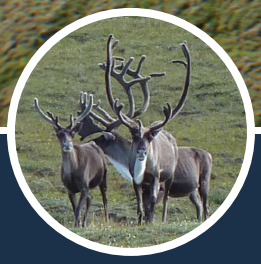


DRAFT

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT for the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth One Development Project

Volume 1: Chapters 1-7

BLM

Alaska

Cooperating Agencies:
U.S. Bureau of Ocean Energy Management • U.S. Environmental Protection Agency • U.S. Fish and Wildlife Service
U.S. Army Corps of Engineers, Alaska District • State of Alaska •North Slope Borough • Native Village of Nuiqsut

The Bureau of Land Management Today

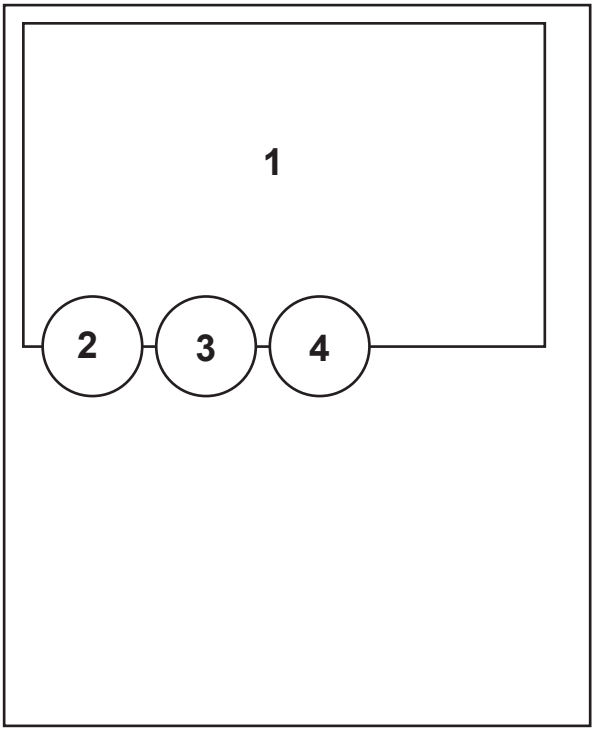
Our Vision

To enhance the quality of life for all citizens through the balanced stewardship of America's public lands and resources.

Our Mission

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

BLM/AK/PL-14/002+5101+AK9300



Cover Photos:

1. Aerial of Blackfish Creek downstream from GMT1 Drilling pad, National Petroleum Reserve in Alaska.

2. Caribou, North Slope, Alaska

3. Ice road construction, National Petroleum Reserve in Alaska.

4. Aerial of production pad, North Slope, Alaska. © ConocoPhillips.

Alpine Satellite Development Plan GMT1 Development Project

DRAFT

Supplemental Environmental Impact Statement

Volume 1: Chapters 1-7

Prepared by:

U.S. Department of the Interior
Bureau of Land Management
Anchorage, Alaska

In cooperation with:

U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. DOI Fish and Wildlife Service
U.S. DOI Bureau of Ocean Energy Management
State of Alaska
Native Village of Nuiqsut
North Slope Borough

February 2014

Alpine Satellite Development Plan
GMT1 Development Project
DRAFT Supplemental Environmental Impact Statement

Lead Agency U.S. Department of the Interior (USDOI), Bureau of Land Management (BLM)

Proposed Action: To provide ConocoPhillips Alaska, Inc. (CPAI) with legal access across public land managed by the BLM, and authorizations to construct, operate, and maintain a drill site, pipelines, an access road, and ancillary facilities to develop and produce petroleum resources on BLM-managed lands within the Greater Mooses Tooth Unit (GMTU) of the National Petroleum Reserve in Alaska (NPR-A).

Abstract: CPAI is proposing to produce hydrocarbon resources from a surface location on federal oil and gas lease AA-081798 in the NPR-A. The proposed GMT1 project includes a drill site in the GMTU, a pipeline and road corridor to CPAI facilities at Colville Delta 5 (CD5), an ancillary water pipeline between CD1 and CD4, and a new gravel source. CD1, CD2, CD3 and CD4 are existing facilities. CD5 is currently authorized and expected to be in operation by late 2015. Development of the GMT1 project is dependent upon construction of CD5.

This Draft Supplemental Environmental Impact Statement (SEIS) is being prepared to evaluate relevant new circumstances and information which have arisen since the Alpine Satellite Development Plan (ASDP) Final EIS was issued in September 2004, to provide opportunities for public participation, as well as to address changes to CPAI's proposed development plan for GMT1 (referred to as CD6 in the ASDP EIS).

GMT1 is part of the ASDP, for which a Final Environmental Impact Statement (EIS) was prepared by the BLM, with a Record of Decision (ROD) approving issuance of the BLM authorizations needed for development of the Alpine Field. The currently proposed GMT1 Development Project is very similar to the CD6 development approved for permitting in the 2004 ASDP ROD, with changes which reduce the overall impact. These changes include moving the drill site location out of the Fish Creek setback; reducing the road and pipeline length, thereby reducing amount of fill required and impacts to wetlands; and increasing the length of the Tiŋmiaqsiġvik (Ublutuoch) River bridge.

The BLM has lead responsibility for preparation of this Draft SEIS. The U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. DOI Fish and Wildlife Service, U.S. DOI Bureau of Ocean Energy Management, State of Alaska, Native Village of Nuiqsut, and the North

Slope Borough are participating in the analysis as Cooperating Agencies.

The Draft SEIS documents the potential effects to: Physiography, Geology, Soils and Permafrost, Sand and Gravel, Paleontological Resources, Water Resources, Surface Water Quality, Climate and Meteorology, Air Quality, Noise, Terrestrial Vegetation and Wetlands, Fish, Birds, Terrestrial Mammals, Marine Mammals, Threatened and Endangered Species, Socio-cultural Environment, State and Local Economy, Subsistence Harvest and Uses, Environmental Justice, Cultural Resources, Land Use, Recreation, Visual Resources, and Transportation. The potential effects of spilled crude oil produced fluids, seawater, and other chemicals have also been evaluated.

This Draft SEIS provides documentation of the analysis of the proposed action and alternatives, based upon issues and concerns identified through the scoping process and meetings of the cooperating agencies.

Further Information: Contact Bridget Psarianos of the Bureau of Land Management, at (907-271-4208) or visit the SEIS website at www.blm.gov/ak.

Comments Comments on issues related to the GMT1 Draft SEIS may be submitted by:

Email: gmt1comments@slrconsulting.com

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Mail: GMT1 Draft SEIS Comments
222 West 7th Avenue, Stop #13
Anchorage, AK 99513.

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Appendix K: GMT1 Air Quality Impact Analyses

Appendix L: ANILCA Section 810 Analysis of Subsistence Impacts

Acronyms

$\mu g/m^3$	micrograms/cubic meter
^0F	degrees Fahrenheit
AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
AAC	Alaska Air Quality Control Regulation
ABR	ABR Inc.
AC	Alaska Commercial Company
ACP	Arctic Coastal Plain
ACS	Alaska Clean Seas
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOR	Alaska Department of Revenue
ADP	Alpine Development Project
AES	ASRC Energy Services, Inc
AHRS	Alaska Heritage Resource Survey
Anadarko	Anadarko E&P Onshore LLC
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
AO	Authorized Officer
AOGCC	Alaska Oil and Gas Conservation Commission
APDES	Alaska Pollutant Discharge Elimination System
APF	Alpine Central Processing Facility
AQRV	Air Quality Related Values
ASDP	Alpine Satellites Development Project
ASH	Alaska Safety Handbook
ASME	American Society of Mechanical Engineers
ASOS	Automated Surface Observing System
ASRC	Arctic Slope Regional Corporation
ATV	All Terrain Vehicle
BLM	Bureau of Land Management
BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management
BOPD	Barrels of oil per day
BPMSL	BP mean sea level
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAH	Central Arctic Herd

CD	Colville Delta
CDSA	Colville Delta Study Area
CEQ	Council on Environmental Quality
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System
CFR	Code of Federal Regulations
CO	Carbon Monoxide
Corps	U.S. Army Corps of Engineers
CPAI	ConocoPhillips Alaska, Inc.
CPF	Central Production Facility
CPU	Coastal Plain Unit
CRU	Colville River Unit
CWA	Clean Water Act
cy	cubic yards
DAT	Deposition Analysis Threshold
dBA	A weighted decibel(s)
DEW	Distant Early Warning
DO	Dissolved Oxygen
DOI	Department of Interior
DPS	Distinct Population Segment
ddv	delta deciview
dv	deciview
EA	Environmental Assessment
EDMS	Emissions and Dispersion Modeling System
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency (for reference as author)
ERD	extended reach drilling
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLIR	forward-looking infrared
FLPMA	Federal Land Policy and Management Act
FOD	Frequency of Detection
FRP	Facility Response Plan
ft	feet
FWTAP	Foothills West Transportation Access Project
GC	Gathering Center

GHG	Green House Gases (e.g., carbon dioxide [CO2], methane, nitrous oxide)
GIS	geographic information system
GMT	Greater Mooses Tooth
GMTU	Greater Mooses Tooth Unit
gpd	gallons per day
GPS	Global positioning system
HMRT	Hazardous Materials Response Team
HSM	Horizontal Support Member
IAP	Integrated Activity Plan
ICAS	Iñupiat Community of the Arctic Slope
IDLH	Immediately Dangerous to Life or Health
IHLC	Iñupiat History, Language, and Culture
IMPROVE	Integrated Monitoring of Protected Visual Environments
in	inch
ISO	International Organization for Standardization
ITU	Integrated Terrain Unit
km	kilometer
KSOPI	Kuukpik Subsistence Oversight Panel, Inc.
LOA	Letter Of Authorization
MBTA	Migratory Bird Treaty Act
MEI	Maximally Exposed Individual
MG	million gallons
mg/m^3	micrograms/cubic meter
MI	Miscible Injectant
MLE	Most Likely Exposure
MMbbl	million barrels
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MPH	Miles per Hour
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NAC	Northern Air Cargo
NASA	NPR-A Study Area
NDE	Non-destructive Examination
NDVI	Normalized Difference Vegetation Index
NE	North East
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Services
NMIM	National Mobile Inventory Model
NO2	Nitrogen Dioxide

NOAA	National Oceanic and Atmospheric Administration
NOX	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System
NPR-A	National Petroleum Reserve-Alaska
NPRPA	Naval Petroleum Reserves Production Act
NPS	National Park Service
NRC	National Research Council
NSB	North Slope Borough
NVN	Native village of Nuiqsut
NWI	National Wetlands Inventory
OCS	Outer Continental Shelf
ODPCP	Oil Discharge Prevention and Contingency Plan (C-Plan)
OHA	Office of History and Archaeology (Alaska DNR)
ORV	Off-road Vehicle
OSHA	Occupational Safety and Health Administration
Pb	Lead
PCH	Porcupine Caribou Heard
PM_{10}	Particulate Matter <10 microns
$PM_{2.5}$	Particulate Matter < 2.5 microns
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
REIM	Remote Electrical and Instrumentation Module
REL	reference exposure level
RFD	Reasonable Future Development
ROD	Record of Decision
ROP	Required Operating Procedure
ROS	Recreation Opportunity Spectrum
ROW	Right of Way
RPS	Response Planning Standard (C-Plan)
SAP	Subsistence Advisory Panel
SDWA	Safe Drinking Water Act
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SLR	SLR International Corporation
SNAP	Scenarios Network for Alaska Planning
SO_2	Sulfur Dioxide
SPCC	Spill Prevention Control and Countermeasures
SPM	Semi-primitive, motorized

sq km	square kilometer
SRB&A	Stephen R. Braund & Associates
SWPPP	Storm Water Pollution Prevention Plan
TAPS	Trans Alaska Pipeline System
TH	Teshekpuk Herd
TLUI	Traditional Land Use Inventory
TRS	Total Reduced Sulfides
TWUP	Temporary Water Use Permit
UIC	Underground Injection Control
ULSD	Ultra Low Sulfur Diesel
UM	Umiat Meridian
USC	United Sates Code
USCG	United States Coast Guard
USDOI	U.S. Department of the Interior
USDOT	United States Department of Transportation
USEPA	U.S. Environmental Protection Agency (for reference as author)
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compounds
VRM	Visual Resource Management
VSM	Vertical Support Members
WAH	Western Arctic Herd
WQS	Water Quality Standards
WRF	Weather Research and Forecasting Model

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CHAPTER 1: INTRODUCTION

In July 2013, ConocoPhillips Alaska, Inc. (CPAI), as Operator and working interest owner in the Greater Mooses Tooth Unit (GMTU), filed applications for permits to develop hydrocarbon resources of the GMTU from a surface location on a federal oil and gas lease in the National Petroleum Reserve in Alaska (NPR-A).

The proposed Greater Mooses Tooth 1 (GMT1) Development Project includes a drill site on federal land in the GMTU, access road and pipelines on federal and private land in the NPR-A, and a pipeline and piperack on private and state lands outside the NPR-A. GMT1 was formerly known as Colville Delta 6 (CD6) development production pad, one of the five drill sites comprising the Alpine Satellite Development Plan (ASDP), for which a Final Environmental Impact Statement (EIS) was prepared by the U.S. Department of the Interior (USDOI) Bureau of Land Management (BLM). The 2004 ASDP Record of Decision (ROD) approved issuance of the BLM authorizations needed for development of the satellites. After 2004, it was determined that satellites CD6 and CD7 were not located in the same reservoir as CD3, CD4, and CD5. In 2008, a new unit (GMTU) was formed within the NPR-A, and CD6 and CD7 became known as GMT1 and GMT2, respectively.

Recently, the BLM completed an EIS to fulfill the requirements of the National Environmental Policy Act of 1969 (NEPA) for approving a new Integrated Activity Plan (IAP) for the NPR-A, including oil and gas lease sales and associated development. Several alternative development scenarios were evaluated, and the related environmental consequences were analyzed. Reasonably foreseeable development that could occur from discovered petroleum resources in the GMTU was consistently considered in all development alternatives, including the alternative adopted by the 2012 NPR-A IAP and 2013 IAP ROD.

The currently proposed GMT1 Project is essentially the same as that approved for permitting in the 2004 ASDP ROD, and evaluated in the 2012 NPR-A IAP/EIS, with changes which reduce the overall impact. These changes include: moving the drill site location out of the Fish Creek setback; reducing the road and pipeline length, and thereby reducing the amount of fill required and associated impacts to wetlands; and increasing the length of the Tiŋmiaqsiġvik (Ublutuoch) River bridge. There is no application for development of GMT2; accordingly, information on GMT2 is conceptual and is considered only in the cumulative analysis.

This Supplemental EIS (SEIS) will assist the BLM and other federal, state and North Slope Borough agencies in evaluating CPAI's permit applications for this project by considering relevant new information or circumstances to determine whether the effects of the proposed GMT1 Project are still within the range of effects analyzed in the BLM 2004 ASDP Final EIS and the BLM 2012 NPR-A IAP/EIS. The SEIS will re-analyze the proposed project in accordance with the requirements of NEPA (42 United States Code [USC] 4321, et seq.) as implemented by Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] 1500-1508).

1.1 Project Location and Land Status

The proposed GMT1 Project is located on the North Slope of Alaska within the NPR-A, immediately to the west of the Colville River Delta. The proposed GMT1 drill site and gravel source are wholly on federal lands within the northeastern portion of the NPR-A. The proposed road and pipeline corridors cross both federal lands and private lands held by the Kuukpik

Corporation (Nuiqsut Village Corporation) within the NPR-A (Figure 1.1-1). The northern portion of the pipeline corridor between CD1 and CD4 North (an area of intersecting pipeline segments north of CD4 known as CD4N) is on land owned by the State of Alaska, and managed by the Alaska Department of Natural Resources (ADNR). Kuukpik owns land along the southern portion of the pipeline corridor between CD1 and CD4N and from CD4N to CD5. None of the proposed project facilities are located on or near Native Allotments.

The proposed GMT1 drill site is located in the GMTU on federal lease AA-081798, issued by the BLM to CPAI and Anadarko E&P onshore LLC (Anadarko), the other working interest owner in the GMTU. Location of lease AA-081798 and the GMTU boundaries are shown on Figure 1.1-1.

The 2008 GMTU Agreement (BLM No. AA-087852) was entered into by CPAI, Anadarko, and Arctic Slope Regional Corporation (ASRC); ASRC has applied for subsurface estate within the GMTU for lands selected by Kuukpik Corporation under the Alaska Native Claims Settlement Act (ANCSA), 43 U.S.C. 1601 et seq., and Section 1431(o) of the Alaska National Interest Lands Conservation Act (ANILCA). The GMTU was expanded in September 2009 to include leases east of the original unit area.

The GMTU Agreement identifies Participating Area boundaries (Figure 1.1-1). These boundaries demonstrate the leases or areas of leases (tracts) which are expected to contribute a portion of the production from each reservoir to the agreement. In the GMTU, where only exploration drilling has occurred at this point, these boundaries represent a theoretical interpretation of the reservoir locations. As geophysical data is evaluated, exploration and production wells are drilled, and the physical extents of each reservoir are discovered, enough information is collected to reasonably determine which leases should be included in a Participating Area. These boundaries are used by BLM to allocate production for royalty purposes to each committed tract within the participating area. Royalties are calculated using the allocation method agreed to in the unit agreement. See 43 CFR Section 3131.81.

ASRC has assumed administration of some leases on Kuukpik land in the NPR-A pursuant to 43 CFR 3135.1-8(b). Pursuant to 43 CFR 3135.1-8(c), the lease terms and conditions continue to apply to the lessee; however, only ASRC (as the new lessor) may enforce the lease stipulations on the conveyed lands; BLM no longer has jurisdiction to do so. Best Management Practices (BMPs) likewise apply on BLM-managed lands only, but may be enforced by ASRC.

1.2 History of Operations in the Area

In 1923, the 23 million acre Naval Petroleum Reserve Number 4 (Pet-4) was created by President Warren G. Harding via Executive Order (EO) 3797 to protect a future oil supply for the Navy. In 1976, the Naval Petroleum Reserves Production Act (NPRPA) renamed Pet-4 as the NPR-A and transferred management to the Secretary of the Interior. In 1980, Congress authorized petroleum production in the NPR-A and directed the USDOI to undertake “an expeditious program of competitive leasing of oil and gas” in the Reserve (P.L. 96-514). Several lease sales were held in the early 1980s, and one exploration well was drilled.

Interest in leasing within the NPR-A lagged until the mid-1990s, when development on adjacent state lands made exploration in the NPR-A an economical option. To pursue this renewed interest, the BLM developed an Integrated Activity Plan (IAP) and associated EIS, assessing potential use of the Northeast NPR-A for oil development. The IAP/EIS was completed in August 1998, with a ROD signed in October 1998, making approximately 87 percent (4 million acres) of the Northeast planning area available for oil and gas leasing. Lease

AA-081798 was issued under the 1998 ROD and included numerous stipulations to protect habitat, subsistence use areas, and other resources in the planning area.

CPAI's first exploration program on leases obtained under the 1998 lease sale included the Lookout prospect. Exploration was authorized by BLM, based on a program-specific Environmental Assessment (EA) (EA: AK-020-00-011) tiered to the 1998 IAP/EIS. Results of exploration indicated that developable reserves exist at Lookout. Lookout was subsequently planned for development as a satellite to CPAI's Alpine Development Project (ADP) in the Colville River Unit (CRU) and the associated drill site was named CD6. Development of the ADP began with construction of the Alpine CD1 and CD2 drilling sites and associated facilities. Oil production from CD1 commenced in November 2000 and from CD2 in November 2001.

In total, the ASDP included five satellite developments (CD3 through CD7) as potential extensions of the ADP. These satellites were planned to bring 3-phase (oil, water, and gas) hydrocarbon production to the Alpine Central Processing Facility (APF) at CD1 for processing and transport via the existing APF and Kuparuk common carrier oil pipelines to the Trans-Alaska Pipeline System (TAPS).

In January 2003, the BLM and cooperating agencies (U.S. Army Corps of Engineers [Corps] the U.S. Environmental Protection Agency [EPA], the U.S. Coast Guard [USCG], the State of Alaska [State], and the North Slope Borough [NSB]) initiated the ASDP EIS for the five proposed drill sites. The Final EIS was issued in September 2004. In November 2004, the Secretary of the Interior issued a ROD which approved the two satellites on federal lands (CD6 and CD7). CD3 was subsequently constructed on State of Alaska lands and CD4 was constructed on Kuukpik land. Production began at those sites in 2006. After a lengthy permit review process, including relocation of the drill site, the Corps issued a permit for CD5 development on Kuukpik land, which is expected to be in operation by late 2015. Development of the GMT1 Project is dependent upon construction of CD5.

While the CD5 approval was in process, it was established that the two satellites on federal land (CD6 and CD7) were not located in the same reservoir as CD1, CD2, CD3, CD4, and CD5. As a result, CPAI requested that the BLM designate and approve the proposed Unit Area so CPAI could perform exploration and development operations in an efficient and logical manner under a unit plan of development. CD6 was renamed to GMT1 after it was determined that it would not be part of the CRU and would be in the newly established GMTU.

1.3 Purpose and Need for the Project

The purpose of the proposed GMT1 Project is to construct a drill site, access road, pipelines, and ancillary facilities to support development of petroleum reserves within the GMTU. The project will produce 3-phase hydrocarbons (oil, gas, and water) which will be carried by pipeline to the APF at CD1 for processing. Sales quality crude oil produced at the APF will be transported from CD1 via the existing Alpine Sales Oil Pipeline and Kuparuk Pipeline to the TAPS for shipment to market.

Under the NPRPA, the Secretary is required to conduct oil and gas leasing and development in the NPR-A (42 USC § 6506a). The Department of the Interior and Related Agencies' Fiscal Year (FY) 1981 Appropriations Act specifically directs the Secretary to undertake "an expeditious program of competitive leasing of oil and gas" in the Petroleum Reserve. The GMT1 Project helps satisfy the purpose to develop oil and gas resources in the NPR-A. Specifically, the NPRPA, as amended, encourages oil and gas leasing in the NPR-A while requiring protection of

important surface resources and uses. EO 13212 (May 2001) directs federal agencies to give priority to energy-related projects: "For energy-related projects, agencies shall expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections."

Development and production of hydrocarbons from GMT1 will help offset declines in production from the Alaskan North Slope. Development will also provide benefits to local, state, and national economies through local hire for jobs created during construction and operations, tax revenues, revenue sharing, royalties, and new resources to help meet US domestic energy demand.

1.4 Purpose and Need for Federal Action

The CEQ regulations direct that an EIS "shall briefly specify the underlying purpose and need to which the agency is responding …" (40 CFR 1502.13). The agency purpose and need for action triggers the NEPA analysis, and also dictates the range of alternatives and provides a basis for the rationale for eventual selection of an alternative and making a decision (BLM 2008c). This document brings together the evaluation needs of the BLM, Corps, and other federal agencies.

