alaska Range and includes several species: inconnu (*Stenodus leucichthys*), round (*Prospium cylindraceum*), pygmy (*Prosopium coulteri*), broad (*Coregonus nasus*), and humpback (*Coregonus pidschian*). Whitefish species are important to native communities as both a food source and as a food source for dogs. Whitefish have been documented on the mainstream of the Kobuk River, the Koyukuk River, and many other rivers, lakes, and streams in the study area. The Alatna River has been identified as a major spawning area for humpback and broad whitefish (USFWS, 2008).

Project changes to fish and fish habitat. Describe anticipated mitigations to fish impacts.

Minimal impacts to fish and fish habitat are anticipated to occur as a result of the project. Water crossings spanning lengths greater than 20 feet would be completed by the construction of bridges. Those bridges with spans greater than 140 feet would likely have piers placed within the waterway. Although this would result in short-term effects during construction, these would not be expected to adversely affect fish populations in the long-term  Water crossings less than 20 feet would be addressed with the placement of oversized culverts. For waterways to be crossed with culverts and which are deemed to be anadromous, the design would comply with ADF&G fish passage standards, which require prescribed velocities and capacities among other design factors.

Trucks hauling concentrate from the mining district to the Dalton Highway would be covered, as described previously, to prevent ore concentrate from escaping the haul trucks and to minimize the potential for adverse effects on streams from concentrate transport.

ADF&G would review proposed work in fish habitat and work would need to comply with ADF&G fish habitat permit stipulations to minimize and/or mitigate for impacts to fish habitat from construction activities and operations.

Provide baseline data on contaminant concentrations in fish species.

No corridor-wide baseline data on contaminant concentrations in fish has been found. However, the USFWS has conducted studies of contaminants in fish in nearby wildlife refuges in interior Alaska (Mueller, Snyder-Conn & Scannell, 1995; Mueller, Snyder-Conn & Scannell, 1996; Mueller & Matz, 2002). Different fish species appear to accumulate particular contaminants in different areas of their bodies, with some species collecting a specific contaminant (metal) in the liver while another accumulates the same metal in the kidneys. Several fish species studied are migratory species (arctic grayling, northern pike, and sheefish) and as such, assigning the origin of contaminants found within these species is not possible.

Mercury was consistently identified in fish regardless of the fish species and sample location; however, mercury concentrations were often within ranges reported for uncontaminated conditions. Arsenic, cadmium, and zinc concentrations in tissues were often determined to be low.

Provide a description and schedule of data to be collected on fish.

Field studies were conducted along the proposed corridor in the summer of 2012 and 2013 to identify fish species in streams and rivers and habitat types focusing on different species of Pacific salmon. Additional studies were conducted by ADF&G in 2014 and 2015. Fisheries study reports along the corridor are included in Appendix 2E.

(b) The proposed road would have no effect on marine mammals.

**19. State whether any hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any of the right-of-way facilities, or used I the construction, operation, maintenance or termination of the right-of-way or any of its facilities. "Hazardous material" means any substance, pollutant or contaminant that is listed as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601 et seq., and its regulations. The definition of hazardous substances under CERCLA includes any "hazardous waste" as defined in the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 U.S.C. 9601 et seq., and its regulations. The term hazardous materials also includes any nuclear or byproduct material as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq. The term does not include petroleum, including crude oil or any fraction thereof that is not otherwise specifically listed or designated as a hazardous substance under CERCLA Section 101(14), 42 U.S.C. 9601 (14), nor does the term include natural gas.**

The Ambler Mining District contains a very wide variety of mineral deposits that have been evaluated over many decades as detailed in a DOI Geological Survey 1977 Regional Alaska Mineral Resource Program publication on mineral resources in the Brooks Range (Grybeck, 1977). A variety of concentrates may be transported from the various mining prospects in the Ambler Mining District, including copper, lead, zinc, gold, silver and others.

Mineral deposits are heterogenic in mineral composition and physical form which complicates predicting precise product characterization. The published PEA on the Arctic deposit in the Ambler Mining District provides some information on components of the ore concentrates. Assay results on copper, lead and zinc concentrates at the Arctic deposit are presented here in Table 17.

**Table 17. Concentrate Assay Results from Arctic Deposit**

| **Composite** | **Copper Concentrate** | **Lead Concentrate** | **Zinc Concentrate** |
|---|---|---|---|
| Mercury | 1.9-9.8 | 2.7-4.5 | No Data |
| Arsenic | 82-4,040 | 114-11,640 | 89-1,310 |
| Antimony | 123-1,370 | 1,000-1,376 | 184-584 |
| Cadmium | 130-259 | 169-249 | 184-584 |
| Copper | N/A | 2.1-5.0 | 0.9-5.8 |
| Lead | 0.8-1.6 | N/A | 0.4-0.8 |
| Zinc | 2.7-4.9 | 2.4-4.7 | 0.4-0.8 |

Source: Tetra Tech, 2013.

Chemicals used in mining processes would be transported along the right-of-way. Again, a comprehensive list of chemicals that would be used over the life of the proposed access road is not possible to identify due to the wide variety of mineral deposits in the area and the correspondingly wide range of potential processes associated with these deposits. However, a list of chemicals often used in mineral processing has been included below:

- Copper sulfate
- Hydrochloric acid
- Lime
- Methyl isobutyl carbinol
- Sodium cyanide
- Sodium diisobutyldithiophosphinate
- Sodium isopropyl xanthate
- Sulfuric acid
- Zinc sulfate
- Adipic acid

**References Cited**

Abrahamson, Mali. 2013. Alaska's mining industry. *Alaska Economic Trends. Volume 33*, issue number 5, pages 4 – 11. Available at: *http://labor.state.ak.us/trends/may13.pdf*.

Adams, Layne G., Robert O. Stephenson, Bruce W. Dale, Robert T. Ahgook, and Dominic J. Demma. 2008.*Population Dynamics and Harvest Characteristics of Wolves in the Central Brooks Range, Alaska.* Wildlife Monographs 170:1-25, DOI: 10.2193/2008-12.

Alaska Department of Environmental Conservation (DEC). 2010. Alaska's Impaired Waters – 2010. Available at: *http://dec.alaska.gov/water/wqsar/Docs/2010impairedwaters.pdf*. Accessed on May 6, 2014.

Alaska Department of Fish & Game (ADF&G). 2008. *Alaska Department of Fish and Game Moose Management report of survey-inventory activities 1 July 2005-30 June 2007*. P. Harper, editor. Juneau, Alaska.

ADF&G. 2010. *Alaska Department of Fish and Game Furbearer management report of survey-inventory activities 1 July 2006-30 June 2009*. P. Harper, editor. Juneau, Alaska.

ADF&G. 2014a. Anadromous Waters Catalog. Available at: *http://extra.sf.adfg.state.ak.us/FishResourceMonitor/?mode=awc*.

ADF&G. 2014b. Arctic Fox (*Alopex lagopus*). Species Profile, Available at: *www.adfg.alaska.gov*.

ADF&G. 2015a. Fisheries and Aquatic Inventory of the Koyukuk, John and Wild Rivers, 2014. ADF&G Division of Habitat. Prepared by Heather L. Scannell. June 2015.

ADF&G. 2015b. Fisheries Investigations along the Proposed Ambler Road Corridor, 2014. Fishery Data Series No. 15-37. Prepared by Klaus G. Wuttig, Matthew L. Albert, April E. Behr, and James W. Savereide. November 2015.

Alaska Department of Labor and Workforce Development (ADLWD). 2014. Alaska Population Estimates by Borough, Census Area, City and Census Designated Place (CDP), 2010-2013. ADLWD Research and Analysis Section.

Alaska Minerals Commission. 2013. Report of the 2013 Alaska Minerals Commission. Available at: *http://commerce.alaska.gov/dnn/Portals/6/pub/mineralsreport2013.pdf*

Alaska Natural Heritage Program. 2013. *Alaska Species Ranking System Summary Report – Snowshoe hare*. Alaska Natural Heritage Program. Available at: *http://aknhp.uaa.alaska.edu/wp-content/uploads/2013/05/Lepus_americanus_report.pdf*

Alt, K.T. 1987. *Fishery Manuscript No. 3. Review of Sheefish (Stenodus leucichtys) Studies in Alaska*. Alaska Department of Fish and Game, Division of Sport Fish.

American Railway Engineering and Maintenance-of-Way Association (AREMA). 2011. *Practical Guide to Railway Engineering.*

Bergerud, A.T., R.D. Jakimchuk, and D.R. Carruthers. 1984. *The Buffalo of the North: Caribou (Rangifer tarandus) and Human Developments*. In Arctic, Volume 37, No. 1, p. 7-22. March 1984.

Berman, Matthew, PhD. 2014. *Suicide Among Young Alaska Native Men: Community Risk Factors and Alcohol Control.* American Journal of Public Health, published online ahead of print on April 22, 2014.

Bloomberg BNA. 2014. Incentives Watch: *Economic Development Director Discusses Alaska's Booming Mining Industry and Exploration Tax Credit*. SALT Talk Blog available at http://www.bna.com/incentives-watch-economic-b17179885869. March 19, 2014.