The purpose of the BLM federal action is to provide CPAI with legal access across public land managed by the BLM and authority to construct, operate, and maintain drill sites, pipelines, an access road, and ancillary facilities to develop and produce petroleum resources on BLM-managed lands within the GMTU of the NPR-A, for which CPAI holds federal oil and gas leases issued by BLM.

The purpose and need of the Corps federal action is founded in the regulations of two laws: NEPA and the Clean Water Act (CWA). Under NEPA, the purpose and need for federal action is to issue a permit pursuant to the CWA to place fill into waters of the U.S., including wetlands, as necessary to construct, operate and maintain drill sites, pipelines, an access road, and ancillary facilities to develop and produce petroleum resources within the GMTU. Under Section 404(b)(1) Guidelines, the Corps has a *basic purpose* to determine whether the proposed project is water dependent. Then, the Corps has an *overall purpose* that, based on the Applicant's purpose and need, serves as the basis for identifying practicable alternatives to the applicant's proposed project (see further discussion in Section 2.2). By this definition, the overall purpose is to produce liquid hydrocarbons from the GMTU.

The need for the action is established by the federal agencies' responsibilities under various federal statutes including the Mineral Leasing Act, NPRPA, and the CWA to respond to CPAI's requests for a right-of-way grant, drilling permits, fill material discharge permit, and other related authorizations to develop and produce petroleum in the GMTU.

The BLM, the Corps, and other authorizing federal agencies will decide whether or not to approve the respective proposed federal authorizations, and if so, under what terms and conditions. Although this SEIS considers the reasonably expected impacts of the GMT1 development on Kuukpik, ASRC, and State owned surface and subsurface estates, these non-federal entities are responsible for land management decisions on their respective lands.

This SEIS has been developed to supplement the 2004 ASDP EIS, focusing on the changes that have occurred in the interim to the project design, the affected environment, and the regulatory framework in order to provide sufficient information for BLM and other federal agencies to fulfill their NEPA responsibilities.

1.4.1 Support for Federal Decisions

In proposing to undertake an action (e.g., issue a permit), federal agencies are required under NEPA to analyze the reasonably foreseeable probable environmental impacts from a proposed project and a reasonable range of alternatives, including a decision to take no action. If more than one federal agency is involved in a related action, a single NEPA document may be developed to meet the requirements of all federal agencies. Typically, as with this project, one agency is designated as the lead agency with other agencies serving as cooperating agencies.

1.4.2 Laws, Regulations, and Permits

Requirements of federal, state, and local laws and regulations associated with development activities in the NPR-A were discussed in detail in the ASDP Final EIS (2004, §§ 1.1.3-1.1.4) and the NPR-A IAP/EIS (2012, §§ 1.8-1.9), which are incorporated by reference. A summary is provided below.

Comprehensive planning and management of oil and gas leasing, exploration, and future development in the NPR-A have been addressed in a series of documents, including the: NPR-A Final Environmental Assessment Federal Oil and Gas Lease Sale (BLM 1981); Oil and Gas Leasing in the National Petroleum Reserve in Alaska, Final EIS (BLM 1983); Northeast NPR-A IAP/EIS (BLM 1998b); Northeast NPR-A Final Amended IAP/EIS (BLM 2005); Northeast NPR-A Final Supplemental IAP/EIS (BLM 2008b); and NPR-A Final IAP/EIS (BLM 2012).

1.4.2.1 Lead and Cooperating Agency Authorities

As the federal manager of the NPR-A, the BLM is responsible for land-use authorizations on federal land in the NPR-A. Upon completion of the SEIS process, the BLM will make decisions regarding CPAI's proposal. The authority for management of the land and resource development options presented in the SEIS comes from several statutes including NEPA, the Federal Land Policy and Management Act (FLPMA), the Federal Oil and Gas Royalty Management Act of 1982, the Minerals Leasing Act, the Naval Petroleum Reserves Production Act of 1976 (NPRPA), as amended, Department of the Interior Appropriations Act Fiscal Year 1981 (P.L. 96-514), which amended the NPRPA, and Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). These BLM authorities are further described below:

- NEPA sets out policy and provides the means by which the federal government, including both the BLM and the federal cooperating agencies, examines major federal actions that may have significant effects on the environment, such as the authorization of oil and gas development contemplated in this SEIS (42 USC § 4231 et seq.).
- Under the FLPMA, the Secretary of the Interior has broad authority to regulate the use, occupancy, and development of public lands and to take whatever action is required to prevent unnecessary or undue degradation of public lands (43 USC § 1732). In accordance with the FLPMA, the BLM manages its lands and their uses to ensure healthy and productive ecosystems.
- The proposed action helps satisfy the purpose of the NPRPA to explore and develop oil and gas resources in the NPR-A. Specifically, the NPRPA, as amended, requires oil and gas leasing in the NPR-A while also requiring protection of important surface resources and uses.
- The NPRPA provides the Secretary of the Interior with the authority to: protect "environmental, fish and wildlife, and historical or scenic values" in the Reserve [42 USC

§ 6503(b)]; and provide "conditions, restrictions, and prohibitions as the Secretary deems necessary or appropriate to mitigate reasonably foreseeable and significantly adverse effects on the surface resources of the National Petroleum Reserve in Alaska" [42 USC § 6506a(b)].

- Title VIII of ANILCA establishes procedures for federal land managing agencies to evaluate impacts on subsistence uses and needs and means to reduce or eliminate such impacts (16 USC § 3120).
- The Mineral Leasing Act (MLA) (30 USC § 185; 43 CFR Part 2880), provides BLM with the authority to issue right-of-way grants for oil and natural gas pipelines and related facilities (not authorized by appropriate leases). Pursuant to this right-of-way grant, BLM will attach appropriate requirements for the construction, operation, maintenance and reclamation of the proposed pipeline between CD5 and GMT1.

The Corps has the authority to issue or deny permits for placement of dredge or fill material in the waters of the United States, including wetlands (which incorporate the vast majority of the project study area) and for work and/or structures in, on, over, or under navigable waters of the United States. Consequently, Corps authority extends, and its decisions following completion of the SEIS will extend, to CPAI's entire proposal, regardless of who owns the land. These Corps authorities are set forth under:

- Section 404 of the CWA (33 USC § 1251 et seq.), the Corps regulates placement of dredge and fill material in waters of the United States, including wetlands. The proposed project is located in an area that is entirely comprised of wetlands that are within the Corps' jurisdiction.
- In accordance with 33 CFR 332.1(c)(3), "compensatory mitigation for unavoidable impacts may be required to ensure that an activity requiring a section 404 permit complies with the Section 404(b)(1) Guidelines." Pursuant to this authority, the Corps will require compensatory mitigation calculated based on the entire functional value of each acre of the direct project footprint, plus an additional multiple of lost functional value associated with impacts to the aquatic ecosystem surrounding the project footprint.
- Section 10 of the Rivers and Harbors Act (33 USC § 401), the Corps has regulatory authority for work and structures performed in, on, over, or under navigable waters of the United States.

The EPA authority to regulate oil and gas development is contained in the CWA (33 USC § 1251 et seq.), Clean Air Act (CAA) (42 USC § 7401 et seq.), and the Safe Drinking Water Act (SDWA) (42 USC § 300f et seq). Like the authority of the Corps, the EPA's authority extends, and its decisions following completion of the SEIS will extend, to CPAI's entire proposal, regardless of who owns the land. These authorities are under:

- Section 402 of the CWA (33 USC § 1251 et seq.), the State of Alaska is delegated authority to issue permits for facilities operating within state jurisdiction of permits issued for the discharge of pollutants from a point source into waters of the United States for facilities, including oil and gas facilities. Point-source discharges that require an APDES permit include, but are not limited to, sanitary and domestic wastewater, gravel pit and construction dewatering, and hydrostatic test water, storm water discharges, etc. (40 CFR 122).

- Section 404 of the CWA (33 USC § 1251 et seq.), the EPA reviews and comments on Corps Section 404 permit applications for compliance with the Section 404(b)(1) guidelines and other statutes and authorities within its jurisdiction (40 CFR 230).
- The SDWA (42 USC § 300f et seq), the EPA's responsibilities include the management of the Underground Injection Control (UIC) program and the direct implementation of Class I and Class V injection wells in Alaska for injection of non-hazardous and hazardous waste through a permitting process for fluids that are recovered from down hole, as well as municipal waste, stormwater, and other fluids that did not come up from down hole (40 CFR 124A, 40 CFR 144, 40 CFR 146). The EPA oversees the Class II program delegated to the State of Alaska that is managed by the Alaska Oil and Gas Conservation Commission (AOGCC), which includes Class II enhanced oil recovery, storage, and disposal wells that may receive non-hazardous produced fluids originating from down hole, including muds and cuttings (40 CFR 147).
- Sections 165 and 502 of the CAA (42 USC § 7401 et seq.), the State of Alaska is delegated authority to issue air quality permits for facilities operating within state jurisdiction for the Title V operating permit (40 CFR 70) and the Prevention of Significant Deterioration (PSD) permit (40 CFR 52.21) to address air pollution emissions. The USEPA maintains oversight authority of the state's program.
- Section 311 of the Federal Water Pollution Control Act of 1972, as amended (CWA; 33 USC § 1321;40 CFR part 112) requires a Spill Prevention Containment and Countermeasure (SPCC) Plan for storage of over 660 gallons of fuel in a single container or over 1,320 gallons in aggregate aboveground tanks.
- The CWA as amended (Oil Pollution Act; 33 USC Chapter 40); (FRP Rule; 40 CFR Part 112, Subpart D, §§ 112.20 and 112.21) requires a Facility Response Plan (FRP) to identify and ensure the availability of sufficient response resources to respond to the worst case discharge of oil to the maximum extent practicable, "…generally for facilities that transfer over water to or from vessels, and maintaining a capacity greater than 42,000 gallons, or any facility with a capacity of over one million gallons."
- 40 CFR parts 1500-1508 and Section 309 of the CAA (42 USC § 7609) requires a review and evaluation of the Draft and Final EIS for compliance with CEQ guidelines.

The USFWS decisions to be made are centered on its responsibilities in enforcing the Endangered Species Act (ESA; including marine mammal and bird species subject to the Act). Specifically, the USFWS will provide consultation (recommendation) as required under Section 7 of the Act. The USFWS also provides consultation under the Fish and Wildlife Coordination Act regarding effects to fish and wildlife resources.

BOEM's Office of Environmental Programs conducts NEPA analyses and compliance documents for each major stage of energy development planning related to offshore oil and gas development. BOEM will not issue permits associated with this project; however, BOEM has provided subject matter expertise in its review of this NEPA document. The Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, established under EO 13580, adopted the concept of Integrated Arctic Management to ensure development and conservation decisions made in the arctic are driven by science, stakeholder engagement, and government coordination. BOEM's participation as a cooperating agency furthers these goals by enabling coordinated government efforts on natural resource development planning in the arctic.

In addition to the statutory authorities described above, a number of EOs apply to all federal agencies. These include: EOs 11988 (Floodplain Management), 11990 (Protection of Wetlands), 12898 (Environmental Justice), 13075 (Tribal Consultation), and 13112 (Invasive Species Control).

The State and the NSB require permits for certain activities within the NPR-A. The NSB, as a Home Rule Borough, issues development permits and other authorizations for oil and gas activities under the terms of its ordinances (NSB Municipal Code Title 19).

The State has responsibility for issuance of several permits. Alaska's Department of Natural Resources issues temporary water use and water rights permits, cultural resources concurrences, and other authorizations for activities associated with oil and gas development. The Alaska Department of Fish and Game (ADF&G) issues fish habitat permits. Under their state implementation plan, the Alaska Department of Environmental Conservation (ADEC) issues prevention of significant deterioration and other air quality permits. The ADEC is responsible for issuing several permits and plan approvals for oil and gas exploration and development activities, including the storage and transport of oil and cleanup of oil spills. The Alaska Oil and Gas Conservation Commission (AOGCC) is responsible for issuing drilling permits and for production, injection, and disposal plan approvals for exploration and development activities in the State of Alaska (BLM 2012, p. 13). Additional State authorities are presented below.

ADNR:

- Issues Rights-of-Way (ROW) and Land Use permits for use of state land, ice road construction on state land, and state freshwater bodies under AS 38.05.850.
- Issues a Temporary Water Use and Water Rights permit under AS 46.15 for water use necessary for construction and operations.
- Issues a Cultural Resources Concurrence for developments on state land (but not federal land) that may affect historic or archaeological sites under the National Historic Preservation Act of 1966, as amended (16 USC § 470 et seq.), and the Alaska Historic Preservation Act (AS 41.35.010 through .240).

ADEC:

- Issues a Certificate of Reasonable Assurance for discharge of dredged and fill material into U.S. waters under section 401, Federal Water Pollution Control Act of 1972, as amended in 1977 (CWA; 33 USC § 1341); AS 46.03.020; 18 AAC chapters 15, 70, and 72.
- Issues a Certificate of Reasonable Assurance/NPDES and Mixing Zone Approval for wastewater disposal into all state waters under section 402, Federal Water Pollution Control Act of 1972, as amended (CWA; 33 USC § 1342); AS 46.03.020, .100, .110, .120, and .710; 18 AAC chapters, 10, 15, and 70, and; § 72.500.
- Issues a Class I well wastewater disposal permit for underground injection of non-domestic wastewater under AS 46.03.020, .050, and .100.
- Reviews and approves all public water systems including plan review, monitoring program, and operator certification under AS 46.03.020, .050, .070, and .720, 18 AAC § 80.005.
- Approves domestic wastewater collection, treatment, and disposal plans for domestic wastewaters (18 AAC Chapter 72).

- Approves financial responsibility for cleanup of oil spills (18 AAC Chapter 75).
- Reviews and approves the Oil Discharge Prevention and Contingency Plan (ODPCP) and the Certificate of Financial Responsibility for storage or transport of oil under AS 46.04.030 and 18 AAC Chapter 75. The State review applies to oil exploration and production facilities, crude oil pipelines, oil terminals, tank vessels and barges, and certain non-tank vessels.
- Issues a Title V Operating Permit and a PSD permit under Clean Air Act Amendments (Title V) for air pollutant emissions from construction and operation activities (18 AAC Chapter 50).
- Issues APDES permits under section 402, Federal Water Pollution Control Act of 1972, as amended (CWA; 33 USC § 1342) for discharges into waters of the U.S.
- Issues solid waste disposal permit for state lands under AS 46.03.010, 020, 100, and 110; AS 46.06.080; 18 AAC § 60.005; and 200.
- Reviews and approves solid waste processing and temporary storage facilities plan for handling and temporary storage of solid waste on Federal and state lands under AS 46.03.005, 010, and 020; and 18 AAC § 60.430.
- Approves the siting of hazardous waste management facilities.

ADF&G:

- Issues Fish Habitat Permits under AS 16.05.871 and AS 16.05.841 for activities within streams used by fish that the agency determines could represent impediments to fish passage, or for travel in, excavation of, or culverting of anadromous fish streams

AOGCC:

- Issues a Permit to Drill under 20 AAC § 25.05.
- Issues approval for annular disposal of drilling waste (20 AAC § 25.080).
- Authorizes Plugging, Abandonment, and Location Clearance (20 AAC § 25.105 through 25.172).
- Authorizes Production Practices (20 AAC §§ 25.200 through 25.245).
- Authorizes Class II Waste Disposal and Storage (20 § AAC 25.252).
- Approves Workover Operations (20 § AAC 25.280).
- Reports (20 AAC §§ 25.300 through 25.320).
- Authorizes Enhanced Recovery Operations under 20 AAC §§ 25.402-460.

1.4.2.2 GMT1 Permit Requirements

Key permits, approvals, and requirements associated with GMT1 development are summarized in Table 1.4-1.

Table 1.4-1. Key Permits, Approval, and Other Requirements for GMT1

AGENCY	PERMITS, APPROVALS, AND OTHER REQUIREMENTS
FEDERAL AGENCIES:	
Lead and Cooperating Agencies	NEPA Review; Supplemental EIS
Bureau of Land Management	• Application for Permit to Drill • Right of Way • Temporary Use Permit • Material Sale • Threatened and Endangered Species formal consultation Biological Assessment; ESA determination for NMFS managed species • Essential Fish Habitat (EFH) Assessment • ANILCA 810 Evaluation and Findings • Compliance with Section 106 of the National Historic Preservation Act • Off-Lease Disposal of Produced Water • Production Commingling and Allocation Approval (CAA) • EO 13075 Tribal Consultation
US Army Corps of Engineers	• CWA Section 404 Permit • Rivers and Harbors Act Section 10 Permit
US Environmental Protection Agency	• Underground Injection Control Class I (Industrial; non-hazardous) disposal well • Spill Prevention, Control, and Countermeasure (SPCC) Plan • FRP
US Fish & Wildlife Service	• Letter of Authorization (LOA) for Incidental Take of Polar Bears • Threatened and Endangered Species formal consultation Biological Opinion
National Marine Fisheries Service (NOAA)	Section 7 Consultation (Endangered Species Act: bowhead whale, bearded seal, and/or ringed seal)
US Coast Guard	Bridge permit for Ublutuoch crossing in compliance with 33 CFR Parts 114 and 115, the Rivers and Harbors Act, and the General Bridge Act. 33 U.S.C. 401, 491, 525.
STATE AGENCIES:	
Alaska Department of Natural Resources	• Land use (ice roads and pads on state land) • Temporary Water Use Permit • Cultural Resourced Coordination/Consultation with State Historic Preservation Office (SHPO)
Alaska Department of Fish & Game	Title 16 Fish Habitat for fish lake water withdrawal and fish stream crossing
Alaska Department of Environmental Conservation	• Air Quality Permit • APDES permit (wastewater/stormwater/hydrotest) discharge • ODPCP • Section 401 Water Quality Certification • Certificate of Financial Responsibility
Alaska Oil and Gas Conservation Commission	• Permit to Drill • Approval for Annular Disposal of drilling wastes • Area Injection Order

Table 1.4-1. Key Permits, Approval, and Other Requirements for GMT1 (Continued)

AGENCY	PERMITS, APPROVALS, AND OTHER REQUIREMENTS
Office of Public Safety	Fire Marshal approval
LOCAL ENTITIES:	
North Slope Borough	• Rezoning to Resource Development District – Master Plan • Title 19 Development Permit/Administrative Approval • Inupiat History, Language, and Culture Division – Traditional Land Use Inventory Clearance
Arctic Slope Regional Corporation	Grant relief of Lease Stipulation K-1 (Fish Creek Setback) (Note: K-1 is in effect on conveyed lands, and may be enforced by ASRC.)[1]
Kuukpik Corporation	Land Use authorization for facilities constructed on Kuukpik land
Native Village of Nuiqsut	EO 13075 Tribal Consultation

1.4.3 Related NEPA Analyses

CEQ Regulations for the implementation of NEPA direct agencies to reduce excessive paperwork and eliminate repetitive discussion of issues by tiering to existing NEPA documents to focus on actual issues ripe for decision (40 CFR 1502.20 and 40 CFR 1502.21). This SEIS seeks to adhere to the CEQ recommendation by summarizing the issues discussed in broader/existing NEPA documents and adopting these discussions by reference. This SEIS tiers to the following NEPA documents:

- 2004 ASDP Final EIS
- 2004 ASDP ROD
- 2008 Northeast NPR-A Final Supplemental IAP/EIS
- 2012 Point Thomson Project Final EIS (recent cumulative effects analysis)
- 2012 NPR-A Final IAP/EIS
- 2013 NPR-A IAP ROD

The 2004 ASDP Final EIS (BLM 2004) was prepared by BLM to evaluate a proposal by CPAI for the phased development of five satellite oil discoveries — two in the Colville River Delta (CD3 and CD4) and three in the NPR-A (CD5, GMT1 [formerly CD6], and GMT2 [formerly CD7]). CD5 is on land conveyed to Kuukpik within the NPR-A boundary while the GMT1 pad is on federal lands administered by the BLM in the NPR-A. Both the potential impacts of proposed development activities and a range of alternatives were evaluated. No additional NEPA analysis was envisioned as necessary to support the proposed development.

The 2004 ASDP ROD (BLM 2004a) states, "This Record of Decision (ROD) documents the Department of the Interior's decision to approve rights-of-way and permits to drill on public lands in response to an application by ConocoPhillips Alaska, Inc. (CPAI). BLM (2004) fulfills the obligation of BLM and its federal cooperating agencies under the National Environmental Policy Act (NEPA), 42 USC § 4321, to analyze the environmental impacts of federal authorizations necessary for CPAI to undertake its proposed development."

[1] The landowner may or may not choose to enforce stipulation K-1 on conveyed land in NPR-A.

The 2008 Northeast NPR-A Final Supplemental IAP/EIS (BLM 2008b) was designed to address the Nation's need for production of more oil and gas through leasing lands in the northeast NPR-A. BLM (2008b) provides local environmental resource information and includes GMT1 development as a basic assumption in the analyses. In addition, BLM (2008b) alternatives evaluated both prescriptive and performance-based lease stipulations and other protective measures intended to mitigate impacts.

The 2012 NPR-A Final IAP/EIS (BLM 2012) was completed by BLM to fulfill the NEPA requirements for oil and gas lease sales (authorized by the 2013 ROD) and for potential renegotiations of the stipulations of previously leased tracts in the entire NPR-A. Several alternative development scenarios were evaluated, with the assessment of related environmental consequences based on a number of assumptions, including potential development of the GMTU (BLM 2012, §§ 4.1 and 4.2). The proposed GMT1 Project is consistent with development scenarios considered in all action alternatives (BLM 2012, § 4.2.1.2, Vol. 2, p. 51).

Additional NEPA analysis is required prior to BLM approval of proposed construction of infrastructure for development of a petroleum discovery based on specific and detailed information about where and what kind of activity is proposed (BLM 2012, p. 9). GMT1 development was subject to a detailed NEPA analysis in BLM (2004), and was reconsidered in BLM (2012). This SEIS focuses on changes and additional information that could affect federal decisions on the permit applications currently under review.

1.4.4 Scope of SEIS

This SEIS will supplement BLM (2004), specifically addressing changes in the project, the affected environment, and regulations that might affect the determinations and decisions associated with BLM (2004) and BLM (2004a). This effort is greatly facilitated by tiering to and incorporating by reference BLM (2004) and BLM (2004a), as well as sections of BLM (2012) and BLM (2013) where applicable.

The scope of this SEIS includes analysis of potential effects of the proposed GMT1 Project, based upon the analyses performed in existing NEPA documents, with a focus on updated or more site-specific information. Resources that have been addressed thoroughly in existing NEPA documents and for which there are no changes in regulation or resource status are briefly summarized in Sections 3 and 4 (Affected Environment and Environmental Consequences, respectively). For those resources where additional data, particularly site-specific and updated information has been identified, or if there has been a change in status, this information is presented in Chapter 3 and incorporated into the analysis of Chapter 4. See Section 4.1 for a discussion on how expected levels of impact are determined.