Bowden, W.B., A. Balser, A. Huyrn, C. Luecke, G. Burkart, J. Larouche, S. Parker, B.J. Peterson, and M. Flinn. 2009. *Aquatic biodiversity, community composition and ecosystem processes in upper Noatak River basin: Gates of the Arctic Park and Preserve and the Noatak National Park Preserve, Alaska.* Natural Resource Technical Report NPS/0000/NRTR—2009/00. National Park Service, Fort Collins, Colorado.

Braund, Stephen R. & Associates. 2012. *Ambler Mining District Access Project, Subsistence Data Gap Memo*, Prepared for the Alaska Department of Transportation and Public Facilities, Fairbanks, Alaska. May 2012.

Cowardin, L. M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Dau, J. 2011. Units 21D, 22A, 22B, 22C, 22D, 22E, 23, 24, and 26A caribou management report. Pages 187-250 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game. Juneau.

Dean, Fredrick C. and David L. Chesemore. 1974. *Studies of birds and mammals in the Baird and Schwatka Mountains, Alaska*. Biological Papers of the University of Alaska 15:1-80.

DiFolco, D. L. 1999. *Snowshoe Hare Abundance in the Wiseman Area of Gates of the Arctic National Park and Preserve, Alaska*. Seventh Annual Survey with 2004 Update and the New Study Plan.

DOT&PF. 2012. Meeting Summary: Public Meeting in Ambler, AK, March 15, 2012.

DOWL HKM. 2012. Ambler Mining District Access, Summary Report, AKSAS 63812. Prepared for the Alaska Department of Transportation and Public Facilities, Fairbanks, AK. May 2012.

Environmental Protection Agency (EPA). 2014. Watershed Assessment, Tracking and Environmental Results. Available at: http://oaspub.epa.gov/tmdl/attains_wb_history_au.control?p_assessment_unit_id=AK-40608-001_00&p_cycle=2010. Accessed on May 6, 2014.

EPA. 2009. *Red Dog Mine Extension, Aqqaluk Project, Final Supplemental Environmental Impact Statement*. Prepared by Tetra Tech, Inc., October 2009.

Exponent. 2002. *Draft Fugitive Dust Background Document DeLong Mountain Regional Transportation System, Alaska*. May 17, 2002. Prepared for Teck Cominco Alaska Incorporated and the Alaska Department of Environmental Conservation.

Fancy, Steve G. 1983. *Movements and Activity Budgets of Caribou Near Oil Drilling Sites in the Sagavanirktok River Floodplain*, Alaska. In Arctic, Volume 36, No. 2, p. 198-197. June 1983.

Fraser Institute. 2013. *Fraser Institute Annual Survey of Mining Companies 2012/2013*. Fraser Institute, Vancouver, British Columbia, Canada.

Grybeck, Donald. 1977. *Known Mineral Deposits of the Brooks Range, Alaska*. U.S Department of the Interior, Geological Survey. Open-file report 77-166C.

Haskell, Shawn P., Ryan M. Nielson, Warren B. Ballard, Matthew A. Cronin, and Trent L. McDonald. 2006. *Dynamic Responses of Calving Caribou to Oilfields in Northern Alaska*, In Arctic, Volume 59, No. 2, p. 1790190. June 2006.

Holt, Emily A. and Peter N. Neitlich. 2010. Lichen Inventory Synthesis, Western Arctic National Parklands and Arctic Network, Alaska. Natural Resource Technical Report NPS/AKR/ARCN/NRTR – 2010/385. National Park Service, Natural Resource Program Center, Fort Collins, Colorado. November 2010.

H.R. 39—96th Congress: Alaska National Interest Lands Conservation Act. 1979. In www.GovTrack.us. Accessed on April 3, 2014, from https://www.govtrack.us/congress/bills/96/hr39.

Larsen, A. S., and H. Kristenson. 2010. Alaska shallow lake monitoring program: 2009 annual report. Natural Resource Data Series NPS/AKRO/NRDS – 2010/119. NPS, Fort Collins, Colorado.

Lowe, Marie E. 2010. *Contemporary Rural-Urban Migration in Alaska*. Alaska Journal of Anthropology, Volume 8, Number 2.

Mueller, K.A., E. Snyder-Conn, and P.O. Scannell. 1995. *Metal and metalloid contaminants in water, sediments, fish, and mammals of Kanuti National Wildlife Refuge, Alaska, 1985-1990*. Ecological Services Fairbanks, AK, U.S. Fish and Wildlife Service, Technical Report NAES-TR-95-02. 127 pp.

Mueller, K.A., E. Snyder-Conn, and P.O. Scannell. 1996. *Water quality and metal and metalloid contaminants in sediments and fish of Koyukuk, Nowitna, and the northern unit of Innoko National Wildlife Refuges, Alaska, 1991*. Ecological Services Fairbanks, AK, U.S. Fish and Wildlife Service, Technical Report NAES-TR-96-03. 79 pp.