1.4.5 Changes and New Information

The primary objective of this SEIS is to identify changes to the project design since it was described in BLM (2004), and to determine whether the effects of the proposed project are still within the range of effects analyzed in BLM (2004). A secondary objective is to review the description of the affected environment and consider whether new information or circumstances exist, and if so, to evaluate the potential environmental effects of the project against the updated description of the affected environment. A summary of changes in GMT1 Project design is provided in Table 1.4-2, with additional detail provided in Section 2.

Table 1.4-2. Summary of Changes in GMT1 Project Design Since 2004

Facility	Change Since 2004
Gravel drilling pad	Moved gravel drilling pad outside the Fish Creek 3-mile setback area
Gravel access road connecting GMT1 to CD5	Reduced total length of access road from GMT1 to CD5 and reduced length of access road crossing through the Fish Creek setback area; thereby reducing footprint
Bridges over fish-bearing streams	Designed longer bridge over the Tiŋmiaqsiġvik (Ublutuoch) River. Bridge over Crea Creek instead of culverts. Eliminated one stream crossing (bridge) by moving drilling pad out of Fish Creek setback area
Pipeline connecting GMT1 to CD5 tie-in to pipeline going to CD1/APF for processing	Reduced total length of pipeline from GMT1 to CD5 and reduced length of pipeline crossing through the Fish Creek setback area
Clover Potential Material Source (Clover) site	Reduced mine footprint from that approved for authorization in 2004
CD5 site	Proposed CD5 pad is located approximately 1.5 miles west of the location analyzed in BLM (2004)

A review of new data and information contained in BLM (2012) shows there are no appreciable changes in the physical, biological, or social resources associated with the project study area since BLM (2004). New data includes multi-year studies on hydrology, birds, and caribou. In addition, CPAI's proposed project was modified to reduce impacts, and more information on the material site (potential gravel source) has been collected. The regulatory framework remains essentially the same, except for several new ESA listings and air quality regulations. Additionally, the project will be subject to various lease stipulations and the new BMPs adopted in BLM (2013).

A summary of changes and additional information by resource is provided in Table 1.4-3.

Table 1.4-3. Environmental Changes and New Information in Project Study Area Since 2004

Resource	Changes in Nature of Resource	New Project Information or Regulatory Controls
Physical Terrestrial Environment	No appreciable change since BLM (2004)	Site specific information on paleontological resources in the area based upon archaeological surveys.
Physical Aquatic Environment	No appreciable change since BLM (2004)	Site specific information on water bodies, hydrology, and interactions during high-water events (e.g., breakup) based upon field surveys.
Physical Atmospheric Environment	No appreciable change since BLM (2004)	Detailed information on air pollutant concentrations in Nuiqsut based upon ambient air quality monitoring. New air quality regulations and agency guidelines.
Climate Change	Continuing trend of effects	Current reports addressing climate change in Alaska.
Vegetation and Wetlands	No appreciable change since BLM (2004)	Site specific information on vegetation, wetlands, and habitat types for the realigned project, based upon surveys initially performed for the 2004 EIS.
Fish	No appreciable change since BLM (2004)	Site specific information regarding fish-bearing lakes from lake studies and anadromous waterways from the ADF&G ***Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes.***
Birds	No appreciable change since BLM (2004)	Site specific information regarding observances of selected bird species based upon multi-year surveys performed for CPAI.
Terrestrial Mammals	No appreciable change since BLM (2004)	Site specific information regarding caribou migration patterns and use of the project study area based upon multi-year surveys performed for CPAI. Additional information on migrations patterns since 2004 has been collected by NSB, ADFG and BLM.
Threatened and Endangered Species	Changing habitat of marine mammals (USFWS, 2009; NOAA/NMFS, 2012) Concern about the vulnerability of yellow-billed loon population due to low starting population, low reproductive rate, and specific breeding habitat requirements (USFWS, 2009)	The polar bear and two species of ice seal were listed, and the yellow-billed loon was designated as a candidate species under the ESA. New site specific information regarding observations of spectacled eiders based upon surveys performed for CPAI. Site specific information on polar bear sightings and den locations provided by CPAI and USGS, respectively. Information on potential denning habitat provided by USGS. Critical habit for the polar bear has been proposed.
Socio-Cultural	No appreciable change since BLM (2004)	Updated population data based on 2010 US Census results. Updated economic data. Community health and welfare information based upon a Health Analysis Report published by NSB in 2012.
Subsistence	No appreciable change since BLM (2004); however, continuing development in the vicinity of Nuiqsut puts additional pressure on subsistence access and resources	Updated information regarding subsistence activities published in 2010 by Stephen R. Braund.
Cultural Resources	No appreciable change since BLM (2004)	Site specific information on cultural resources in the area based upon several archaeological surveys and SHPO consultation.

Table 1.4-3. Environmental Changes and New Information in Project Study Area Since 2004 (Continued)

Resource	Changes in Nature of Resource	New Project Information or Regulatory Controls
Land Use	Two new land use plans in the NPR-A: 2008 Northeast NPR-A IAP ROD and 2013 NPR-A IAP ROD Both new land use plans designate a ½-mile setback from Tiŋmiaqsiġvik (Ublutuoch) River and include restrictions for permanent facilities Both 2008 and 2013 RODs authorize new lease sales in the project study area Selected land in project study area transferred to Kuukpik Corporation Administration of some oil and gas leases transferred to ASRC (Kuukpik land) New leases, exploration, and development on State land and water New OCS leases and planned exploration CD3 and CD4 constructed and operating CD5 scheduled for construction beginning winter 2014 Nuiqsut Spur Road permitting underway Inter- and intra-state gas pipeline(s) permitting underway	For purposes of the analysis, Tiŋmiaqsiġvik (Ublutuoch) River and Fish Creek setbacks are considered to be in effect on Kuukpik land as well as federal land. A permit from the landowner (Kuukpik) will be required for road and pipelines on private land. The cumulative effects analysis of BLM (2012) and the 2012 Point Thomson FEIS address relevant new and reasonably foreseeable projects as used in the analysis.

1.5 Public Involvement

Public involvement is an important part of the NEPA process. CEQ regulations require agencies make diligent effort to involve the public in preparing and implementing their NEPA procedures (40 CFR 1506.6(a)). Typically, public involvement begins with scoping and continues throughout preparation of the analysis and the decision. (BLM 2008c, § 6.9),

1.5.1 Scoping

Additional scoping for a SEIS is not required (40 CFR 1501.9 (c)(4)); however, scoping is an effective process by which the BLM can acquire internal and external input on the issues, impacts, and potential alternatives to be addressed, as well as determine the extent to which those issues and impacts will be analyzed. The intent of scoping is to focus the analysis on significant issues and reasonable alternatives in order to eliminate extraneous discussion, and reduce the length of the EIS (BLM 2008c, § 9.1.3).

The BLM solicited public scoping comments on the GMT1 Project in the Notice of Intent to Prepare a SEIS, published in the Federal Register on August 16, 2013. Scoping comments were formally accepted through September 6, 2013, but scoping comments received after that date have been also considered in identifying the range of issues and additional mitigation measures to be addressed in the SEIS.

In all, fourteen sets of comments were received from private citizens, environmental organizations, and government agencies, including the NSB and the Native Village of Nuiqsut. The comments were tabulated and a number of themes were identified. These include:

- Potential effects of past and proposed development on community health;
- Potential effects on the availability of key subsistence resources, particularly caribou and fish, and access to those resources;
- Potential effects of increased development and activity on the local lifestyle, on wildlife, and associated cumulative effects;
- Potential effects on fish and wildlife and their habitats;
- Existing effects of noise and disturbance created by aircraft and concern over additional and cumulative effects;
- Potential effects of existing and proposed development on local water quality and associated effects on people and wildlife;
- Potential effects of existing development and proposed development on air quality, including the need for a comprehensive assessment and modeling of pollutants to determine nearfield and farfield effects, cumulative effects, and impacts on Nuiqsut (e.g., particulates, NO_2);
- Effects of greenhouse gas emissions and climate change;
- Need to consider a range of alternatives to the proposed project, including a roadless alternative, alternative source of support services (e.g., Nuiqsut), and the environmentally preferable or least environmentally damaging alternative;
- Effectiveness of mitigation and permit requirements; spill mitigation; and
- Ensure meaningful public involvement, specifically for Nuiqsut.

A number of local, state, and federal agencies have been involved in identifying issues for the SEIS. Key agency issues to date have focused on:

- Effects of road development on hydrology and sheet flow;
- Effects on air quality;
- Effects on aquatic resources; and
- Effects on and of oil and gas development.

1.5.2 Other Stakeholder opportunities

In addition to scoping, the public has opportunities to become involved in the NEPA process. The draft SEIS is available for public comment for a period of no less than 60 days. The document is available over the internet and hard copies have been provided for public review in Barrow, Nuiqsut, Atqasuk, Wainwright, Point Lay, Anaktuvuk Pass, Fairbanks, and Anchorage. Meetings will also be held in interested communities during the public comment period to ensure better understanding of the project, the alternatives, and impacts as well as to obtain public comments. BLM provides NEPA documents and public notices on their website and takes input from the public throughout the NEPA process.

During the development of BLM (1998b), BLM (2004), BLM (2008b), and BLM (2012), extensive input from other federal agencies, the State, the NSB, thousands of individuals, and many institutions was received by the BLM. BLM consults with Federally-recognized tribes and holds meetings in local communities to discuss oil and gas activities in the NPR-A as part of its NEPA processes.

Additionally, since 1998, the BLM has required Applicants to engage in community consultation before conducting activities in the NPR-A and to submit documentation of that consultation to BLM. BLM also holds Subsistence Advisory Panel meetings twice a year in rotating NPR-A villages to talk with residents about impacts to and concerns about subsistence.

The Native Village of Nuiqsut is participating in the SEIS process as a cooperating agency in addition to participating through the Government-to Government (G2G) consultation process. EO 13175 (November 2000), *Consultation and Coordination With Indian Tribal Government*s, was signed to establish regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications and to strengthen the United States government-to-government relationships with Native Americans and Alaska Natives. BLM has also engaged in consultation with Kuukpik Corporation and the Arctic Slope Regional Corporation.

CHAPTER 2: PROPOSED PROJECT AND ALTERNATIVES

The GMT1 Project is the first satellite to be developed in the GMTU, located in the Northeast NPR-A on Alaska's North Slope near the Beaufort Sea. The project was originally described in detail in BLM (2004, §§ 2.3 and 2.4).

2.1 Project as Proposed in 2004 ASDP Record of Decision

The following describes what was adopted as the Preferred Alternative in BLM (2004a).

The Preferred Alternative described in BLM (2004) specified that a 9.1 acre drill site would be constructed on Kuukpik owned land inside the 3-mile Fish Creek setback, with the capacity for 20-30 wells. Produced fluids would be transported by a 13.2-mile pipeline to CD5. A 13 mile gravel road would connect the drill site with CD5, with a 120-foot bridge constructed across the Tiŋmiaqsiġvik (Ublutuoch) River. All roads would be designed and constructed to provide adequate cross-flow to prevent raising the water level on the upstream side by more than 6 inches compared to that for the downstream side for more than one week after peak discharge. Gravel would be extracted from the Clover site or ASRC Mine Site. Upon completion of construction and drilling activities, crews based at APF would service and maintain the drill pad.

The BLM Preferred Alternative described in BLM (2004) was adopted by BLM (2004a) with the following minor modifications: (1) the acceptance of CPAI's proposed bridge and approach design; (2) the inclusion of requirements for sedimentation monitoring to determine if additional erosion mitigation might be required for the bridge; and (3) the adoption of terms and conditions and a conservation recommendation included by the USFWS in the Endangered Species Act Biological Opinion. The BLM (2004) project adopted by the BLM (2004a) serves as the basis of the applicant's proposed action in the GMT1 SEIS.

The BLM (2004a) granted exceptions to three BLM stipulations controlling activities in the NPR-A at that time (i.e. BLM 1998a). Two of the three stipulations are applicable to GMT1. The rationale provided in BLM (2004a, pp. 3, 4, and 16 through 20) for granting those two exceptions is described below:

- BLM Lease Stipulation 39(d) (now Stipulation K-1[e]) prohibits permanent oil facilities within the 3-mile setback from Fish Creek, but essential road and pipeline crossings within the setback may be approved on a case-by case basis. Approval for an exception in 2004 was based on technical, economic and environmental factors. The original Stipulation 39[d] was re-designated as Lease Stipulation K-1[e] in BLM (2008e) and carried forward in BLM (2013).
- BLM Lease Stipulation 41 (now Stipulation E-2) prohibits oil infrastructure within 500 feet of water bodies. Approval for an exception in 2004 was based on technical infeasibility of total compliance due to the hydrology and number of water bodies in the area as well as implementation of other measures that would protect waterbodies (e.g., use of secondary containment). The original stipulation 41 was re-designated as Lease Stipulation E-2 in BLM (2008e) and carried forward in BLM (2013), with the most recent 500-foot setback restricted to fish-bearing waterbodies.

2.2 Summary of Proposed Project Changes from 2004

The GMT1 Project (Alternative A) is similar to the project approved for permitting in the BLM (2004a), with several notable changes. Notable changes to the GMT1 site from 2004 include:

- Relocated drill site, approximately 2.7 miles of access road, and approximately 2.4 miles of pipeline corridor has been moved out of the Fish Creek setback, in response to agency concerns;
- Reduced road length by approximately 3.4 miles, as a result of drill site relocation;
- Reduced pipeline length by approximately 2.8 miles, as a result of drill site relocation;
- Increased Tiŋmiaqsiġvik (Ublutuoch) River Bridge length from the minimum 120 feet (defined in BLM 2004a) to 350 feet, in response to agency concerns;
- Increased pad footprint from 9.1 acres to 11.8 acres.
- The net amount of fill for the construction of the drill site and shorter road length would be reduced by approximately 23 acres, though the proposed drill site will be 2.7 acres larger;
- Reduced Clover site footprint to 18.7 acres from the 65 acres authorized under BLM (2004a) and relocated about 0.5 mile to northeast to increase gravel potential; and
- Added 3.3 miles of pipe rack to support ancillary injection water pipeline from CD1 to ensure sufficient supply of water for enhanced recovery injection and provide space for a future 24-inch line.

Other components of the GMT1 project are also different than originally proposed in BLM (2004a). The CD5 pad location is approximately 1.5 miles west of its location in the BLM (2004a); likewise, the Niqliq Channel bridge is planned for construction approximately 3 miles south of the BLM (2004a) location.

2.3 Alternatives to the Proposed Project

NEPA directs the BLM to "study, develop, and describe appropriate alternatives to recommend courses of action in any proposal that involves unresolved conflicts concerning alternative uses of available resources;…" (NEPA, Section 102(2)(E)). In determining the alternatives to be considered in satisfying the purpose and need, the emphasis is on what is *reasonable* rather than on whether the Applicant likes or is itself capable of implementing an alternative (40 CFR 1502.14; BLM NEPA Handbook.p.49). "Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant." (CEQ, 1981 as amended--Question 2a, CEQ, Forty Most Asked Questions Concerning CEQ's NEPA Regulations).

Guidelines developed under Section 404(b)(1) of the CWA direct the Corps to use the overall project purpose (based on the Applicant's purpose and need) to define alternatives and determine which alternative is the least environmentally damaging practicable alternative. Where an activity is not "water dependent," practicable alternatives that do not involve special aquatic sites are presumed to be available, and presumed to have less adverse impact to the aquatics ecosystem, unless it is clearly demonstrated otherwise (40 CFR § 230 10(a)(3)). The term *practicable* means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purpose (40 CFR § 230 3(q)).

2.3.1 Alternatives Selection Process

In supplementing BLM (2004), this SEIS began the process of developing alternatives with an appraisal of the full range of applicable alternatives that were considered by the BLM and cooperating agencies in BLM (2004). For the 2004 analysis, the BLM and other cooperating agencies (Corps, EPA, U.S. Coast Guard, and State) in the BLM (2004) developed alternatives to CPAI's proposed action by considering comments from scoping and public reviews, input from tribal consultations, and the purpose and need for the ASDP Project. The alternatives covered the full range of reasonable development scenarios, while addressing specific concerns associated with components of the proposed ASDP development.

The alternatives and related analyses in BLM (2004) were based on development of five Alpine Satellites under conditions existing at that time. Since then, two of the satellites (CD3 and CD4) have been constructed. Construction of a third satellite (CD5) is underway, with the design and location of CD5 facilities modified during permitting. These and other changes and new information, as summarized in Section 1.4.5, need to be considered in the current update and analysis of alternatives for the GMT1 SEIS. Additionally, there have been changes to CPAI's proposed GMT1 Project.

Changes to the existing infrastructure include construction and operation of facilities that were not in place at the time of the BLM (2004) described above, as well as changes that are not yet operational, but are reasonably foreseeable (e. g., Nuiqsut Spur Road). Additionally, other factors have changed, including land status, oil field practice, technology, and regulatory controls. New information has been collected, including biological studies, oil and gas resource updates, and subsistence surveys. Several comprehensive NEPA analyses have more recently evaluated North Slope development, both current and reasonably foreseeable future development, expanding the information base on which to develop alternatives.

2.3.1.1 Development and Screening of Alternatives

BLM and the cooperating agencies held a series of meetings to develop, screen, and select alternatives for full analysis in the SEIS, as summarized below in Table 2.3-1.

Table 2.3-1. Alternatives Development Meeting Summary

Meeting Date	Cooperating Agencies[1]	Objective
9/12/2013	BLM, Corps, EPA, USFWS, BOEM, STATE, NSB, NVN	Review range of alternatives considered for BLM (2004). Identify reasonable alternatives to the GMT1 Project.
9/16/2013	BLM, Corps, EPA, USFWS, BOEM, STATE, NSB, NVN	Develop framework for defining and evaluating limited access/roadless alternative.
9/18/2013	BLM, Corps, EPA, USFWS, BOEM, STATE, NSB, NVN	Review Nuiqsut hub alternative and alternative that complies with all BLM lease stipulations. Advance development of limited access alternative. Consider options for gravel supply.
9/27/2013	BLM, Corps, USFWS, BOEM, STATE, NSB, NVN	Review and refine alternatives discussed at first three meetings for screening.
10/21/2013 Teleconference[2]	BLM, Corps	Discuss screening criteria to determine alternatives to carry forward through full analysis.
10/24/2013	BLM, Corps, USFWS, EPA, NSB	Review screening criteria and screen alternatives. Identify final alternatives to carry forward for full analysis.

[1] BLM - Bureau of Land Management (lead); Corps- US Army Corps of Engineers, EPA – U.S. Environmental Protection Agency; USFWS – U.S. Fish and Wildlife Service;. BOEM – Bureau of Ocean Energy Management; State – State of Alaska; NSB – North Slope Borough; NVN – Native Village of Nuiqsut.

[2] Teleconference was to develop information to facilitate the full team of cooperating agencies moving forward following the three week federal government shutdown, during which no meetings were held.

During the first meeting, the BLM and cooperating agencies concluded that the alternatives considered but not carried forward for analysis in BLM (2004) offer no new or different environmental benefit and would not be carried forward in this SEIS. The considered alternatives that were not carried forward are summarized below in Section 2.3.2. It was also determined that three action alternatives in BLM (2004) remain conceptually reasonable alternatives to GMT1, and were therefore selected for further evaluation in the SEIS, based on agency and public scoping comments as well as current conditions and available information.

Throughout the next five meetings, the three action alternatives carried forward from BLM (2004) were modified and updated for conditions specific to the GMT1 Project. These alternatives were evaluated for potential benefit based on a number of criteria including footprint size, on-site activity, subsistence and other environmental impacts, reservoir production, and support for future development. It was concluded that the three action alternatives from BLM (2004) remain conceptually reasonable alternatives to CPAI's proposed GMT1 Project, and they are analyzed in this SEIS, as further described in Section 2.3.3.

2.3.2 Alternatives Considered But Not Carried Forward

A range of alternatives were evaluated in BLM (2004). At that time, alternatives that were considered, but not carried forward for further detailed analysis included: buried pipelines; pipelines elevated more than 7 feet; pile-supported production pads; drilling pad(s) at substantially different locations; supporting western ASDP development from a Nuiqsut Operations Center; and development with access other than gravel road or air. The rationale that eliminated these alternatives from further consideration is provided in BLM (2004, § 2.6). Drilling from different locations using extended reach drilling (ERD) is an evolving technology; however, ERD is still not technically feasible for the GMT1 Project based on well completion requirements to develop the reservoir and variations in subsurface geology. The BLM (2004a, p. 17) noted that ERD is problematic due to the geologically unstable shales in this area that tend to collapse.

2.3.3 Alternatives Carried Forward in the SEIS

As noted above in Section 2.3.1, BLM and other cooperating agencies reconsidered the action alternatives analyzed in BLM (2004), and brought forward certain components of those alternatives in order to create conceptually similar, updated versions of these alternatives for the GMT1 Project SEIS. In this SEIS, Alternative A is the CPAI proposed GMT1 Project, which is based on the Preferred Alternative of BLM (2004). Alternative B is based on the 2004 Alternative B, Conformance with Stipulations. Alternative C is based on the 2004 Alternative C, Alternative Access Routes. Alternative D is based on the 2004 Alternative D Roadless Development. Alternatives B, C, and D maintain the concept or theme of the 2004 action alternatives, but have been updated to fit existing conditions. The No-action Alternative must be evaluated in the SEIS (40 CFR 1502.14[d]).

The alternatives analyzed in the SEIS are:

- Alternative A – CPAI Proposed GMT1 Project
- Alternative B – Avoid Fish Creek Setback
- Alternative C – Alternative Access (via Nuiqsut)
- Alternative D – Roadless Access to GMT1

- Alternative E – No Action

The following tables summarize the components of the five alternatives:

- Table 2.3-2 – Footprints and Gravel Requirements for Project Alternatives
- Table 2.3-3 – Road and Pipeline Lengths for Project Alternatives

Table 2.3-2. Footprints and Gravel Requirements for Project Alternatives

Alternative	Pads (ac)	Pads (cy)	Roads (ac)	Roads (cy)	Airstrip (ac)	Airstrip (cy)	Total Footprint[1] (ac)	Total Gravel Requirement (cy)
A	12.5	137,500	60	488,000	0	0	72.5 acres	625,500
B	13.2	144,000	66.1	538,000	0	0	79.3 acres	682,000
C	12.5	137,500	76	633,500	9	88,700	97.5 acres	859,700
D	31.3	314,800	9.6	77,800	46.4	453,000	87.3 acres	845,600

[1] VSM Footprint is relatively minor and is not factored into the total comparative footprint.

Table 2.3-3. Road and Pipeline Lengths for Project Alternatives

Alternative	Road Length (miles)	Pipeline Length (miles)
Alternative A	7.8	8.1
Alternative B	8.6	8.4[1]
Alternative C	7.8	8.1
Alternative D	1.2	8.1

[1] Pipeline assumed to parallel road, with incremental increase in length (0.3 mile).

As developed for the SEIS, Alternatives A, B, C, D, and E are described below. After full analysis, additional cooperating agency coordination, and input from the public during the public comment period, BLM will identify its preferred alternative for the GMT1 Final SEIS.

2.4 Alternative A: CPAI Proposed Project

CPAI's proposed GMT1 Project is approximately 14 miles west of the CPAI-operated Alpine field, as shown on Figure 2.4-1. The proposed GMT1 Project includes the following components:

- 11.8 acres gravel drill site with capacity for 33 wells.
- 7.8 mile long gravel access road connecting GMT1 to CD5.
- 8.1 mile long elevated pipeline, with messenger cable (power and fiber optic lines) on Vertical Support Members (VSMs), from GMT1 to CD5.
- Two 0.35-acre manual valve gravel pads.
- Bridges over Crea Creek and Tiŋmiaqsiġvik (Ublutuoch) River capable of supporting drill rig transport.
- 3.3 mile long pipeline rack on VSMs from CD1 to CD4N.
- 6.1 mile 14" injection water pipeline on existing VSMs from CD4N to CD5.
- Pipeline intersections (tie-ins) at CD5 and CD1/APF.

- Gravel supply from Clover site and/or the ASRC Mine Site.
- Approximately 39 – 48 miles of ice road for construction support.

Major proposed infrastructure for the GMT1 Project is shown on Figure 2.4-2. More detailed design drawings for the GMT1 Project are included in Appendix A.

In siting the GMT1 pad, the access road, and the pipeline, eight criteria were considered. These included the Fish Creek and Tiŋmiaqsiġvik (Ublutuoch) River setback areas (see Figure 2.4-3), wetland habitats, archaeological resources, hydrology and drainage, topography, minimizing gravel footprint, load weight requirements (road and bridge), and local community interests (information provided by Applicant).

2.4.1 Location

The proposed GMT1 drill site is located in Section 6, Township 10N, Range 3E (T10N, R3E), Umiat Meridian (UM), at latitude 70.2543 and longitude -151.4835. The road and pipeline corridors cross through Section 6, T10N, R3E UM; Sections 24 through 29, 32, and 33 (pipeline only), 24 through 28, 31, 32, and 33 (road only); T11N, R3E UM; and Sections 18 and 19, T11N, R4E UM.

The proposed Clover site is located in Section 6, T10N, R4E UM, at latitude 70.2505 and longitude -151.2335.

The location of the proposed GMT1 drill site and Clover site do not vary among the alternatives.

2.4.2 Drill Site Design and Facilities

The proposed 11.8-acre GMT1 pad would be constructed with gravel and be a minimum of 5 feet deep with side slopes of 2 feet wide to 1 foot high (2:1) (Appendix A, Sheet 22 of 36). Additional pad thickness will be provided if needed for thermal protection of permafrost. The pad surface is designed to be 1,200 feet by 463 feet at its widest point where the access road enters the pad, narrowing to 290 feet at its narrowest point.

The pad is sized and designed to allow for all drill site facilities, valve shelters, rig movement, drilling material storage, and well work equipment. A total of 33 wells at 20-foot wellhead spacing (Appendix A, Sheet 6 of 36) are planned. Insulated conductors and thermosyphons will be used to reduce subsidence and protect structural components from freeze-thaw damage.

The GMT1 pad layout under all alternatives (Appendix A, Sheet 6 of 36) will include the following on-pad facilities:

- Emergency shutdown valve skid
- Test separator
- Remote electrical and instrumentation module
- Pig launching/receiving module
- Chemical injection module (including tanks, containment, and truck loading area)
- Production heater
- Communication tower

- Lighting as needed

No processing of production fluids beyond routine well testing and process fluid heating is planned at the drill site. The pad will be oriented northeast to southwest to minimize snow accumulation on the site. This orientation also allows the access road and pipeline corridor to intersect the pad on the northeast side, resulting in a configuration that reduces the access road length compared to other pad orientations.

Electric power for GMT1 operations will be provided by the existing Alpine power system. Power cables will be suspended from the pipeline vertical support members (VSMs) via a messenger cable, as shown in Appendix A, Sheets 18 and 19 of 36. The drilling rig will be initially powered with on-site diesel electric generators using ultra low sulfur diesel (ULSD) fuel until a power connection is commissioned. A fiber optic cable providing communication support between CD1/APF and GMT1 will be suspended from VSMs via the same messenger cable as the power lines, as shown in Appendix A, Sheets 18 and 19 of 36.

2.4.3 Pipelines

The GMT1 Project includes three pipeline segments:

- GMT1 to CD5 pipelines/systems (Appendix A, Sheets 8 through 13 of 36), includes:
  - 20-inch produced fluids pipeline – crude oil, gas, and water from GMT1 to APF for processing.
  - 14-inch injection water pipeline – seawater or produced water transported from APF for injection to support enhanced oil recovery.
  - 6-inch gas pipeline – lean gas transported from APF for artificial lift.
  - 6-inch MI pipeline – Miscible Injectant transported from APF for injection to support enhanced oil recovery.
  - Power and fiber optic communication lines.
  - Space for a 24-inch pipeline.
- CD5 to CD4N 14-inch injection water pipeline located on an existing pipe rack – seawater or produced water transported from APF to GMT1 for injection to support the enhanced oil recovery.
- CD4N to APF 14-inch water pipeline for seawater or produced water transported from APF to GMT1 for injection to support the enhanced oil recovery. New pipe rack and VSMs will be installed along this route. This pipe rack will support the new pipeline as well as provide space for future installations (Appendix A, Sheets 16 and 17 of 36), as follows:
  - 14-inch injection water pipeline – water transported from APF for injection.
  - Space for an 8-inch future pipeline.
  - Space for a 24-inch future pipeline.

The project will produce oil, gas, and water that will be carried from the GMT1 drill site by pipelines that tie into the CD5 pipeline going to the APF at CD1 for processing. Sales quality crude oil processed at the APF will be transported from CD1 via the Alpine Oil Pipeline and Kuparuk Pipeline to TAPS for shipment to market. MI and injection water (for the enhanced oil recovery project) will be delivered to the GMT1 drill site from CD1 by pipelines that tie-in at

CD5. Lean gas for artificial lift will also be transported from CD1 to GMT1 (via a tie-in at CD5). The production crude and water injection pipelines will be designed to allow pipeline inspection and maintenance (pigging) between GMT1 and APF.

Pipelines will be supported on common VSMs placed approximately 55 feet apart. Approximately 1,000 new VSMs will be required between GMT1 and CD5 (footprint approximately 0.072 acres). Fiber optic cable and power cables will be suspended from the same VSMs via messenger cable. The decision to use messenger cables rather than cable trays (as proposed in BLM [2004]) was based on CPAI's experience showing that over time cable trays do not have sufficient structural integrity to span the distance between VSMs; messenger cables are the current industry design standard. Pipelines (including suspended cables) will be a minimum of 7-feet above ground surface as shown in Appendix A, Sheets 19 and 20 of 36.

At each stream or river crossing, the pipeline will be installed on a straight-line elevation between VSMs on each side of the crossing, such that the height above the watercourse would be greater than the 7-foot minimum clearance. Where possible, pipelines will be constructed at least 500 feet away from the road to minimize caribou disturbance (Cronin et. al., 1994). This also prevents excessive snow accumulation. Pipelines are typically constructed within 1,000 feet of roads to allow for visual inspection from the road. Pipeline design would comply with the American Society of Mechanical Engineers (ASME) Codes B31.4 and B31.8, applicable federal and state standards, and CPAI internal standards. All pipelines will be hydrotested prior to startup as required by the code of construction (e.g., B31.4 and B31.8).

Under Alternatives A, B and C, the GMT1 to CD5 pipeline route is located just north of the proposed access road and travels in a roughly straight line to the east-northeast from GMT1 until reaching the Tiŋmiaqsiġvik (Ublutuoch) River. After crossing the Tiŋmiaqsiġvik (Ublutuoch) River on the proposed 350-foot-long bridge, the pipeline runs roughly north-northeast in a straight line to CD5. Under Alternatives A, C and D, the pipeline crosses through the southern portion of the Fish Creek 3-mile setback and crosses the Tiŋmiaqsiġvik (Ublutuoch) River 0.5 mile setback for a short distance.

The proposed GMT1 14-inch water injection pipeline will be installed on the existing piperack from CD5 to CD4N. From CD4N, the water injection pipeline will run approximately 3.3 miles north on a new set of VSMs, parallel to the existing CD4 pipeline and the existing Alpine Oil Pipeline. This new set of pipeline VSMs are required because there is insufficient capacity for transport of water to GMT1 in existing pipelines. Approximately 400 new VSMs (footprint approximately 0.029 acres) will be aligned to match existing VSM spacing to avoid offsets (also known as "picket-fence effect") that could impede caribou movement.

2.4.3.1 Manual Valves

Manual valves will be located on each side of the Tiŋmiaqsiġvik (Ublutuoch) River, isolating the production pipeline on either side of the bridge to minimize potential spill impacts in the event of a leak or break. A manual valve approximately 1,700 feet west of the Tiŋmiaqsiġvik (Ublutuoch) River bridge will be located on a 0.35 acre gravel pad adjacent to the gravel road. A similar manual valve and valve pad will be located approximately 700 feet east of the bridge adjacent to the gravel road. (Appendix A, Sheets 7 and 23 of 36).

2.4.4 Gravel Road

A 7.8-mile-long gravel road is proposed to connect GMT1 with CD5 and the proposed CD5 to CD4N road, which will connect to the existing Alpine field road system. The road is designed to maintain the existing thermal regime and to withstand a 50-year flood event plus 3 feet of freeboard. The proposed access road will be constructed with gravel and will be a minimum of 5 feet deep with side slopes of 2:1 (Appendix A, Sheet 22 of 36). The roadway surface will be 32 feet across (crown width). The proposed road will be located immediately south of the proposed GMT1 to CD5 pipeline and travel from GMT1 along a roughly direct route to the east-northeast, immediately north of several lakes, until reaching the Tiŋmiaqsiġvik (Ublutuoch) River.

The road crosses the Tiŋmiaqsiġvik (Ublutuoch) River with a proposed 350-foot-long bridge, then runs roughly north and curves to the east, connecting to the CD5 access road. Under Alternatives A and C, the GMT1 access road crosses through the Fish Creek setback and the Tiŋmiaqsiġvik (Ublutuoch) River setback.

BLM protective and mitigation measures (Best Management Practices) from BLM (2013) apply in select biologically sensitive areas. These measures designate setback areas for many major waterways. The Fish Creek (3-mile setback) and Tiŋmiaqsiġvik (Ublutuoch) River (½-mile setback) are the only such waterways recognized as "biologically sensitive" by BLM (2013) in the GMT1 Project vicinity. Best Management Practice K-1 prohibits permanent oil and gas facilities, including gravel roads, pads, airstrips, and pipelines within the setback. On a case-by-case basis essential pipeline and road crossings are permitted through setback areas. As stated in BLM (2004, § 2.1), the BLM (2004a) granted exceptions to the GMT1 access road and pipeline crossing into the Fish Creek setback.

At the point where the GMT1 road crosses the CD5 access road, it crosses over a buried section of the CD5 pipeline. To ensure that the existing thermal regime (i.e., permafrost) is maintained, the GMT1 road and CD5 pipeline crossing will be installed according to Appendix A, Sheet 21 of 36 with an impermeable membrane and rigid insulation installed under the pipelines, between the pipelines and existing ground.

2.4.5 Bridges and Culverts

Bridges are proposed for the two anadromous stream crossings along the GMT1 access road: a 350-foot-long bridge crossing the Tiŋmiaqsiġvik (Ublutuoch) River and a 40-foot bridge crossing Crea Creek (ADF&G 2013a). The State of Alaska is required to permit the road, including culverts and bridges under the Department of Fish and Game's permitting authority. The State has collaborated with CPAI on the bridge design, which involved extensive data collection and studies as well as modeling for flood events. As a result, the bridge abutments for the currently designed Tiŋmiaqsiġvik (Ublutuoch) River bridge are proposed to be located on the banks of the river, as opposed to in the channel (Morris, 2014).

Culverts will be placed in the road to maintain natural surface drainage patterns. The typical design of culverts and culvert batteries is shown in Appendix A, Sheets 33 and 34 of 36. Culvert(s) will be installed at Barely Creek, between Crea Creek and the Tiŋmiaqsiġvik (Ublutuoch) River to maintain flow. Other culvert locations will be optimized using aerial photography and site inspections by the design engineers during breakup. The majority of culverts will be installed prior to breakup but additional culverts may be placed after breakup as site-specific needs are further assessed. Once the final road alignment is chosen, the route will be closely surveyed to note low-lying areas where culverts should be placed, to ensure placement is based on on-the-ground data.

2.4.5.1 Tiŋmiaqsiġvik (Ublutuoch) River Bridge

The proposed crossing of Tiŋmiaqsiġvik (Ublutuoch) River would utilize a bridge constructed of 5 sets of 32-inch pilings positioned approximately 85 feet apart (Appendix A, Sheets 29 through 31 of 36). The bridge deck would be elevated approximately 26 feet BP Mean Sea Level (BPMSL) above the ground level, made of 31-foot-wide precast concrete slabs, and equipped with removable guardrail. The bridge would be designed to carry a drilling rig. The pipelines would be located on structural steel supports attached to the bridge girders, below the bridge deck. Sheet pile abutments for erosion protection would be located at each end of the bridge.

The 350-foot-long Tiŋmiaqsiġvik (Ublutuoch) River bridge would extend bank to bank, and is designed to avoid impacts to the main channel and be wide enough to span a 50-year flood (approximately 11.9 feet BPMSL). The main channel is located on the eastern side and has a typical summer water level of approximately one foot BPMSL. No piers will be located within the main channel, resulting in a span over this channel of 93 feet. See Appendix A for construction details.

Additional information about the design of stream and river crossings is presented in Section 4.2.2, Water Resources.

2.4.5.2 Crea Creek Bridge

The 40-foot-long Crea Creek bridge would be constructed using two sets of pilings positioned approximately 40 feet apart with sheet pile abutments for erosion protection located at each end of the bridge. The bridge deck would have a removable guardrail and would be designed to support a drill rig. The opening for water flow would be 25 feet wide. The Crea Creek bridge design is shown in Appendix A, Sheet 32 of 36. The pipeline would cross Crea Creek on VSMs spanning the creek.

Additional information about the design of stream and river crossings is presented in Section 4.2.2, Water Resources.

2.4.6 Gravel supply options

Issuance of BLM permits for the sale and extraction of gravel from an approximately 65-acre Clover site was approved in BLM (2004a, p.3). Alternative A includes development of 18.7 acres for 625,500 cubic yards of gravel. BLM (2004a) included mitigation requiring that the mine be rehabilitated, based on the Rehabilitation Plan included as Appendix O of BLM (2004), including interim reclamation (BLM 2004a, p. 23).

A total of approximately 625,500 cubic yards of material required for this project would be used to fill approximately 72.5 acres. Table 2.4-1 shows the amount of material used for project components. Two potential gravel sources are proposed:

The Clover site is located approximately 3 miles north northwest of Nuiqsut within T10N, R4E, Section 6.

The ASRC Mine Site is located 4.5 miles east of northeast Nuiqsut and east of the East Channel of the Colville River within T10N, R5E, Sections 10, 11, 14, 15, and 23.

Table 2.4-1. Gravel Use for Alternative A

Facility	Footprint (Acres)	Fill Quantity (Cubic Yards)	Notes/dimensions
GMT1 Drill Site [a]	11.8	131,000	290 feet to 463 feet wide by 1,200 feet long
Access Road [a]	60.0	488,000	7.8 miles long; 32 feet crown width and minimum 5 feet depth
Valve Pads (east and west)	0.7	6,500	Each pad is 100 feet x 100 feet; with 20 feet x 25 feet extension.
Total Gravel Requirement for GMT1	72.5	625,500	Pads and roads
Clover site	18.7 [b]	626,000	610 feet x 1,210 feet
ASRC Mine Site (existing)	25.4	626,000	Configuration depends on use and availability of material at this existing commercial gravel pit when gravel is needed for construction of GMT1.

Note: Values are approximate and may change during final design.

APF = Alpine Central Processing Facility

a = Appendix A, Sheet 5 of 36.

b = Material site pit footprint

2.4.6.1 Clover Potential Material Source

The Clover site is the proposed primary gravel supply; however, in the event it is not available or sufficient gravel is not available at that site, gravel would be obtained from the existing ASRC Mine Site (shown on Figure 2.4-4).

Gravel mining at the Clover site is to be completed in a single winter season, at the end of which the site will be rehabilitated. The rehabilitation plan will include backfilling the overburden into the mined pit and contouring the organic fill material to provide shallow water habitat when the pit floods naturally during annual spring breakup. Side slopes that remain above water after flooding will be seeded with native vegetation, as will any disturbed areas outside the excavated areas. Additional information can be found in Appendix I.

2.4.6.2 ASRC Mine Site

The ASRC Mine Site is an existing commercial gravel source located approximately 6 miles southeast of CD4 and 4.5 miles east northeast of Nuiqsut on the East Channel of the Colville River as shown in Figure 2.4-4. The existing ASRC Mine Site was permitted in 1997 for a 150-acre footprint providing approximately 5 million cubic yards of sand and gravel material. Use of the gravel source is divided into phases, and the mine site itself is divided into cells. Gravel from Phase 1 (67 acres) of the ASRC Mine Site was used, and the area is now closed to additional mining.

Mining has occurred in two cells of Phase 2 (83 acres); 25 acres of the 83 acres site has been mined (Corps 2012a). The remaining 58 acres currently permitted is estimated to have nearly 2 million cubic yards of available gravel. A total of 1.1 million cubic yards has been designated for two other projects: approximately 595,700 cubic yards for CD5 (Corps 2010) and approximately 455,000 cubic yards for the Nuiqsut Spur Road project (Corps 2013). As noted above, 625,500 cubic yards would be needed for Alternative A, but 845,600 cubic yards would be required for Alternative D.

Access to the remaining 900,000 cubic yards within Phase 2 is practically unachievable. The 2005 existing cell contains more than 100 million gallons of water. To safely gain access to the

gravel within 400 feet of an existing cell, any and all water must be removed prior to excavating the gravel. Upon completing the excavation for the 2014 cell, supporting the CD5 Project and Nuiqsut Spur Road, it is estimated the 2014 cell will contain over 150 million gallons of water. Removing approximately 250 million gallons of water from the existing cells at the remotely located ASRC Mine Site is impractical and unachievable.

Phase 3 is an unproven portion of the ASRC Mine Site, directly south of Phase 2. It is reasonable to assume there is a similar source of gravel within Phase 3, equal to the same quantities of gravel per acre as identified within Phase 2. For example, under a similar footprint of 58 acres within Phase 3, there may be approximately 2 million cubic yards of gravel available for GMT1 and other future projects.

Based upon permitted gravel extraction and committed gravel resources, gravel from the ASRC Mine Site is potentially available for use in the GMT1 project. ASRC applied for a permit under Section 404 of the CWA to expand the mine site by an additional 430 acres, for a total permitted site of 580 acres. Additional geotechnical exploration work is necessary to delineate and assess sand and gravel resources within the proposed mine site expansion area. Additional description of the ASRC Mine Site is provided in Section 3.2.1.5.

Because the ASRC Mine Site is an existing commercial mine, some impacts (e.g., potential disturbance of vegetation and habitat associated with removal of overburden, creation of ramps, etc.) are potentially less than for developing a new mine in an undeveloped location. However, gravel from the ASRC Mine Site would have to be transported approximately 12 miles further than material from the Clover site, increasing some aspects of construction impacts (e.g., noise, dust, traffic, emissions). Additionally, there is uncertainty as to whether the ASRC Mine Site has sufficient gravel to fulfill the needs of other public and private users (e.g. Nuiqsut Colville River boat ramp), the GMT1 Project, and the reasonably foreseeable future development at GMT2. If the ASRC mine lacks sufficient gravel, mining at the Clover site would likely be required at some point in the future. For these reasons, the impacts of using both gravel sources (i.e. Clover site and ASRC Mine Site) are analyzed in this document.

2.4.7 Construction Activities

CPAI proposes to construct the GMT1 facilities on a two-year schedule:

- 3Q 2013 – Submit permit applications and supporting documents
- 4Q 2014 to 1Q 2016 – Order long lead materials for the GMT1 Project (e.g., steel)
- 4Q 2015 – Begin first season ice road construction in support of GMT1 construction
- 1Q 2016 – Gravel Mining
- 1Q 2016 – Construction of gravel road and pad, bridge piers substructure and superstructure
- 4Q 2016 – Begin second season ice road construction in support of GMT1 construction
- 1Q 2017 – Install VSMs, pipelines, power and telecom cables, and facilities
- 4Q 2017 – First production

As detailed design progresses, the schedule may be modified. However, the identified work will occur in the indicated seasons and sequence. Well maintenance operations will occur intermittently throughout the life of the field.

2.4.7.1 Camp Requirements

During construction, the following camps may be used:

- GMT1 pad – an electrified camp associated with the drill rig;
- One or two camps in Nuiqsut; and
- Existing facilities at Alpine

Sanitary wastes that may be generated from a temporary construction camp will be hauled to an approved disposal site, or treated and discharged under the North Slope General APDES Permit AKG-33-1000. Food waste will be incinerated at Alpine and non-burnable waste will be recycled or trucked to the NSB landfill at Deadhorse.

2.4.7.2 Water Use

Fresh water is required for domestic use at remote construction camps and for construction and maintenance of ice roads and ice pads. Potable water requirements are based on a demand of 100 gallons per day (gpd) per person (estimated up to 100 people at a remote camp), totaling approximately 10,000 gpd during construction seasons. Freshwater may be used for hydrostatic testing. Approximately 1.5 million gallons (MG) of water per mile are used for ice road construction and maintenance (90 days). Under Alternative A, approximately 22 miles of ice road will be required (33 MG) during year one of construction for the GMT1 Project. During year two of construction, between 17 and 26 miles of ice road will be required (up to 39 MG), depending upon completion of the Tiŋmiaqsiġvik (Ublutuoch) River bridge and the proposed Nuiqsut Spur Road. The water requirement for an ice lay down pad (400 feet by 400 feet; maintained for 90 days) is estimated at 2.2 MG, although the pad size and maintenance requirements will vary. Water for construction and maintenance of ice roads and pads will be withdrawn from lakes in the vicinity of the GMT1 Project as authorized by State of Alaska temporary water use permits and fish habitat permits where necessary. See Table 2.4-2 for water use for the project alternatives.