Mueller, K.A. and A.C. Matz. 2002. *Water quality and metal and metalloid concentrations in water, sediment, and fish tissues from Innoko National Wildlife Refuge, Alaska, 1995-1997*. U.S. Fish and Wildlife Service, Northern Alaska Ecological Services, Technical Report NAES-TR-02-01. 155 pp.

Myers-Smith, Isla H., Britt K. Arnesen, Ross M. Thompson, F. Stuart Chapin III. 2006. *Cumulative Impacts on Alaskan Arctic Tundra of a Quarter Century of Road Dust*. In Ecoscience 13(4): 503-510. 2006.

National Park Service (NPS). 1986. General Management Plan/Land Protection Plan/Wilderness Suitability Review, Gates of the Arctic National Park and Preserve, Alaska. November 1986.

NPS. 2006a. *2006 Aerial Moose Survey in the Upper Kobuk Drainage, Alaska. Natural Resource Report*. NPS/AR/NRTR—2006-057.

NPS. 2006b. *Mammal Inventory of Alaska's National Parks and Preserves*; Arctic Network Inventory & Monitoring Program. November 10, 2006

NPS. 2006c. Inventory of Montane-Nesting Birds in the Arctic Network of National Parks, Alaska. Arctic Network Inventory & Monitoring Program. National Park Service, Alaska Region.

NPS. 2010. *Dall's Sheep in Gates of the Arctic National Park and Preserve, Alaska. Natural Resource Data Series*. NPS/GAAR/NRDS—2011/198.

NPS. 2011. *Gates of the Arctic National Park and Preserve, Transportation Data and Visitor Projection Analysis. Final Report.* Prepared by URS Corporation for the National Park Service, Denver Service Center, Alaska Region, Gates of the Arctic National Park and Preserve. June 2011.

National Research Council (NRC). 2003. *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope*. Committee on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, Board on Environmental Studies and Toxicology, Polar Research Board, Division on Earth and Life Studies. The National Academies Press, Washington, D.C.

Neitlich, Peter and Linda Hasselbach. 1998. Lichen Inventory and Status Assessment for Gates of the Arctic National Park and Preserve, Alaska. GAAR-98-001. NPS, Gates of the Arctic National Park, Fairbanks, Alaska. January 15, 1998.

Northern Land Use Research Alaska (NLURA). 2013. Preliminary Report on Cultural Resources Fieldwork Conducted for the Ambler Mining District Access Project. Confidential Report for DOWL HKM. October 2013.

NLURA. 2014. Level I Cultural Resources Survey—2013, Ambler Mining District Industrial Access Road Project. Confidential Report for DOWL HKM. July 2014.

Pacific Northern Associates. 1998. Air Transport of Mined Metal Products in Northwest Alaska. Confidential Report for Kennecott Minerals. November 1998.

Rosgen, Dave. 1996. *Applied River Morphology*. Wildland Hydrology. Pagosa Springs, CO.

SRK Consulting. 2012. NI 43-101 Preliminary Economic Assessment, Ambler Project, Kobuk, Alaska. Report Prepared for NovaCopper, Vancouver, British Columbia, Canada. March 9, 2012.

Swanson, Shelli A. 1992. *Water Quality Sampling and Lake Bathymetry, Summer 1991*. GAAR-92-001, September 8, 1992.

Tetra Tech. 2013. Nova Copper Preliminary Economic Assessment Report on the Arctic Project, Ambler Mining District, Northwest Alaska.

U.S. Fish and Wildlife Service (USFWS). 1999. Water Bird Abundance and Distribution on Selawik National Wildlife Refuge and Noatak Lowlands, Alaska, 1996-1997. Robert M. Platte. Migratory Bird Management Project. February 8, 1999.

USFWS. 2008. Revised Comprehensive Conservation Plan. Kanuti National Wildlife Refuge. Prepared by Region 7, USFWS. September 2008.

U.S. Geological Survey (USGS). 2014. Watershed Boundary Dataset (Alaska). Available at: *http://water.usgs.gov/GIS/new_huc_rdb.txt*. Accessed on September 21, 2014.

Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. *The Alaska Vegetation Classification*. Gen. Tech. Rep. PNW-GTR-286. Portland, Oregon: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1992, 278pp.

Western Arctic Caribou Herd (WACH) Working Group. 2011. Western Arctic Caribou Herd Cooperative Management Plan - Revised December 2011. Nome, Alaska.

Western Regional Climate Center. 2014. Alaska Climate Summaries. Accessed on May 12, 2014 at *http://www.wrcc.dri.edu/summary/climsmak.html*.