Table 2.4-2. Water Use for the Project Alternatives

Alternative	Year	Ice Roads (mi)	Construction Estimate (Million Gallons)					
			Ice Roads*	Ice Pads	Const. Misc.	Drill Site Camp Support	Summer Construction Workforce	Construction Total
A	1	22.0	33.0	2.2	1.0			36.2
	2	26.0	39.0	2.2	1.0			42.2
	3-6							
B	1	25.5	38.3	2.2	1.0			41.5
	2	18.0	27.0	2.2	1.0			30.2
	3-6							
C	1	30.5	45.8	2.2	1.0			49.0
	2	11.0	16.5	2.2	1.0			19.7
	3-6							
D	1	20.0	30.0	2.2	1.0			33.2
	2	27.0	40.5	2.2	1.0			43.7
	3-6	12.0	20.0			0.5	2.7	23.2

Alternative	Year	Drilling Estimate (Million Gallons)					Annual Totals (mg)	Alternative Total (mg)
		Drilling	Camp Support	Drilling Misc.	Drilling Years	Drilling Total		
A	1						36.2	97.2
	2						42.2	
	3-6	1.0	2.7	1.0	4	18.8	4.7	
B	1						41.5	90.5
	2						30.2	
	3-6	1.0	2.7	1.0	4	18.8	4.7	
C	1						49.0	87.5
	2						19.7	
	3-6	1.0	2.7	1.0	4	18.8	4.7	
D	1						33.2	161.7
	2						43.7	
	3-6	16.0	4.2	1.0	4	84.8	21.2	

*Alt. D Drilling includes additional 2 MG for ice bridge.

**Does not include water demand for the construction work force housed in Western North Slope estimated at 3.6 MG per year for construction (years 1-2) for all the alternatives.

2.4.7.3 Ice Road and Pad Construction

Ice roads would be constructed to access the gravel source and construction areas (road, bridges, drill site, and pipelines). Separate ice roads are required for pipeline construction, gravel placement, and general traffic. The approximate ice road routes for Alternative A are shown in Appendix A, Sheets 35 and 36 of 36; exact routes may vary by up to a mile based on topography and other field conditions.

Ice pads measuring approximately 400 feet by 400 feet would be required for the GMT1 Project. During Year 1 of construction, ice pads would be built at the gravel source, gravel haul route, slurry plant and laydowns for the two bridges, totaling approximately 130 acres. During Year 2 of construction, ice pads would be built at both ends of the pipeline route, plus an additional pad for construction laydown, totaling about 50 acres. Additionally, Alternatives A, B, and C would include a 5-acre ice pad for each year of drilling.

2.4.7.4 Tiŋmiaqsiġvik (Ublutuoch) River Bridge Construction

Construction of the 350-foot Tiŋmiaqsiġvik (Ublutuoch) River Bridge is a major component of the GMT1 Project and will take place over one winter construction season. Due to its size and the complexity of construction activities, it may be necessary to temporarily place equipment and materials and to perform certain construction activities on the river ice. To facilitate this, ice will be thickened across the entire width of the channel for a length of approximately 200 feet upstream and downstream of the bridge. Traction material such as nut plug may be used on channel ice for safety purposes to prevent slips. Soil cuttings from installation of the piers will be disposed of at one of the mine sites and traction material, if used, will be collected prior to closing out the site at the end of the construction season, before the ice bridge thaws.

Due to safety and logistical concerns, CPAI may request approval to refuel equipment on the channel ice. Appropriate spill containment and CPAI's best management practices will be used for all refueling. Mixing of grout and concrete will be performed on channel ice with containment beneath these operations.

2.4.7.5 Access

Personnel, equipment, and materials would be transported overland on ice roads or the installed gravel road from Alpine to GMT1. Construction of GMT1 and associated facilities would result in increased vehicular traffic as a direct result of transporting materials (including gravel), equipment, and personnel. The most intensive activity would be gravel haul over ice roads. It is currently estimated that 12,000 vehicle round-trips between the selected material site and GMT1 construction locations would occur over a 2-3 month period each year of the estimated 2-year construction phase.

Although the GMT1 Project would not include an airstrip under Alternatives A, B, and C, construction activities would include some increase in air traffic; predominantly work crew transportation to CD1/APF from Fairbanks, Anchorage, or Deadhorse. Some materials and equipment may also be transported to CD1/APF by air. Between 5 and 15 additional (above baseline) Otter/Casa flights would be required each month under Alternatives A, B, and C in 2016 to support construction activities. Under these alternatives, June and July would experience the most flights, with a high of 15 flights per month. In addition to construction-related flights, up to 213 helicopter flights per month would be added to support special studies throughout May, June, July, and August of 2016. CPAI stated that after August 2016, it intends

to complete its special studies via road and that there would be no increase over baseline of flights from the existing Alpine field for special studies (DeGeorge, 2013).

Under Alternative D, between 5 and 15 additional (above baseline) Otter/Casa flights would be required each month in 2016, with November and December having the highest increase of 15 flights. July through October would have one additional DC-6 flight. There would also be an increase in helicopter flights. Up to 60 additional helicopter flights would occur May through October for gravel working crews and up to 517 additional flights would occur May through August for special studies. In 2017, Alternative D would have the same range of Otter/Casa flights and the same amount of special studies helicopter flights as in 2016. There would be no DC-6 flights or helicopter flights for gravel working crews. No flights beyond baseline flights are expected to occur past 2017.

Aircraft would maintain elevations of 1,000 feet or more except during takeoff and touchdown (within 3.6 miles of the airstrip). Flight paths would depend upon prevailing winds, but would generally align with the airstrip orientation.

See Table 2.4-3 below for flight requirements for the project alternatives.

Table 2.4-3. Flight Requirements for Project Alternatives

2016 Flights Required per Month by Alternative

		January	February	March	April	May	June	July	August	September	October	November	December
Alternatives A, B, and C[1]	Otter / Casa	5	10	10	10	10	15	15	10	10	10	10	10
	DC 6	0	0	0	0	0	0	0	0	0	0	0	0
	Helicopter (flights for special studies)	0	0	0	0	213	213	152	152	0	0	0	0
	Total New	**5**	**10**	**10**	**10**	**223**	**228**	**167**	**162**	**10**	**10**	**10**	**10**
	Total Including Baseline	153	140	199	206	619	628	512	353	210	229	229	210
Alternative D[2]	Flights for Operations Personnel at GMT1 (Otter/Casa)	0	0	0	0	0	0	0	0	0	0	0	0
	Construction to Alpine (Otter/Casa)	10	5	5	5	5	5	5	5	5	10	15	15
	Drilling (Otter/Casa)	0	0	0	0	0	0	0	0	0	0	0	0
	Operations Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Construction Cargo (DC-6)	0	0	0	0	0	0	1	1	1	1	0	0
	Drilling Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Large Cargo (C130)	0	0	0	0	0	0	0	0	0	0	0	0
	Flights to GMT1 for gravel working crew (Helicopter)	0	0	0	0	10	60	60	60	60	60	0	0
	Flights for Special Studies (Helicopter)	0	0	0	0	517	517	259	259	0	0	0	0
	Total New	**10**	**5**	**5**	**5**	**532**	**582**	**325**	**325**	**66**	**71**	**15**	**15**
	Total New Construction Flights	10	5	5	5	15	65	66	66	66	71	15	15
	Total New Operations Flights	0	0	0	0	0	0	0	0	0	0	0	0
	Total Including Baseline	158	135	194	201	928	982	670	678	266	290	234	215
Alternative E (Baseline)[3]	Otter / Casa	118	100	159	166	175	179	179	187	170	189	189	170
	DC 6	30	30	30	30	30	30	30	30	30	30	30	30
	Helicopter (flights for special studies)	0	0	0	0	191	191	136	136	0	0	0	0
	Total	**148**	**130**	**189**	**196**	**396**	**400**	**345**	**353**	**200**	**219**	**219**	**200**

Table 2.4-3. Flight Requirements for Project Alternatives (Continued)

2017 Flights Required per Month by Alternative

		January	February	March	April	May	June	July	August	September	October	November	December
Alternatives A, B, and C[1]	Otter / Casa	5	5	5	5	10	10	10	10	10	10	5	5
	DC 6	0	0	0	0	0	0	0	0	0	0	0	0
	Helicopter (flights for special studies)	0	0	0	0	213	213	152	152	0	0	0	0
	Total New	**5**	**5**	**5**	**5**	**223**	**223**	**162**	**162**	**10**	**10**	**5**	**5**
	Total Including Baseline	149	135	194	201	619	623	507	515	210	229	224	205
Alternative D[2]	Flights for Operations Personnel at GMT1 (Otter/Casa)	0	0	0	5	20	20	20	26	26	26	26	26
	Construction to Alpine (Otter/Casa)	5	5	5	5	10	10	10	10	10	10	15	15
	Drilling (Otter/Casa)	0	0	0	20	70	70	70	70	70	70	70	70
	Operations Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Construction Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Drilling Cargo (DC-6)	0	0	0	5	20	20	20	20	20	20	20	20
	Large Cargo (C130)	0	0	0	0	0	0	0	0	2	0	0	2
	Flights to GMT1 for gravel working crew (Helicopter)	0	0	0	0	0	0	0	0	0	0	0	0
	Flights for Special Studies (Helicopter)	0	0	0	0	517	517	259	259	0	0	0	0
	Total New	**5**	**5**	**5**	**35**	**637**	**637**	**379**	**385**	**128**	**126**	**131**	**133**
	Total New Construction Flights	5	5	5	30	100	100	100	100	102	100	105	107
	Total New Operations Flights	0	0	0	5	20	20	20	26	26	26	26	26
	Total Including Baseline	153	135	194	231	1033	1037	724	738	328	345	350	333
Alternative E (Baseline)[3]	Otter / Casa	118	100	159	166	175	179	179	187	170	189	189	170
	DC 6	30	30	30	30	30	30	30	30	30	30	30	30
	Helicopter (flights for special studies)	0	0	0	0	191	191	136	136	0	0	0	0
	Total	**148**	**130**	**189**	**196**	**396**	**400**	**345**	**353**	**200**	**219**	**219**	**200**

Table 2.4-3 – Flight Requirements for Project Alternatives (Continued)

2018 Flights Required per Month by Alternative

		January	February	March	April	May	June	July	August	September	October	November	December
Alternatives A, B, and C[1]	Otter/Casa	0	0	0	0	0	0	0	0	0	0	0	0
	DC 6	0	0	0	0	0	0	0	0	0	0	0	0
	Helicopter (flights for special studies)	0	0	0	0	0	0	0	0	0	0	0	0
	Total New	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Total Including Baseline	148	130	189	196	396	400	345	353	200	219	219	200
Alternative D[2]	Flights for Operations Personnel at GMT1 (Otter/Casa)	4	4	4	4	20	20	20	20	20	20	20	20
	Construction to Alpine (Otter/Casa)	0	0	0	0	0	0	0	0	0	0	0	0
	Drilling (Otter/Casa)	70	70	70	70	0	0	0	0	0	0	0	0
	Operations Cargo (DC-6)	3	3	3	3	3	3	3	3	3	3	3	3
	Construction Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Drilling Cargo (DC-6)	20	0	0	5	0	0	0	0	0	0	0	0
	Large Cargo (C130)	0	0	0	0	0	0	0	0	0	0	0	0
	Flights to GMT1 for gravel working crew (Helicopter)	0	0	0	0	0	0	0	0	0	0	0	0
	Flights for Special Studies (Helicopter)	0	0	0	0	517	517	259	259	0	0	0	0
	Total New	**97**	**77**	**77**	**82**	**540**	**540**	**282**	**282**	**23**	**23**	**23**	**23**
	Total New Construction Flights	90	70	70	75	0	0	0	0	0	0	0	0
	Total New Operations Flights	7	7	7	7	23	23	23	23	23	23	23	23
	Total Including Baseline	245	207	266	278	936	940	627	635	223	242	242	223
Alternative E (Baseline)[3]	Otter/Casa	118	100	159	166	175	179	179	187	170	189	189	170
	DC 6	30	30	30	30	30	30	30	30	30	30	30	30
	Helicopter (flights for special studies)	0	0	0	0	191	191	136	136	0	0	0	0
	Total	**148**	**130**	**189**	**196**	**396**	**400**	**345**	**353**	**200**	**219**	**219**	**200**

Table 2.4-3 – Flight Requirements for Project Alternatives (Continued)

2019 and Beyond Routine Alternative D Operations (to occur once construction and drilling are complete)

		January	February	March	April	May	June	July	August	September	October	November	December
Alternative D[2]	Flights for Operations Personnel at GMT1 (Otter/Casa)	4	4	4	4	20	20	20	20	20	20	20	20
	Construction to Alpine (Otter/Casa)	0	0	0	0	0	0	0	0	0	0	0	0
	Drilling (Otter/Casa)	0	0	0	0	0	0	0	0	0	0	0	0
	Operations Cargo (DC-6)	3	3	3	3	3	3	3	3	3	3	3	3
	Construction Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Drilling Cargo (DC-6)	0	0	0	0	0	0	0	0	0	0	0	0
	Large Cargo (C130)	0	0	0	0	0	0	0	0	0	0	0	0
	Flights to GMT1 for gravel working crew (Helicopter)	0	0	0	0	0	0	0	0	0	0	0	0
	Flights for Special Studies (Helicopter)	0	0	0	0	517	517	259	259	0	0	0	0
	Total New	7	7	7	7	540	540	282	282	23	23	23	23
	Total Including Baseline	155	137	196	203	936	940	627	635	223	242	242	223

[1] A, B, and C (above current baseline): Alternative A drilling needs will be handled by flights that are already part of the ongoing operations. No additional flights are anticipated. Under Alternative A once construction of the GMT1 road and pad are complete there will be no need for routine additional fixed wing flights as operation and maintenance will be handled by staff at the existing Alpine Facility (CD1) who will travel by road. The planned order of construction is ice roads, bridges, and gravel roads January-May 2016. Gravel, CD5 Pad, and APF work will occur during the summer season of 2016. Ice roads, pipelines, GMT1 pad, and VSM work winter will occur from January-May 2017. GMT1 modules, pipe rack, pipeline hydro-test, and tie-ins summer and possibly into fall 2017. Drilling and well tie-ins fall of season 2017. Special studies flights above the baseline are primarily hydrological related. Hydrological studies will peak during breakup (May and June). Approx. 70 percent of the hydrological studies will be conducted using boats launched from the road system.

[2] Alternative D: First winter (2016), no runway or camp at GMT1. Construction crews will stage out of Nuiqsut Hotel, Nuiqsut 10-Acre, and Alpine. Construction Otter/Casa flights during the winter of 2016 will land at Alpine. May to October 2016, 2 helicopter flights a day for small gravel-working crew at GMT1- no GMT1 camp or runway availability. Second summer (2017) - GMT1 facilities install contractors working from GMT1 camp. Some personnel, cargo, and seasonal drilling flights would continue, beyond these dates, throughout the life of the project. Special Studies above the baseline are primarily hydrological related. Hydrological studies will peak during breakup (May & June). All of the hydrological studies will be conducted using helicopter flights.

[3] Current (baseline): Otter/Casa flight counts are monthly averages from the years 2011-2013. DC-6 flight numbers may vary by month but are equally distributed based on the expected number of annual flights for estimation purposes. Special Studies includes Biological and hydrological. Hydrological studies peak during breakup (May & June), biological studies remain constant.

The baseline "flights for Special Studies" in the above table include biological and hydrological studies. Hydrological studies generally peak during breakup (May and June). Biological studies remain constant.

Alternatives A, B, and C drilling needs would be handled by flights that are already part of the ongoing operations. No additional flights are anticipated. Once construction of the GMT1 road and pad are complete, there would be no need for routine additional fixed wing flights as operation and maintenance would be handled by staff at the existing Alpine Facility (CD1), who

would travel by road. Approximately 70 percent of the hydrological studies would be conducted using boats launched from the road system.

Under Alternative D, the winter of 2016 would consist of no runway or camp at GMT1, so construction crews would stage out of the Nuiqsut Hotel, Nuiqsut 10-Acre, and Alpine. Otter/Casa flights used for construction during the winter of 2016 would land at Alpine. Two helicopter flights per day would be required for a small gravel-working crew at GMT1 from May to October 2016 because there would be no GMT1 camp or runway available at that time. During the summer of 2017, GMT1 facilities would be installed with contractors working from the GMT1 camp. Some personnel, cargo, and seasonal drilling flights would continue beyond these dates, throughout the life of the project. Under Alternative D, all of the hydrological studies would be conducted using helicopter flights.

2.4.8 Drilling and Operations

Drilling is planned to begin in the second quarter of 2017 and would continue until all planned wells are completed, estimated to be 15 to 48 months. The drilling rig and associated camp would initially be fueled by ULSD until power lines are installed. A temporary camp would be located at GMT1 during drilling. Sanitary wastes that may be generated from the camp would be hauled to an approved disposal site, or treated and discharged under the North Slope General APDES Permit AKG-33-1000. Food waste would be incinerated at Alpine and non-burnable waste would be recycled or transported to the NSB landfill at Deadhorse. No permanent camp facilities are required at GMT1.

Following the initial round of drilling, operations would focus on well operations, production, and transportation of produced hydrocarbons. Standard CPAI operations and maintenance practices would be implemented. Key elements of drilling and operations are addressed below.

2.4.8.1 Access

During drilling activities, the number of monthly vehicle round-trips between CD5, APF, and GMT1 is estimated at 390-450, and during operations vehicle round-trips are estimated at two to four a day (68-120 per month) (BLM 2004, Table 2.3.10-1).

Under Alternatives A, B, and C, drilling and production activities will require an additional five to ten flights per month into APF during the fall of 2017. Helicopter flights to support special studies will be in addition to these five to ten flights per month, and will range from 152 to 213 flights per month throughout May, June, July, and August. Once drilling and construction are completed, operations support is expected to be delivered via road access for Alternatives A, B and C.

Under Alternative D, during drilling activities, it is estimated that up to 90 aircraft flights into Alpine would be required each month from April 2017 to April 2018. During operations air traffic would decrease by a maximum of 26 one-way flights a month in 2017. Most of these flights would occur May through December with no flights occurring January through March. Up to 23 flights a month would occur 2018 and beyond, with most of these also occurring May through December. Aircraft would maintain elevations of 1,000 feet or more except during takeoff and touchdown (within 3.6 miles of the airstrip at Alpine). Flight paths would depend upon prevailing winds, but would generally align with the airstrip orientation. Specifics for flight numbers under Alternatives A, B, and C are presented in Table 2.4-3 for the 2016 and 2017 flights required per month by alternative).

2.4.8.2 Water Use

Fresh water is required for domestic use at the drilling camp and during drilling activities. Potable water requirements are based on a demand of 100 gallons per day (gpd) per person (estimated up to 75 people), totaling approximately 7,500 gpd during drilling. Drilling water requirements are estimated at 20,000 - 38,000 gpd. Water for drilling would be withdrawn from lakes in the vicinity of the project as authorized by temporary water use permits and fish habitat permits where necessary. See Table 2.4-2 for water use for the project alternatives.

2.4.8.3 Erosion Control Measures

The GMT1 Project would follow the Alpine Facilities Erosion Control Plan, which was updated to include GMT1 and is included in Appendix C. The erosion protection design for GMT1 culverts and bridges are included in Appendix A, Sheets 11 and 12 of 36. The Alpine Facilities Erosion Control Plan outlines procedures for operation, monitoring, and maintenance of various erosion control methods. Erosion control at Alpine is accomplished using a combination of biotechnical and engineering control (physical armor) methods. Temporary erosion protection would be placed before breakup following the first construction season to provide protection from a flood event. The temporary protection would be replaced with permanent erosion protection once the gravel had been allowed to season (settle and drain). Alpine's Storm Water Pollution Prevention Plan (SWPPP) would be amended to cover management of GMT1 and other pads' drainage.

The Alpine Erosion Control plan also contains snow removal and dust control plans. Snow removal plans include the use of snow blowing equipment to minimize gravel carryover to the tundra and placing cleared snow in designated areas. The dust control plan includes watering gravel roads to minimize dust impacts on the tundra and maintain the integrity of the roads.

2.4.8.4 Spill Prevention

GMT1 Project facilities have been designed to minimize the possibility of spills. For a detailed discussion of the impacts associated with potential spills, and for potential new mitigation measures related to spill prevention and response, see Section 4.5. In addition, CPAI would implement a pipeline maintenance and inspection program and an employee spill prevention training program to further reduce the likelihood of spills occurring. BLM received scoping comments suggesting new mitigation measures and best management practices related to spill prevention and response, which it has considered as part of this NEPA process.

CPAI would design and construct the pipelines to comply with applicable state, federal, and local regulations, and would go beyond those minimum requirements, as described below. The pipelines would be constructed of high-strength steel and would have wall thicknesses equal to or in excess of regulatory requirements. Welds would be validated using non-destructive examination (NDE) (i.e., radiography and ultrasonic) during pipeline construction to ensure their integrity, and the pipelines would be tested hydrostatically prior to operation. The production crude and water injection pipelines would be fully capable of using pigs for cleaning and corrosion inspection operations. Manual valves would be placed on the production pipeline on both sides of the Tiŋmiaqsiġvik (Ublutuoch) River to minimize spill volume in the event of a release.

CPAI's design of production facilities would include provisions for secondary containment for hydrocarbon-based and hazardous materials, as required by state and federal regulatory requirements.

Spill Prevention and Response

Spill prevention and response measures that would be used during construction and operation of the GMT1 drill site are outlined in the Alpine Development Participating Area ODPCP and Alpine SPCC Plan. The intent of the ODPCP and SPCC Plan are to demonstrate CPAI's capability to prevent oil and hazardous materials spills from entering the water and land and to ensure rapid response if a spill event occurs. The Alpine ODPCP complies with State of Alaska requirements in AS 46.03.020(10)(A) and 18 AAC 75, federal EPA regulations in 40 CFR 112 for FRPs, and US Department of Transportation (USDOT) requirements in 49 CFR 194. The SPCC Plan complies with the federal EPA regulations in 40 CFR 112. Additional new potential spill response mitigation measures can be found in Section 4.5.

CPAI would implement an oil spill contingency plan designed to minimize accidental oil spill impacts. The current Alaska Department of Environmental Conservation (ADEC) approved Alpine ODPCP would be amended to include the GMT1 drill site. Through the amended Alpine ODPCP, CPAI will ensure that readily accessible inventories of appropriate oil spill response equipment and personnel at Alpine will be available for use at the drill site. In addition, the spill response cooperative, Alaska Clean Seas (ACS), will act as CPAI's primary response action contractor and will provide trained personnel to manage all stages of a spill response, from containment, to recovery, and cleanup.

The threat to rivers and streams from a possible pipeline spill between the drill site and Alpine would be minimized by quickly intercepting, containing, and recovering spilled oil near the waterway-pipeline crossing points. The response strategy for GMT1 involves two approaches: (1) a design component, and (2) equipment pre-staging, as described below:

(1) The pipelines would be located north (downstream) of the road from CD4 westward until exiting the western edge of the delta, and would continue on the north side of the road outside of the delta until near their connection at the CD5 pad. In the delta, placing the pipelines on the downstream side (i.e., north) side of the road would prevent ice impacts to the pipelines during breakup because the road would act as a barrier to ice. Outside (west) of the delta the pipelines would also be on the north side of the road because the topography slopes toward the Nigliq Channel in this area and the road would act as a barrier to potential spilled oil reaching the Nigliq Channel. The road stream crossings would be used as the primary control points to contain the spilled oil. The road could be used for access and staging for spill response.

(2) Spill response equipment would be placed at the drill site for an initial response. This strategy will facilitate the rapid deployment of equipment by personnel. The effective response time would be considerably reduced by this pre-staging concept and this would expedite equipment deployment to contain and recover spilled oil and to minimize the affected area. During summer, pre-staged containment boom placed at strategic locations in selected river channels would also help to mitigate a spill and facilitate a rapid response.

The Alpine SPCC Plan is implemented to prevent oil discharge to waters of and incorporates a comprehensive spill prevention program to minimize the potential for oil discharges at Alpine facilities. The plan would be updated to include GMT1 facilities.

Spill Training and Inspections

CPAI provides regular training for its employees on the importance of preventing oil or hazardous material spills, and spill response. CPAI provides new-employee orientation, annual environmental training seminars, and appropriate certification classes about specific issues, including spill prevention and response. CPAI employees participate in frequent safety

meetings, which address spill prevention and response issues, as appropriate. The CPAI Incident Management Team also participates in regularly scheduled training programs and conducts spill response drills in coordination with federal and state agencies.

CPAI is required to conduct visual examinations of the pipeline and facility piping at least monthly during operations. CPAI is capable of providing aerial overflights as necessary to allow inspection both visually and with the aid of forward-looking-infrared (FLIR) technology. Infrared technology permits identification of spills based on the temperature "signature" resulting when warm fluid (oil) leaks. The FLIR technology is capable of detecting warm spots in darkness or when other circumstances such as light fog or drifted snow limit visibility. FLIR technology also has the ability to identify trouble spots along the pipeline, such as damaged insulation, before a problem occurs. CPAI would also conduct regular ground-based visual inspections of facilities and pipelines from gravel roads under Alternatives A, B and C. Inspections would be conducted via ice road and air under Alternative D.

2.4.8.5 Fuel Storage

Diesel may be stored on site during drilling and construction operations under all alternatives. During the operations phase other fluids that may be stored include corrosion inhibitor, scale inhibitor, methanol, emulsion breaker, and foam inhibitor.

Fuel storage would comply with state and federal oil pollution prevention requirements, according to the Alpine ODPCP and SPCC Plan. Secondary containment for fuel storage tanks would be sized as appropriate to container type and according to governing regulatory requirements in 18 AAC 75 and 40 CFR 112. BLM is also analyzing new potential mitigation measures related to fuel storage, found in Section 4.5.

2.4.8.6 Waste Handling and Disposal

Sanitary wastes that may be generated from the camp would be hauled to an approved disposal site or treated and discharged under the North Slope General APDES Permit AKG-33-1000. Food waste would be incinerated at Alpine and non-burnable waste would be recycled or trucked to the NSB landfill at Deadhorse. Other hazardous and solid waste associated with the GMT1 Project would be managed under ADEC and EPA regulations as well as BLM Best Management Practices (BMPs) A-1, A-2, A-6 and A-7 (BLM 2013).

Drilling wastes (i.e., muds and cuttings) would be disposed of through annular disposal on-site and/or transported to an approved Class II disposal well such as the Alpine disposal well at CD1. Drill cuttings may be washed and reused. Reserve pits are not required and would not be constructed. A temporary storage cell would be constructed for staging of muds and cuttings prior to disposal. Produced water would be processed and re-injected to the subsurface. Well work waste materials would be managed according to the Alaska Waste Disposal and Reuse Guide.

2.5 Alternative B

In 2004, the Alternative B theme was "Conformance with Stipulations," specifically directed at complying with three stipulations in place in 2004 requiring an exception, as described in Section 2.1. Alternative B for the current SEIS has been updated since 2004 in the following ways:

The BLM (2004) determined that it is technically infeasible to locate all facilities at least 500 feet from a waterbody. Thus, Alternative B in the SEIS does not keep all facilities and infrastructure at least 500 feet from a waterbody. (Note: the term "body of water or waterbody" is defined in BLM (1998a, p. 29), BLM (2008e, p. 33), and BLM (2013, p.40), as "*a lake, river, stream, creek, or pond that holds water throughout the summer and supports a minimum of aquatic life*.")

The Tiŋmiaqsiġvik (Ublutuoch) River setback (stipulation K-1[g])) did not exist in 2004. Stipulation K-1(g) was adopted in BLM (2008e) and carried forward in BLM (2013). The Tiŋmiaqsiġvik (Ublutuoch) River setback Stipulation in BLM (2013) allows for essential road and pipeline crossings of the main channel, which will be part of the GMT1 Project.

The BLM (2004) alternatives did not consider the Fish Creek setback extending into Kuukpik land. The Applicant may be subject to the lease stipulation K-1(e) on both BLM-managed land and Kuukpik-owned land at the discretion of the new surface landowners.

For these reasons, the current Alternative B is based on keeping all GMT1-related infrastructure out of the Fish Creek setback. Alternative B is very similar to Alternative A, as it would involve the same drill site location and facility design – the difference between the two alternatives is the location of the road and pipeline. It is assumed that all other components of construction, drilling, and operations described in Section 2.4 for CPAI's proposed Alternative A are the same for Alternative B. Ice roads and pads would be located to support construction of the road and pipeline along the corridor described.

Alternative B differs from Alternative A by routing the access road and pipeline from GMT1 to CD5 south of the Fish Creek setback and tying it in to the CD5 road and pipeline east of the CD5 drill site at a new tie-in pad, as depicted in Figure 2.5-1, and described below. Alternative B would also eliminate the need for a bridge over Crea Creek and a culvert placed at Barely Creek.

This alternative would require a slightly longer road and pipeline, as well as an additional pad of approximately 0.7 acres that would be required for additional automatic shut-off valves, pipeline pigging capability, and valve maintenance activity with vehicular access. The configuration of the road under Alternative B requires the additional tie-in pad, located east of the CD5 drill site in order to avoid having the pipeline from GMT1 tie-in to CD5 within the Fish Creek setback.

As a result, Alternative B will have a slightly larger footprint and greater fill requirement than the Alternative A development, as summarized in Table 2.4-1. This route is technically challenging for road construction and maintenance (e.g., poor soils, thaw stability) due to the extent of thaw basins along the route. This route would also be approximately 8.6 miles long (0.8 mile longer than Alternative A).

2.6 Alternative C

Alternative C would feature the same GMT1 drill site location and facility design, as well as the same route for the access road and pipeline to CD5 as described for Alternative A. Additional features of Alternative C are shown in Figure 2.6-1, and described below:

- Upgrade of the Nuiqsut Spur Road, which is a 5.8-mile, 24-foot-wide roadway (44-foot-wide base) between the CD5 Access Road to the Nuiqsut Dump Road, to a 32-foot

roadway (52-foot-wide base). Nuiqsut Spur Road construction is proposed for the winter of 2013-2014. The Nuiqsut Spur Road was proposed by Kuupkik to provide better access to oilfield facilities for potential economic gain (e.g., training, jobs, and services) and to increase subsistence user access to resources by providing increased road access (Kuukpik Corporation [Nuiqsut Spur Road Project Description] 2013, pp. 2 and 3).

- The upgrade of the Nuiqsut Dump Road is a proposed improvement as part of the Nuiqsut Spur Road Project, which would construct a 24-foot-wide roadway with a 44-foot-wide base over the existing road surface. Alternative C would further upgrade this road to a 32-foot-wide roadway with a 52-foot-wide base between the intersection of the Nuiqsut Spur Road and the new Airport Access Road.
- Construction of an approximately 1.2-mile new Airport Access Road between the Nuiqsut Dump Road and a new logistics pad at the Nuiqsut Airport. The roadway would be 32-feet wide with a 52-foot-wide base.
- Construction of a 400-foot x 400-foot (3.7-acre) logistics pad with a 1.4-acre taxiway-apron connecting to the existing airstrip. The logistics pad would include areas for vehicle storage, warehouse, and fuel storage and dispensary.
- Construction of a 500-foot extension of the existing runway on the west end, resulting in an approximately 1.6 acre of footprint.
- Upgrade of the Nuiqsut Airport would allow for its use as a logistics center for the GMT1 Project whereby personnel and certain supplies would be brought to Nuiqsut rather than to APF, then transported to GMT1 by road vehicles. The Nuiqsut Airport has an unattended 4,589-foot gravel runway. For comparison, the APF runway is a 5,000-foot gravel runway. The diversion of air traffic from APF to Nuiqsut would potentially reduce air traffic at APF and the potential for disturbing subsistence resources and activities in the Colville Delta around APF. A reduction in air traffic at APF is not certain under this Alternative, since the Applicant has stated their intention to continue using APF as the primary location for air logistics for the GMT1 Project regardless of which Alternative is selected. BLM does not have jurisdiction over the Nuiqsut airport, which is on private land.

Alternative C would have a larger footprint than Alternative A, therefore requiring additional fill (see Table 2.4-1).

Existing infrastructure at Nuiqsut includes limited lodging and stores; upgrading these facilities is not part of Alternative C. The Nuiqsut runway is lighted and used year-round. Northern Air Cargo (NAC) operates regularly scheduled cargo flights to Deadhorse with connecting flights to Nuiqsut. ERA Alaska operates regularly-scheduled flights into Nuiqsut originating from Anchorage, Fairbanks, Barrow, and Deadhorse. Daily flights from Barrow and Deadhorse are supplemented with an additional flight on Monday, Wednesday, and Friday (ERA Aviation, 2013). An increase in flight operations at Nuiqsut would be expected under Alternative C, assuming use of Nuiqsut as an air logistics alternative access for the GMT1 Project. Flights into Nuiqsut could be used for transport of personnel, materials, parts, food, camp supplies and to meet other support needs at the GMT1 site. A logical result would be diversion of some flights from APF to Nuiqsut, resulting in reduced air traffic in the area of APF.

Extension of the Nuiqsut Airport Runway to the west would cross a small stream that may be problematic due to the culvert length that would be necessary to maintain drainage at that site.

Therefore, a bridge is proposed. The stream is not identified as anadromous by the Alaska Department of Fish and Game (ADF&G), but may be fish-bearing.

Equipment, supplies, and personnel destined for GMT1 would be flown or trucked directly into Nuiqsut, and then transported via the Nuiqsut Spur/GMT1 road system to the drill site. Alternative C would include a road connection to the Nuiqsut airport that would bypass the village to the west. The 3.7-acre logistics pad would provide vehicle storage and a repair warehouse to shelter and service vehicles. The vehicles could include pickup trucks, road graders, water trucks, and front-end loaders. The pad would also have cold storage and warm storage. Electrical power supplied from the Nuiqsut grid would be connected to vehicle storage area facilities. The pad would have a water storage tank and a waste accumulation tank. Water would be supplied from Nuiqsut. Wastewater would be hauled by tank truck to existing approved treatment and disposal facilities at Nuiqsut.

Utility services in Nuiqsut are limited; however, they do provide a potential source of electricity, water, sewer, and trash disposal. Electrical power at Nuiqsut is provided by the NSB Nuiqsut Utility power plant. The Nuiqsut Landfill is a Class III (village) landfill authorized for disposal of septage, inert, municipal, ash, sludge, construction debris, fish waste, and animal waste. The landfill is operated by the North Slope Borough. The Nuiqsut Wastewater Treatment Plant allows disposal of secondary treated domestic wastewater. Interior water piping and sewage connections to all buildings in Nuiqsut were made in 2002; these utilities may be available for connection at the logistics pad. Nuiqsut drinking water is derived from a nearby lake then treated and stored in a holding tank. Residents also have individual water tanks with water delivery service, and use honeybuckets to dispose of sewage. Sewage hauling services are provided.

Except for access and logistical differences described above, it is assumed that all other components of construction, drilling, and operations described in Section 2.4 for Alternative A are the same for Alternative C. Ice roads and pads would be located to support construction of the road and pipeline along the corridor described in Alternative C.

2.7 Alternative D

Alternative D defines development in which there is no year-round road access between GMT1 and the existing APF. In this roadless or limited access scenario, transportation to GMT1 from the existing APF would be primarily by aircraft approximately 9 months of the year (May through January), and primarily via ice road approximately 3 months of the year (February through April). To access the drill site, during the winter season an ice road would be constructed along a corridor from the seasonal Alpine ice road to the airstrip. Alternative D is depicted in Figure 2.7-1. Drilling would continue year-round to achieve economic and production goals, unlike the seasonal drilling activity at the roadless CD3 pad. Alternative D would have the same drill site location and pipeline route to CD5.

On-Site Facilities

The following facilities are required to complete drilling and operations activities at a limited access GMT1 drill site:

- 5000 foot airstrip and parking apron that is Hercules C-130 capable for transporting a relief well drilling rig in the event of a well blowout or other emergency;
- Airstrip maintenance and equipment storage building;

- Mud plant and bulk cement facilities;
- Storage silos for cement and mud;
- Tanks for mineral oil, diesel and brine;
- Class 1 disposal well;
- Disposal tanks and piping;
- Injection pump module;
- Drilling and mud plant water supply;
- Water storage tanks;
- Permanent full service operations camp;
- 25 man sleeping quarters;
- Kitchen – dining facilities;
- Recreation, office, storage space;
- Water and wastewater treatment plant;
- Potable water supply 2-inch pipeline;
- Potable water storage;
- 2-inch diesel pipeline;
- Storage tank;
- Fueling station;
- Mineral oil pipeline to GMT1 mud plant;
- On-site solid waste processing;
- Waste staging area;
- Permanent tank farm and piping (chemical storage);
- Pad space for 10-month supply of drilling tubulars and tools;
- Pad space for redundant equipment parking;
- Bullrails for vehicle block heaters;
- Class I disposal well Injection Facility;
- Mud plant and bulk cement facility;
- Drilling and Mud plant raw water pump module;
- Incremental 40-man drilling support rig camp;
- Incremental 200-man construction support camp;
- Permanent full service operations camp;
- Waste water treatment plant;
- Potable water supply pump module;
- Diesel supply pump module on-site solid waste facility;

- Permanent tank farm and piping (chemical storage);
- Warm and cold storage facilities;
- Fleet maintenance shop;
- Emergency response facility; and
- Flight operations storage facilities.

Limited access requires that certain services, equipment and supplies otherwise provided at the APF would need to be duplicated at the drill site. A full-time workforce at GMT1 would also be required. GMT1 would be re-supplied during the ice road season, requiring long-term storage of drilling and operating fluid and supplies. A tank farm would be needed to provide appropriate storage volumes for all operating fluids such as methanol and anti-corrosion chemicals. A new mud plant and bulk cement facility would be required for drilling because the existing plant at APF must remain in place to service drilling operations at the other satellites. Diesel fuel for powering the drill rig would be transported to the site via a new 2-inch diesel pipeline from APF. Waste fluids from drilling would not be transported for disposal at APF; therefore, a new Class 1 disposal well with injection facilities would be required at GMT1.

Additional construction and drilling camp facilities would be required when there is no dependable access to lodging at Alpine. Construction activities in the summer months would require either an onsite man-camp, commuting via aircraft to APF, or a combination of both. The shift from an unmanned facility (post-drilling) to a manned facility would require permanent full-service living quarters to support long-term operations. On-site potable water supply and wastewater management would be required. During the summer months, other wastes would require on-site management. The additional facilities would increase the required gravel pad space requirement and associated footprint of this alternative. For this alternative, the GMT1 pad was designed to separate occupied facilities (e.g. housing) from the drilling operations to comply with safety regulations.

Alternative D would have a larger footprint than Alternative A, requiring additional fill, as summarized in Table 2.4-1.

As with the proposed access road, local hydrology would likely require cross drainage structures for the Alternative D airstrip. Due to prevailing wind patterns, the Alternative D runway is designed to be orientated similarly to the CD5 roadless alternative runway from BLM (2004) (see Figure 2.4-2). Therefore, as an initial assumption, the 35 degree skew angle used at CD5 for estimating cross drainage culverts results in a cross drainage culvert length greater than 250 feet at the airstrip at GMT1.

Access

A limited access GMT1 would be accessible from the APF by air travel at all times, weather permitting. Under frozen ground conditions, an approximately 12- mile ice road from the annual Alpine ice road, crossing the Tiŋmiaqsiġvik (Ublutuoch) River with an ice bridge, would also provide dependable access to the drill site for approximately three months of the year.

Alternative D would involve air transport of personnel who would be staged at the GMT1 site during construction, drilling, and operation phases. The operations center for all Alpine satellite facilities are located at APF, most of the scheduled air traffic would continue to fly to APF. Personnel needing access to GMT1 would then continue on another short flight across the delta

to their final destination. Additional project specific flights between APF and GMT1 would be expected to transport personnel, materials, parts, food, waste management, camp supplies and other support.

Under Alternative D, construction related activities would require between 5 and 71 flights per month in 2016, with the heaviest volume of flights occurring from June through October. Construction and drilling-related flights under Alternative D would vary from 5 to 107 flights per month in 2017, with the heaviest volume occurring from May through December. Drilling-related activities in the first four months of 2018 would require an additional 75 to 90 flights per month, with the most occurring in January.

Once construction and drilling are completed for Alternative D (in 2018), air transportation will be needed on an ongoing basis to support operations. Required flights would range from 7 to 23 flights per month, with 7 occurring January through April, and 23 occurring June though December. In addition to these flights, flights for special studies would remain ongoing, and would range from 259 to 517 flights per month throughout the study season (March through August). Specifics for flight numbers under Alternative D are presented in Table 2.4-3 for 2016, 2017, and 2018 flights required per month by alternative.

Water Use

Water would be piped to the site via a 2-inch water line from the APF. Water use from local lakes would increase by approximately 20 to 24 million gallons per year to construct the annual ice road (estimated at 1.5 million gallons per mile; includes lake access roads and ice bridge across the Tiŋmiaqsiġvik [Ublutuoch] River). See Table 2.4-2 for water use for the project alternatives.

Power Requirements

The limited access of Alternative D would require significantly greater power consumption than the unmanned development proposed in Alternative A. This increase in power consumption is required to provide pump power, lighting, heat and ventilation for the facilities required in a limited access concept. The table below provides a summary of power needs per Alternative.

Table 2.7-1. Summary of Power Needs Per Alternative

Alternative	Summary of Power Needs	Megawatts
A	Total Power required for the GMT1 Project: Alternative A, an un-manned development including remote electrical module, pigging module, test separator module, fuel gas module, production heater, chemical injection module, emergency shutdown module, pad lighting, heat trace and other drill site power requirements (shown in Appendix A on Sheet 6 of 36).	1.0 MW
D (Additional)	Additional elements required for Alternative D: • Class I disposal well Injection Facility • Mud plant and bulk cement facility • Drilling and Mud plant raw water pump module • Incremental 40-man drilling support rig camp • Incremental 200-man construction support camp • Permanent full service operations camp • Waste water treatment plant • Potable water supply pump module • Diesel supply pump module on-site solid waste facility • Permanent tank farm and piping (chemical storage) • Warm and cold storage facilities • Fleet maintenance shop • Emergency response facility • Flight operations storage facilities	6.0 MW
D	Total	7.0 MW

Emergency Response

Pipeline inspections and maintenance and emergency response activities would depend on air logistics up to 9 months of the year. An emergency response facility would be required at GMT1, with dedicated equipment staged onsite. Mobilizations of emergency response equipment, supplies, and personnel housed at the APF would be challenging, particularly during periods of adverse weather. Safety response time could also be compromised when air access is restricted by adverse weather. As noted above, due to adverse weather, air travel has been restricted at APF 13 to 22 percent each year over the last four years. Under Alternative D, the incremental challenges associated with being able to timely respond to Emergency Life Saving and Spill events increases safety and environmental risks throughout the life of the project.

2.8 Alternative E

Under the No-Action Alternative, the current conditions and expected future condition in the absence of the project are evaluated. CPAI's right-of-way application, application for permit to drill, and related authorizations would not be approved by BLM.

The No Action Alternative assumes continuing exploration work as required under the GMTU Agreement. For NEPA purposes, BLM does not assume that if CPAI's GMT1 applications are denied that exploratory drilling will cease. The No Action Alternative further assumes that the Nuiqsut Spur Road and CD5 would be constructed, as those authorizations are independent of CPAI's proposed project.

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CHAPTER 3: AFFECTED ENVIRONMENT

A comprehensive description of the affected environment in and around the Alpine Field, including the proposed GMT1 development, was provided in BLM (2004). The BLM (2012) provided updates of some aspects of the affected environment. The summaries of the existing environment provided in Section 3 are tiered to, and incorporate by reference BLM (2004, § 3) and BLM (2012, § 3), with specific references cited below.

3.1 Introduction

The objective of this section of the SEIS is to summarize the affected environment, as described in BLM (2004), and supplement it with new information to determine whether the effects of the proposed project are still within the range of effects analyzed in BLM (2004). In some cases, the 2004 information has not changed (e.g., vegetation), but the description presented herein is based on new site-specific monitoring of the GMT1 pad. Where more recent information is available, including CPAI studies undertaken to comply with stipulations of BLM (2004a) and to support final GMT1 Project site location(s) and design, this information is included to provide a more robust description of the affected environment.

3.1.1 Project Study Area

The GMT1 project facilities and proposed drill site are located entirely within the Northeast NPR-A, on the North Slope of Alaska, immediately west of the Colville River Delta. The water injection pipeline component from CD4N to APF/CD1, as described above in Section 2.4.3, will be located within an existing pipeline ROW and parallel to two existing pipe racks in the Colville River Delta. New pipeline VSMs will be located to match existing VSMs to avoid a "picket-fence" effect that could impede caribou movement.

The project study area defined for this SEIS is depicted on Figure 3.1-1. The study area extends 2.5 miles in radius from proposed project facilities and covers 102,487 acres. Resources have a varied geographic scope, depending upon each individual resource. For example, the geographic scope of air quality analysis is broader than the scope used for soil analysis.

3.1.2 Existing and Planned Infrastructure

The proposed GMT1 drill site lies approximately 12 miles northwest of Nuiqsut, a community of about 400 people (see Section 3.4.1 for more information). An approximately 4,500 foot airstrip, owned and operated by the NSB, serves Nuiqsut year-round. Seasonal ice roads to Alpine facilities are typically extended to Nuiqsut, allowing access to the Prudhoe Bay road system during the winter.

Kuukpik Corporation, the Nuiqsut Village Corporation, has applied for permits to construct an approximately 5.8-mile-long gravel road connecting to the CPAI CD5 access road (Figure 2.6-1), which would include a new 10-acre gravel storage pad near the juncture. The road is intended to increase access to subsistence resources; provide access for training and employment of local residents at the Alpine oilfield; improve access from Alpine to Nuiqsut to facilitate local business opportunities (e.g., camp facilities); and provide year-round transportation for life/safety/health response, spill response (e.g., mutual aid), and medical emergencies. Improvements to the Nuiqsut Dump Road which is part of the Nuiqsut spur road construction is scheduled to begin winter 2013 -2014. The main Alpine development complex at CD1/APF is

approximately 14 miles northeast of the proposed GMT1 drill site, as shown in Figure 2.4-1. A gravel road connecting CD5 with APF is planned for construction in 2014. Alpine is not connected by gravel road to any existing North Slope road system, and is only accessed by seasonal ice road and by air.

There are several cabins in the area. A number of federal and industry exploration wells are in the project study area, but no development has occurred. Several small weather stations are located west of the project study area.

3.1.3 Hazardous and Solid Waste Sites

This section tiers to information provided in BLM (2004, §§ 3.1.2 and 4.3); BLM (2008b, § 3.2.10); and BLM (2012, § 3.2.11), and updates spill data through October 2013 from the ADEC Spills Database (ADEC 2013).

3.1.3.1 Existing Sites

Inside the NPR-A, hazardous and solid waste locations have been identified and mapped including landfills, reserve pits, formerly used defense sites, and privately-owned sites. None are in the project study area (BLM 2008b, § 3.2.11; Figure 3.1-1). Other sites with potential for hazardous materials and solid waste inside and outside of the NPR-A (e.g., Nuiqsut community sources, winter travel routes, recreational trails, and oil and gas exploration sites) are described by BLM (2004, § 3.1.2.3).

One contaminated site was identified near the project study area (Nuiqsut Power Plant; ADEC Contaminated Sites database; ID 25937). Other potential sources include more recent oil industry exploration sites, three production pads (CD1, CD2, and CD4), and associated pipelines in the vicinity of the proposed pipeline alignment between CD4 and CD1/APF. No unregulated hazardous or solid waste sites are known to exist in these areas.

The EPA Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) was also researched for any sites identified within the Alpine Field Development Area. CERCLIS consolidates facility information from multiple EPA systems. No sites were listed within the Alpine Field Development Area. The records review is based on data extracted October, 2013.

3.1.3.2 Alpine Spill History

Oil and gas exploratory and production wells exist in the Alpine Field region and produce a large amount of crude oil (daily oil production in 2011 averaged 55,246 barrels of oil per day [BOPD]). Pipelines within the Alpine Field consist of a gathering line that transports unprocessed oil and water from CD2, CD3, and CD4 to the APF/CD1 and a 34-mile long oil sales pipeline that connects the processing facility to the Kuparuk River oil field. VSMs elevate the pipelines above the tundra, except at the Colville River main channel crossing where the pipeline is underground (ARRT, 2012). The transportation, storage, and use of petroleum products create the potential for spills, leaks, and contamination. Industry facilities with potential to create spills include onshore wellheads, crude oil production facilities, major crude oil and non-crude oil storage, and pipeline facilities.

A review of the ADEC Spills Database, for State-registered spills, showed 195 entries for spills reported within the Alpine Field for the entire operating period, 1998 through October 2013. The largest volume of spilled product was from seawater spills (45 percent or 5,340 gallons)

making up nearly half of all spills recorded for the Alpine Field since inception. This was followed by spills from non-crude oil (e.g., diesel, hydraulic oil, engine lube oil, aviation fuel) at 33 percent (or 3,920 gallons). Non-crude spills accounted for the greatest number of spills occurring during this time period, making up 142 recorded spills out of the 195 entries. Of this total, diesel makes up more than 60 percent (or 2,525 gallons) of the non-crude spills. Produced water contributed about 18 percent (or 2,138 gallons) of the total volume of spills from the Alpine Field.

There is a generally decreasing trend in spill occurrences since 2006 following construction and startup of production at CD3 and CD4, which had the highest number of spills (27) for the period of analysis. Spill volume by source showed leaks to be the greatest source of spills occurring at Alpine (5,098 gallons), followed by equipment failure (2,222 gallons), human error (1,113 gallons), and valve failure (940 gallons). Spills of unknown origin accounted for 795 gallons of the total volume spilled.

Further analysis revealed a seasonal increase in the number of spills during the January through April timeframe. This could be the result of increased exploration activities during the winter months. This is also consistent with the spills analysis and trends reported in the Alaska Regional Response Team's North Slope Subarea Contingency plan (ARRT 2012) for spills occurring in the entire North Slope subarea (North Slope Borough). The North Slope Subarea Contingency Plan supplements the Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases (Unified Plan), and provides information specific to the NSB area, including emergency response phone numbers, available response equipment and other resources, specific response guidelines, and information on hazardous substance presence and sensitive areas protection. Additional spill information and analysis is described in Section 4.5.

The most prevalent geomorphic units present within the project study area include ice-rich margin thaw basin (17 percent), fresh water (17 percent), delta inactive overbank deposit (15 percent), alluvial-marine deposit (14 percent). Descriptions of these units are provided in Jorgenson et al. (2003, p. 13).

Supplemental site-specific information relevant to the evaluation of physiography within the project study area was not identified.

3.2 Physical Characteristics

The following description of physical characteristics of the project study area is structured and organized to match BLM (2004).

3.2.1 Terrestrial Environment

The terrestrial environment remains essentially the same as described in BLM (2004), but there is an increased understanding of the role of climate change in the Arctic.

3.2.1.1 Physiography

The physiography (physical geography) of the project study area is described in BLM (2004, § 3.2.1) and BLM (2012, §§ 3.2.4 - 3.2.5) following Wahrhaftig (1965).

The project study area is on the Arctic Coastal Plain (ACP), an area characterized by low topographic relief, numerous lakes, meandering stream channels, and polygonal patterned ground. The geomorphic classification of the project study area is shown in Figure 3.2-1. The areal extent of each geomorphic unit occurring with the project study area is listed in Table 3.2-1.

Table 3.2-1. Geomorphic Units[1] in the Project Study Area

Geomorphic Unit	Acres	Project Study Area (%)
Thaw Basin, Ice-rich Margin	15,392.0	17%
Fresh Water	15,136.4	17%
Delta Inactive Overbank Deposit	13,334.2	15%
Alluvial-Marine Deposit	12,715.6	14%
Thaw Basin, Ice-rich Center	7,608.1	8%
Old Alluvial Terrace	5,664.6	6%
Delta Abandoned Overbank Deposit	4,035.5	4%
Coastal Water	3,498.1	4%
Delta Thaw Basin, Ice-poor	3,119.5	3%
Delta Active Channel Deposit	2,274.5	3%
Meander Inactive Overbank Deposit	1,471.1	2%
Delta Active Overbank Deposit	1,142.9	1%
Thaw Basin, Ice-poor Margin	1,126.3	1%
Eolian Inactive Sand Deposit	1,107.1	1%
Delta Inactive Channel Deposit	785.7	1%
Delta Thaw Basin, Ice-rich	301.0	<1%
Eolian Active Sand Deposit	291.9	<1%
Lowland Headwater Floodplain	196.0	<1%
Fill and Embankments	177.1	<1%
Thaw Basin Pingo	146.2	<1%
Gravel Fill	128.2	<1%
Meander Abandoned Overbank Deposit	100.0	<1%

Table 3.2-1. Geomorphic Units[1] in the Project Study Area (Continued)

Geomorphic Unit	Acres	Project Study Area (%)
Meander Fine Inactive Channel Deposit	96.6	<1%
Thaw Basin, Ice-poor Center	72.3	<1%
Thaw Basin, Ice-rich Undifferentiated	53.5	<1%
Inactive Tidal Flat	37.2	<1%
Meander Active Overbank Deposit	18.7	<1%
Solifluction Deposit	13.9	<1%
Thaw Basin, Ice-poor Undifferentiated	7.0	<1%
Meander Fine Active Channel Deposit	4.5	<1%
Sewage Lagoon	3.1	<1%
Total	90,058.9	100%

[1] Data from Jorgenson et al. (2004).

3.2.1.2 Geology and Minerals

The proposed project is in the NPR-A, where the geology has been studied by the U.S. Geological Survey (USGS) for more than 100 years. Information on geology of the project study area is presented by BLM (2004, § 3.2.1.2), BLM (2008b, § 3.2.4) and BLM (2012, § 3.2.5).

Supplemental site-specific information relevant to the evaluation of geology and mineral resources within the project study area was not identified.

3.2.1.3 Petroleum Resources

The petroleum geology of the NPR-A, historical and recent exploration efforts, leasing activity, and oil and gas potential is described in BLM (2008, § 3.2.5) and BLM (2012, § 3.2.6).

Geologists assess oil and gas potential of the area by defined geologic plays, each with unique characteristics. In 2010, the USGS assessed the undiscovered technically recoverable oil resource in the NPR-A at 896 million barrels (MMbbl) (BLM 2012, § 3.2.6.3). Based on data from industry exploration, the USGS estimated that 120 to 200 MMbbl of discovered oil (oil and condensate) may also be technically recoverable in the NPR-A (USGS 2010). Other information on geology is provided in BLM (2004, § 3.2.1.2) and BLM (2012, § 3.2.5).

3.2.1.4 Soils and Permafrost

Soils and permafrost in the Northeast NPR-A within the project study area are described in BLM (2004, §§ 3.2.1.3-3.2.1.4), with additional information provided in BLM (2008b, § 3.2.7) and BLM (2012, § 3.2.8).

The soils in the region are shallow and wet, with deep permafrost beneath. In the project study area, vegetation covers much of the surface, with an associated layer of ice-rich organic silt, silt, and sandy silt. Detailed results of soil samples collected around the general project study area are reported in *Geomorphology of the Northeast Planning Area, National Petroleum Reserve–Alaska,* by Jorgenson, et al. 2003.

The project study area is underlain by continuous permafrost, which on the North Slope, ranges from depths of about 650 feet to more than 2,000 feet. During the Arctic summer, solar radiation thaws a shallow layer of soil at the surface, creating a seasonally unfrozen zone

termed the active layer. Beneath the active layer, almost all material remains frozen; segregated and massive ice formations are common. A continuing supply of available water is required to maintain many of these features and without new water they may degrade rapidly, resulting in a change of vegetation and ecosystems. Permafrost impedes the infiltration of surface water, resulting in saturated surface soils. Vegetation insulates the permafrost, and disturbance of surface vegetation can increase melting of permafrost and result in subsidence. The potential for subsidence varies with ice content of the soils. As noted above, the alluvial-marine deposits in the project study area contain fairly high mean ice volumes. These same deposits are typically found out of the active floodplain, yielding a lower potential to impound water which would promote permafrost degradation (BLM 2004, § 3.2.1.3). Information is provided in BLM (2004, § 3.2.1.3) and BLM (2012, § 3.2.8.2).

Climate change and the effects on the terrestrial environment in the project study area are discussed in Section 3.2.4.

3.2.1.5 Sand and Gravel Resources

Sand and gravel resources in the project study area and the region are discussed in BLM (2004, § 3.2.1.5), BLM (2008b, § 3.2.8) and BLM (2012, § 3.2.9). The sand and gravel material sites identified within the project study area include the existing ASRC Mine Site located east of the Colville River and the proposed Clover site on the west side of the river described in BLM (2004, p. 160). The locations of these are identified in Figure 3.1-1.

The area west of the Colville River is characterized by an apparent scarcity of suitable gravel for construction (BLM 2012, § 3.2.9).

On federal lands in the NPR-A, subsurface sand and gravel are owned by the federal government, and the Secretary of the Interior can dispose of these resources for use in permitted activities within the NPR-A, including energy production and development.

3.2.1.6 Paleontological Resources

Paleontological resources occur in many parts of the NPR-A, with important known localities associated with bluffs and banks of the northern Colville River, notably around Ocean Point. Previous surveys were performed and included documentation of paleontological resources in the project study area. Because of the sensitive nature of this information and laws limiting its dissemination, the specific locations of identified sites are not included herein. These studies were reviewed and no paleontological resources were documented that would be directly affected by the project. Other information on paleontological resources is provided in BLM (2004, § 3.2.1.6) and BLM (2012, § 3.2.7).

3.2.1.7 Renewable Energy

The renewable energy resources within the NPR-A are discussed in BLM (2012, § 3.2.3). The existing and potential development areas for renewable energy projects, including wind, solar, and biomass are evaluated by BLM as part of land use planning.

The potential for commercial wind energy generation facilities in the project study area is likely to be low. Generation sites need to be close to end-users (communities). Most of the land around villages is owned by Native corporations; the BLM manages very little land adjacent to communities (BLM 2012, p. 152). The potential for commercial solar or biomass energy operations is very low in the NPR-A (BLM 2012, p. 152).

3.2.1.8 Wildland Fire

Wildland fire in the NPR-A is discussed in BLM (2004, § 3.3.3) and includes both wildfires and prescribed fires. Wildfires are unplanned fires that occur in wildlands and are caused by human or natural means (e.g., lightning strikes), whereas prescribed fires are naturally or manually ignited fires that occur in areas where burning is planned. Prescribed fires have not been used as a management tool within the NPR-A and are not proposed (BLM 2012, p. 222).

Large wildfires are rare in the tundra; most are small and although fires larger than 10,000 acres have occurred, the 256,000-acre Anaktuvuk River Fire in 2007 was unprecedented. Palynological (pollen) investigation of two foothills lakes shows little evidence of large, extensive fires in the past 5,000 years and analysis of deeper lake cores have revealed only a few large fires in the past 9,000 years or so. The number of recorded fires on the North Slope has increased over the past 40 years, although this may be attributed to increased detection (BLM 2012, p. 222).

Previous occurrence of wildfire in the project study area is unknown.

3.2.2 Water Resources

The aquatic environment, including the project study area is described in BLM (2004 § 3.2.2.1) and BLM (2012 §3.2.10.1).

Water resources in the project study area consist mainly of rivers, shallow discontinuous streams, lakes, and ponds. Springs are absent, deep groundwater is saline, and shallow groundwater is limited to shallow areas below rivers and lakes. Streams in the ACP typically freeze relatively early and thaw relatively late (e.g., September and June). Wetlands are described in Section 3.3.2, Vegetation and Wetlands.

Hydrology in the project study area is predominantly a function of climate and permafrost, which limits water availability. More than half the annual precipitation occurs as snow, and snowmelt contributes the majority of annual runoff and helps maintain a saturated layer of surface soils.

This section summarizes relevant information originally presented in the BLM reports cited above and includes supplemental information regarding hydrology in the proposed project area and project study area obtained from studies conducted in 2009 through 2011 by Michael Baker Jr., Inc. (2009, 2010, and 2011).

3.2.2.1 Rivers, Streams, and Drainage Basins

The following discussion is drawn from BLM (2012, § 3.2.10.1). While hydrologic data for the proposed project study area is limited, streams and rivers for which data are available share flow characteristics that are unique to the region (Brabets 1996). In the winter, flow is generally nonexistent or so low as to not be measurable. River flow begins during breakup in late May or early June as rapid flooding and when combined with ice and snow, can inundate extremely large areas in a matter of days. More than half of the annual discharge for a stream can occur during a period of several days to a few weeks (Sloan 1987). Most streams continue to flow throughout the summer, but at substantially lower discharges. Rainstorms can increase stream flow, but they are seldom sufficient to cause flooding within the ACP. Stream flow rapidly declines in most streams shortly after freezeup in September and ceases in most rivers by December. Streams on the North Slope are generally divided into three types, based on the

physiographic province of their origin: those that originate: (1) on the ACP, (2) in the Arctic Foothills, or (3) in the Brooks Range.

The ACP is a mosaic of tundra wetlands with extremely low relief. Because the permafrost prevents water from entering the ground and the low relief limits runoff, the ACP is covered with lakes, ponds, and generally slow-moving streams. Streams originating in the ACP generally have the latest breakup and earliest freeze up. The Tiŋmiaqsiġvik (Ublutuoch) River and Fish Creek both originate in the ACP.

Streams originating in the Arctic Foothills have a steeper gradient and consequently more gravel bar and cut bank features than those on the ACP. These streams tend to break up earlier, freeze up later, and have a slightly higher average unit runoff than streams of the ACP. Judy Creek, located within the project study area, has its origin in the Arctic Foothills.

The Colville River is the largest river on the North Slope originating in the Brooks Range. As the only river that includes mountainous and glacial drainage, the Colville River carries the highest sediment load and exhibits the greatest range of geomorphic features of any river in the area. Breakup and freezeup are more complex along the Colville River because of the extreme length and range of elevation. Flow persists later in the year on the Colville River than on other North Slope rivers in the region.

More than half the project study area is located within the Colville River drainage basin, although the project study area is also located within the Fish Creek drainage basin, Judy Creek drainage basin, and the Tiŋmiaqsiġvik (Ublutuoch) River drainage basin. The project study area is located primarily within the eastern portion of the Fish Creek drainage basin (MBJ 2009; BLM 2004; BLM 2012).

A summary of general hydrologic data for the major drainages within the project study area is provided in Table 3.2-2 and shown on Figure 3.2-2.

Table 3.2-2. Summary of Drainage Basins within the Project Study Area

Drainage Basin	Waterbody	Headwater Origin	Receiving Water	Drainage Area (MI^2)	Lake Coverage (%)
Colville River	Colville River (Nigliq Channel and East Channel)	Brooks Range	Harrison Bay	20,920	Unknown
Fish Creek	Fish Creek	Arctic Foothills and Arctic Coastal Plain	Harrison Bay	1,827	22%
Judy Creek	Judy Creek	Arctic Foothills	Fish Creek	666	18%
Tiŋmiaqsiġvik (Ublutuoch) River	Tiŋmiaqsiġvik (Ublutuoch) River	Arctic Coastal Plan	Fish Creek	248	15%

Adapted from BLM (2004,Table 3.2.2-2) with additional information from BLM (2012, Table 3-12)

Colville River and Colville River Delta

The Colville River is the longest river (370 miles) and has the largest drainage basin (20,920 mi^2) on the North Slope of Alaska, extending from the Brooks Range to the Arctic Ocean (Jorgenson et al. 1997). The Colville River Delta is more than 25 miles-long and covers approximately 250 mi^2 (Jorgenson et al. 1994). The head of the Colville River Delta is the downstream-most point where the river flows in a single channel. No new information

regarding the Colville River or Colville River Delta are presented herein; the information remains unchanged from BLM (2004, § 3.2.2.1).

Fish Creek Basin Streams

The general Fish Creek drainage basin and stream information is described in BLM (2004, § 3.2.2.1) and BLM (2012, § 3.2.10.1).

The Fish Creek drainage basin is relatively large (1,827 mi^2) with portions of its headwaters in the Arctic Foothills, as well as the ACP. The Fish Creek basin consists of three significant tributary basins: Inigok Creek drainage basin, Judy Creek drainage basin, and Tiŋmiaqsiġvik (Ublutuoch) River drainage basin (URS Corporation 2003). Only the Judy Creek drainage basin has a significant portion of its headwaters in the Arctic Foothills (BLM 1998a).

Supplemental information relative to the project study area and more recent studies are presented below.

The Fish Creek drainage basin has two significant streams affected by the proposed project plan, Fish Creek and its tributary, the Tiŋmiaqsiġvik (Ublutuoch) River. Fish Creek flows northeast and enters Harrison Bay just west of the Colville River delta. The Tiŋmiaqsiġvik (Ublutuoch) River (as well as the Nigliq Channel of the Colville River) is used by residents of Nuiqsut for access to hunting and fishing areas (BLM 2004, §3.4.9.4).

The hydrology of the project study area, including the Tiŋmiaqsiġvik (Ublutuoch) River sub-drainage has been studied from 2001 through 2011 to support GMT1 project design. The Tiŋmiaqsiġvik (Ublutuoch) River is a tributary of Fish Creek that flows north approximately 7 river miles, connecting to Fish Creek approximately 10 river miles upstream from Harrison Bay. It is characterized by numerous meander bends, often with undercut banks (MBJ 2009) which are vegetated with dense brush (Dietzmann et al., 2002).

Eight drainage and sub-drainage basins, including the Tiŋmiaqsiġvik (Ublutuoch) River drainage, are crossed along the proposed route to GMT1. Delineation of sub-drainage basins that contribute to the flow at various points along the proposed corridor for the GMT1 project show that water flow along the road corridor is typically from the south to north. In general, the sub-drainage basins are relatively small (4.1 mi^2 or less) and water flow across the proposed access route would be limited (MBJ 2009).

The Tiŋmiaqsiġvik (Ublutuoch) River is the largest and only perennial stream along the GMT1 proposed corridor ROW. Two other small streams are crossed by the proposed GMT1 access road. Barely Creek is a channel of beaded streams that drain to a small sub-basin of ponds and marshes located just to the west of the Tiŋmiaqsiġvik (Ublutuoch) River. The proposed access road crosses Crea Creek approximately 0.75 mile west of Barely Creek. At this location, Crea Creek flows between two smaller lakes and has a firm channel bed with underlying sedge and banks dominated by willows (MBJ 2009).

Flooding Regime

Flooding of North Slope rivers is influenced by the type of physiographic region drained, the size of the drainage area, and the frequency of the event. Snowmelt flooding occurs annually in all North Slope rivers. For rivers in the project study area, snowmelt flooding nearly always produces the annual peak discharge. On some of the larger rivers, summer precipitation or late summer/fall snowmelt events have been observed to produce low magnitude floods. Ice jams during breakup can also influence or result in flooding as described in the sections below.

As spring breakup flooding is normally the largest annual flooding event each year on the North Slope, monitoring of this event is integral to understanding regional hydrology. The breakup cycle is the result of several factors including snow pack, sustained cold or warm temperatures, ice thickness, wind speed and direction, precipitation, and solar radiation (MBJ 2009).

Colville River and Colville River Delta

The flooding regime for the Colville River and Colville River delta remain essentially as described in BLM (2004, § 3.2.2.1).

Fish Creek Basin

The hydrologic conditions on Fish Creek, Judy Creek, and the Tiŋmiaqsiġvik (Ublutuoch) River were investigated during breakup in 2001, 2002 and 2003 (URS Corporation 2001 and 2003; MBJ 2003). These studies were presented in BLM (2004, §3.2.2.1) and included monitoring sites at six locations along Fish Creek, four locations along Judy Creek, and two locations along the Tiŋmiaqsiġvik (Ublutuoch) River.

The hydrologic conditions within the Fish Creek drainage basin were further studied in 2009, 2010, and 2011 to support the proposed GMT1 project (MBJ 2009, 2010, 2011). These findings are summarized below and peak discharge, stage, and date information obtained for the Tiŋmiaqsiġvik (Ublutuoch) River, location 6.8, from 2003 through 2011 is summarized on Table 3.2-3.

In 2009 nine locations were monitored during the breakup including seven small drainages along the proposed access road corridor, the proposed pad site, and the Tiŋmiaqsiġvik (Ublutuoch) River at the proposed road crossing. The nine locations represented sub-drainage basins within the Fish Creek drainage basin ranging in size from 0.4 mi^2 to 4.1 mi^2. The 2009 breakup was slightly earlier than the historical average (a period of unseasonably warm weather preceded breakup), characterized by relatively low water surface elevation, small stream flooding resulting from local melt, and slightly lower peak discharge readings. Peak stages within the eight sub-drainage basins were observed between May 29 and June 3, 2009 (MBJ 2009).

In 2010, seven locations were monitored, during the breakup, including four locations at the Clover site, one small drainage near GMT2, a small stream crossing the proposed GMT1 access road, and the Tiŋmiaqsiġvik (Ublutuoch) River at the proposed GMT1 road crossing. The Clover site monitoring data is discussed in Section 3.2.2.4. The 2010 breakup was slightly later than the historical average, characterized by relatively lower peak water surface elevations and lower peak discharges. In fact, breakup on the Tiŋmiaqsiġvik (Ublutuoch) River occurred approximately five days later than the historical average on June 8 with some ice jamming present at the time of peak flow (MBJ 2010).

In 2011, observations and measurements were collected from 16 locations along the proposed GMT1 and GMT2 access road corridor and the proposed Clover site during breakup. The Clover site monitoring data is discussed in Section 3.2.2.4. The 2011 breakup was characterized by relatively low surface water locations, and slightly earlier peak discharge (MBJ 2011).

Table 3.2-3. Tiŋmiaqsiġvik (Ublutuoch) River Historical Peak Discharge, Stage, and Date

Year	Peak Discharge		Peak stage	
	Volume (cfs)	Date Observed	Stage (ft bpmsl)	Date Observed
2011	2,350	June 2	9.39	June 2
2010	5,360	June 8	10.38	June 8
2009	1,990	May 30	8.45	May 29
2006	1,290	June 6	6.19	June 7
2005	1,680	June 9	10.01	June 7
2004	2,800	June 5	10.50	June 6
2003	1,300	June 9	10.14	June 6

Adapted from Table 1.1 in Michael Baker Jr. Inc. 2011. Data only includes location 6.8.

cfs – cubic feet per second

BPMSL – BP (British Petroleum) mean sea level

Flood Frequency Predictions

The flood-peak discharge estimates for head of the Colville River, Fish Creek, Judy Creek, and the Tiŋmiaqsiġvik (Ublutuoch) River were presented in BLM (2004, § 3.2.2.1, Table 3.2.2-7).

Michael Baker Jr., Inc. (2009a) noted that the proposed GMT1 access road bridge crossing at the Tiŋmiaqsiġvik (Ublutuoch) River will be the largest drainage structure between CD5 and GMT1 and calculated flood frequency predictions and peak stage estimates as shown in Table 3.2-4.

Table 3.2-4. Tiŋmiaqsiġvik (Ublutuoch) River Flood Frequency and Peak Discharge and Stage Estimates

Recurrence Interval (yr)	Peak Discharge (cfs)	Peak annual stage estimates (ft bpmsl)
2	3,600	9.2
5	5,300	10.5
10	6,500	11.1
25	7,900	Not Presented
50	8,800	11.9
100	9,800	12.1

Adapted from Tables 5.1 and 5.3 in Michael Baker Jr. Inc. 2009. Data only includes location 6.8.

cfs – cubic feet per second

BPMSL – BP (British Petroleum) mean sea level

3.2.2.2 Lakes and Ponds

The characterization of lakes and ponds within the project study area, remains essentially as described in BLM (2004, § 3.2.2.1) and BLM (2012, § 3.2.10.1), as summarized in the sections below.

Lakes and ponds are the most common hydrologic feature on the ACP, including the project study area, with most of the lakes and ponds in this region originating from the thawing of ice-rich sediments (Sellman et al. 1975). Surface water sources located in close proximity to proposed GMT1 project facilities include a lake immediately south of the proposed GMT1 drill pad, as well as several lakes, drainages, and creeks along the access road.

Unlike streams, lakes store water year-round and are the most readily available water source on the North Slope (Sloan 1987), with availability of year-round water determined by the depth of the lake. Lakes are generally classified by depth, as either shallow (less than 6 feet) or deep (greater than 6 feet) lakes.

Recharge of lakes in the project study area occurs through three mechanisms: (1) melting of winter snow accumulations within the lake's drainage basin, (2) overbank flooding from nearby streams, and (3) precipitation in the form of rainfall (MBJ 2002). Smaller lakes may also be recharged by other lakes within the project study area if they are connected by a channel.

Shallow Lakes and Ponds

Seasonally flooded wetlands, ponds, and shallow lakes dominate the ACP in the project study area. The shallow lakes and ponds generally begin to freeze in September, freeze to the bottom by mid-winter, and become ice-free between mid-June and early July, about a month earlier than the deeper lakes (Walker 1983 and Hobbie 1984).

While ponds and shallow lakes generally lack fish because they usually freeze to the bottom, they can provide important summer rearing fish habitat if they have a channel connecting them to a stream or deep lake that supports overwintering fish. They also provide important habitat to emergent vegetation, invertebrates, and migratory birds due to the earlier availability of ice-free areas.

Deep Lakes

Deep lakes (greater than 6 feet deep) with relatively large areas are present in the southern and western areas of the ACP. Some deep lakes are present within the project study area. Because deep lakes do not freeze to the bottom, they provide an overwintering area for fish and aquatic invertebrates and are the most readily available supply of water during the winter. Deep lakes also have a larger thermal mass, thus the deeper lakes may remain covered by ice into early July, much later than the shallow lakes (Walker et al. 1978).

Deep lakes, along with river channels deeper than 5 to 7 feet, provide the most important fish habitats within the project study area.

Lake Water Use

Ongoing and future oilfield activities within the project study area would utilize ice roads and pads during the winter for access and transportation. Each winter season, millions of gallons of fresh water are withdrawn from regional lakes for the construction of ice roads and pads. Water withdrawals for construction can begin as early as December and continue through April. Ice roads are usually completed mid-winter; however, water withdrawals for ice road and pad maintenance continue throughout the season. Freshwater lakes are also used as a potable water source and as sources of make-up water for exploratory drilling operations (MBJ 2002). Between 1999 and 2006, approximately 513 million gallons (MG) of water from 126 lakes were used for exploration and construction of ice roads and pads (BLM 2006). Generally, water withdrawals during winter occur from lakes 7 feet deep or deeper and are limited to 15 percent of the estimated free-water volume remaining below the ice.

During the construction phase of the project, fresh water would be required for domestic use at remote construction camps and for the construction and maintenance of ice roads and ice pads. Potable water requirements are estimated at 10,000 gallons per day (gpd) during construction seasons. Approximately 1.5 MG of water per mile are needed for ice road construction and maintenance (90 days). The estimated miles of ice roads, area of ice pads, and associated water

use for the action alternatives is summarized in Table 2.4-2 and Section 2.4.7.4. Water for construction and maintenance of ice roads will be withdrawn from lakes in the vicinity of the project as authorized by temporary water use permits and fish habitat permits where necessary.

The proposed project will require fresh water for domestic use and for drilling activities during the drilling and production phase. Potable water requirements during drilling are estimated at 7,500 gpd during drilling. Drilling water requirements are estimated at 20,000 to 38,000 gpd. Water for drilling will be withdrawn from lakes in the vicinity of the project as authorized by temporary water use permits and fish habitat permits where necessary.

Lake Studies

The BLM (2004, § 3.2.2.1) described several lake studies conducted between 2000 and 2003 that are located within the project study area. Key findings from these studies are summarized briefly below.

- Over a five-year study period, water withdrawals generally did not affect water chemistry, nor did they directly affect fish populations (MJM Research 2003). With respect to the lakes' water quality, pumping did not appear to affect temperature, pH, turbidity, sulfate, or nitrate levels (MBJ 2002).
- Lake water quality changed little as a result of pumping (for water withdrawal), water surface elevation changes in pumped lakes were within the range of changes seen in reference lakes, and changes in water surface elevations were correlated with changes in ice thickness (Oasis 2001).
- Water withdrawal rates were typically well below the maximum allowable. The water level decreases caused by pumping did not advance the freezing rate of the study lakes, and water levels depressed by pumping returned to pre-pump levels before freezeup (MBJ 2002).
- Water surface elevations in the majority of pumped lakes were lowered more than in reference lakes. The dominant mechanism for recharge of the lakes was melting winter snow accumulations. Data from 2001 and 2002 studies as well as anecdotal information at seven North Slope communities (including Nuiqsut) indicated that the magnitude of spring recharge has always been sufficient to compensate for withdrawals (MBJ 2002).

3.2.2.3 Subsurface Water (Groundwater)

The characterization of groundwater within the project study area remains essentially as described in BLM (2004, §3.2.2.1) and BLM (2012, § 3.2.10.1), as summarized in the sections below.

In general, usable subsurface water in the project study area is limited to distinct and unconnected shallow zones due to the presence of permafrost, which is almost continuous across the North Slope (BLM 2004, § 3.2.2.1). The frozen state of the soils combined with their fine-grained characteristics and saturated conditions form a confining layer that prevents percolation and recharge from surface water sources, and prohibits the movement of groundwater. Because percolation and recharge are restricted, the formation of usable subsurface water resources is limited to unfrozen material on top of the permafrost or taliks (thawed zones) beneath relatively deep lakes, or zones in thawed sediments below major rivers and streams. In general, while these shallow groundwater zones do exist, they are typically very small and the water is likely unsuitable for drinking and potentially harmful to vegetation when discharged on the tundra surface (BLM 2004, § 3.2.2.1).

In the project study area, shallow supra-permafrost water also occurs seasonally within the active zone above the impervious permafrost; the thickness of the active layer is typically 1.5 feet, but ranges from 1 feet to 4 feet (BLM 2004, § 3.2.2.1).

Groundwater within permafrost or intra-permafrost water occurs in discontinuous confined locations, where often the presence of dissolved salts depresses the freezing point of the water. Like shallow groundwater, the saline quality of the intra-permafrost groundwater makes it unsuitable for drinking water and potentially harmful to vegetation if discharged to the tundra surface. The usability of this type of groundwater source is likely to be limited because of the nature of its formation.

Deep wells drilled through the permafrost have encountered highly mineralized groundwater at depths of 3,000 feet to more than 5,000 feet in the vicinity of Prudhoe Bay and at depths of 1,600 feet to 2,500 feet near Barrow, but little data on deep water sources in the project study area exist (Sloan 1987, BLM 1998a, Kharaka and Carothers 1988). Available data suggest that deep groundwater in the NPR-A would probably be similar to that found at Barrow and Prudhoe Bay, and would be too saline for domestic use.

Recharge

Snowmelt provides the major source of water for recharge to the shallow water-bearing zones that occur below large lakes and major streams and to the annual thaw zones that occur beneath ponds and marshy areas (BLM 2004, § 3.2.2.1). However, deeper groundwater zones beneath the permafrost are not as readily recharged. Sub-permafrost water may be recharged from areas to the south in the Arctic Foothills and the Brooks Range by infiltration of meltwater. It is also possible that the sub-permafrost water could represent stagnant and/or isolated water zones that were cut off from recharge and groundwater movement as a result of the formation of permafrost during the Pleistocene, or that were isolated by orogenic events associated with the formation of the Brooks Range.

Springs

Landsat imagery analysis was used to locate numerous groundwater springs on the North Slope by identifying the large overflow icings (aufeis) created downstream during the winter. However, none of these springs were located in the project study area (BLM 2004, § 3.2.2.1).

3.2.2.4 Clover Potential Material Source Site

The proposed Clover site is bounded on the north by the Tiŋmiaqsiġvik (Ublutuoch) River and on the west, east, and south by drainage channels that only experience flow during breakup. Bill's Creek (also referred to as Clover B), located on the west side of the proposed Clover site, flows during summer and is important to feeding fish, including broad whitefish. Observed breakup conditions at the Clover site are characterized by local melt resulting in little to no overland flow (MBJ 2009).

Four locations were monitored near the proposed Clover site during breakup in 2010. In 2010, all four locations were noted to have observable flow by June 6; on June 4 only localized melt had been observed. Peak flow for the four sites occurred between June 7 and June 8. Three of the four locations still had observable flow at the end of July; the fourth site had water present, but no observable flow as of mid-July and was not visited later in the season (MBJ 2010).

Seven locations were monitored near the proposed Clover site during breakup in 2011. At these sites, the 2011 breakup proceeded rapidly after the initial melt associated with the warmer spring temperatures until June 3, then slowed. Peak water surface elevations were observed

between June 1 and June 3 in the Clover B drainage and between May 31 and June 2 in the Clover C drainage (MBJ 2011).

3.2.2.5 Surface Water Quality

A summary of surface water chemistry by analyte in the project study area is contained in the ASDP Final EIS as cited in BLM (2004, § 3.2.2.2) and in BLM (2012, § 3.2.10.2). Results for water quality that are relevant to the project study area are summarized below.

It is important to have knowledge of existing water quality conditions in determining potential impacts of proposed actions. Surface water is used by fish and wildlife in the project study area and could be a source of potable water for humans. The State of Alaska water quality standards are published in 18 AAC 70. The State of Alaska drinking water regulations prescribe treatment for potable use. Drinking water regulations for the State of Alaska are published in 18 AAC 80. Drinking water is obtained from lakes near the Alpine development (lakes L9313 and L9312) and Nuiqsut. A discussion regarding drinking water for these sources is included in Section 3.4.1.5 Community Health and Welfare.

Most freshwaters in the project study area are considered pristine as stated in BLM (2012, § 3.2.10.2); however, fecal contamination above State of Alaska water quality standards may occur in areas with dense avian, caribou, and lemming populations. Cold water temperatures tend to prolong the viability of fecal coliform. Ponds and local streams are highly colored from dissolved organic matter and iron, and most freshwater bodies in the NPR-A have low turbidity and dissolved oxygen (DO) near saturation. According to ADEC, no freshwater in the proposed project area is impaired by pollutants (BLM 2004a, § 3.2.2.2, p. 184).

Water quality data specific to the lakes in the vicinity of GMT1, CD1, and CD4 were collected in 2002, 2004, and 2006-2012 as described in MJM Research (2004), MJM Research (2006), MBJ (2009b), North Slope Science Initiative Alaska (2009), MBJ (2010), and Derry et al. (2012). Surface water features, including named lakes, are included in Figure 3.2-3.

These data can be used to evaluate the potential impact to water quality from roads and pads associated with CD1 and CD4 and provide background water quality data for the proposed project area. Turbidity measured was variable between lakes and during monitoring years but, in all cases, was well below the levels that affect aquatic organisms. DO measured during the summer was typically near 100 percent saturation in the lakes sampled as discussed in MJM Research (2006), MBJ (2009b), and MBJ (2010). DO concentrations for lakes approximately 10 feet deep remained high during the March 2011 sampling event but were about half for lakes 6 feet deep as discussed in Derry et al. (2012).

In one study, lakes M9924 and M9925 (see Figure 3.2-3), located north and south of the proposed project area, respectively, were sampled four times in August 2002. Results from the samples analyzed for each lake met the water quality standards for DO, pH, and turbidity (MJM Research 2004). In 2006 and 2008, water chemistry results from lake samples collected within 10 miles of the proposed project area, also met the water quality standards for DO, pH, and turbidity (North Slope Science Initiative 2009).

Information available for alkalinity and pH, with respect to freshwater bodies within the proposed project area, remain essentially as described in BLM (2004, § 3.2.2.2) and in BLM (2012, § 3.2.10.2).

3.2.3 Atmospheric Environment

The general nature of the atmospheric environment is essentially as described in BLM (2004). Emerging trends in climate change that were described in 2004 have continued, with more recent information provided in BLM (2012).

3.2.3.1 Climate and Meteorology

The Project is in the Arctic climate zone. Weather is typical of the North Slope, with long, cold winters and short, cool summers. The annual mean temperature in the NPR-A is about 10^0F, with subfreezing temperatures from mid-October into May. Summaries of temperature and precipitation data collected at Umiat and Barrow (within the NPR-A), Kuparuk Oil Field (east of NPR-A), and Nuiqsut (the community closest to the NPR-A) are presented in Table 3.2-5. Temperature data collected from 2008 through 2012 at the private meteorological monitoring station in Nuiqsut, operated by CPAI, are summarized below.

- Maximum daily mean temperature = 70.3°F; maximum temperature 83.5°F.
- Minimum daily mean temperature = -54.9°F; minimum temperature -57.1°F.
- Mean temperature = 10.0°F.

Snowfall is greatest in October, but can occur during any month of the year. Snow cover is common from October through May. Average snow depth (December through April) ranges from 10 inches in Barrow to 15 inches in Umiat (BLM 2012, § 3.2.1). Snow depth is not monitored in Nuiqsut. Additional data are provided in BLM (2004, § 3.2.3.1).

Table 3.2-5 Monthly Weather Summary

Umiat [1,2]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temperature (F)	-12.7	-13.8	-6.7	11.5	32.4	57.5	66.2	57.7	41.4	18.2	-0.7	-11.9	19.9
Average Min Temperature (F)	-28.9	-31.2	-26.8	-11	15.7	37	42.5	37.2	26.1	2.4	-16.8	-28	1.5
Average Total Precipitation (in)	0.38	0.26	0.16	0.21	0.07	0.68	0.79	1.06	0.47	0.68	0.38	0.33	5.46
Average Total Snowfall (in)	4.5	2.4	2.3	1.9	1.2	0.2	0	0.2	2.6	8.5	5.2	4.2	33.2
Average Total Snow Depth (in)	14	16	17	17	9	0	0	0	0	5	9	12	8
Kuparuk [1,2]	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Max Temperature (F)	-11.1	-11.6	-8.2	8.5	28.3	47.4	55.9	50.6	39	21.3	3.5	-4.8	18.2
Average Min Temperature (F)	-23.6	-24.4	-22.5	-6.5	16.9	33	38.8	36.7	28.8	10.6	-9.6	-17.8	5
Average Total Precipitation (in)	0.12	0.17	0.08	0.15	0.07	0.34	0.88	1.05	0.49	0.35	0.15	0.13	3.98
Average Total Snowfall (in)	2.5	2.5	2.2	2.8	1.8	0.5	0	0.3	3.1	8.3	4.2	3.5	31.8
Average Total Snow Depth (in)	8	8	9	9	5	0	0	0	0	3	6	7	5
Barrow WSO Airport 1,2	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Max Temperature (F)	-7.4	-11	-8	6.9	24.7	38.9	45.7	43.1	34.7	20.5	5.6	-4.6	15.8
Average Min Temperature (F)	-19.8	-23	-20.6	-7	15.2	30	34	33.7	27.9	11.4	-5.6	-16.3	5
Average Total Precipitation (in)	0.18	0.15	0.13	0.18	0.16	0.35	0.9	1.03	0.66	0.48	0.24	0.16	4.61
Average Total Snowfall (in)	2.3	2.4	1.9	2.6	2.2	0.6	0.3	0.7	3.9	7.4	4	2.4	30.8
Average Total Snow Depth (in)	9	10	11	11	6	1	0	0	1	4	7	8	6
Nuiqsut [3,4]	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Max Temperature (F)	-8.4	-10	-9.4	8.7	27.1	50.2	57	51.2	40.9	23.1	7.8	-1.1	19.8
Average Min Temperature (F)	-23	-23.6	-24.1	-7.1	16.5	34.6	40.2	37.5	30.3	12.5	-6.9	-15.3	6
Average Total Precipitation (in)	0.15	0.07	0.01	0.21	0.02	0.16	0.59	0.51	0.18	0.02	0.02	0.19	2.12

[1] Source: BLM (2012, Table 3-1)

[2] Period of Record: Umiat (1949-2001); Kuparuk (1983-2009); Barrow (1949-2009)

[3] Source: Nuiqsut (PAQT) FAA ASOS data, (7/1998-12/2008)

[4] Total snowfall and snow depth are not monitored in Nuiqsut.

Wind speed data are collected at Nuiqsut. The wind rose shown in Figure 3.2-4 depicts wind speed and direction measured at this station from 2008 through 2012. The Nuiqsut wind data show a general annual persistence of northeast through east winds. Annual south-southwest through west winds are also present, but are more significant during the winter. The mean hourly wind speed averaged 10 miles per hour (mph), and the maximum hourly wind speed recorded was 51 mph on January 23, 2008 (CPAI 2008).

Air temperature, wind speed, and wind direction data are collected by the USDOI at twelve weather stations in the NPR-A – one at Fish Creek, operating since 1998. These data are available on the internet, accessed at: http://ppbs.usgs.gov/of/2013/1063/.

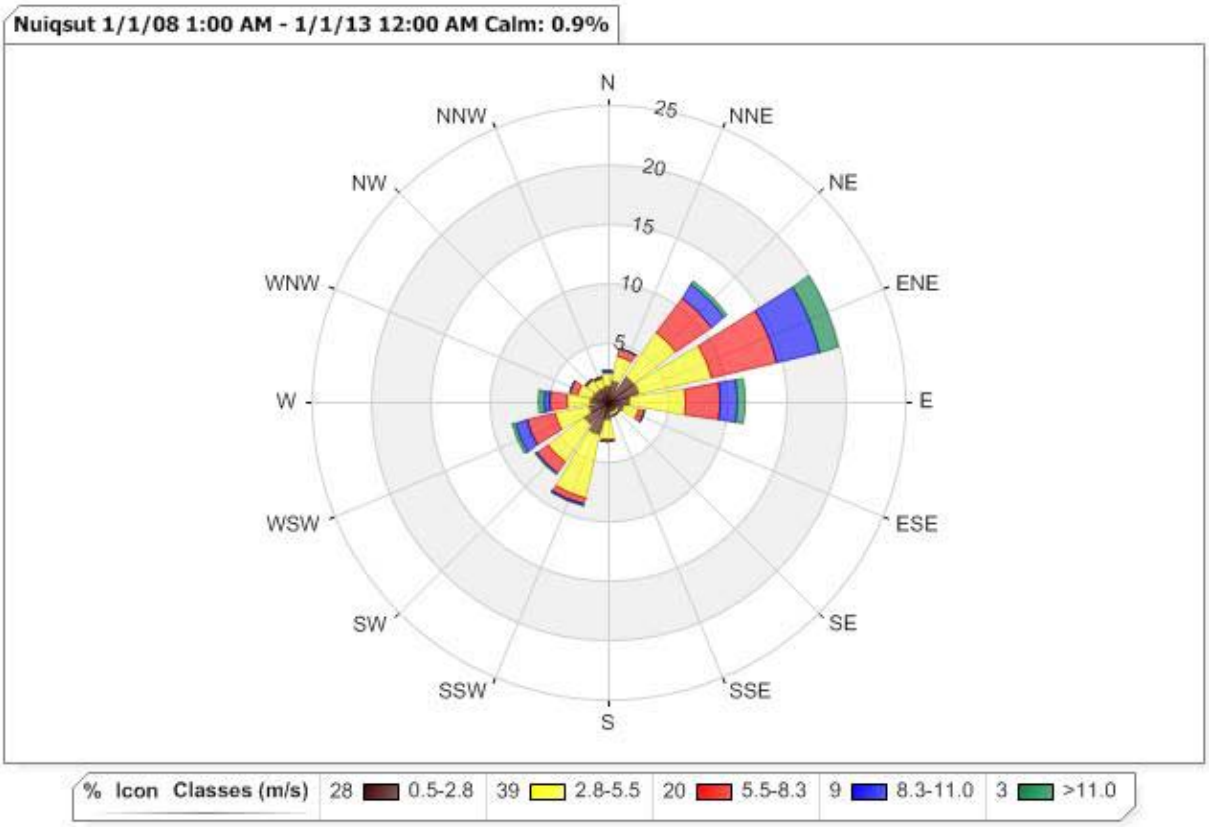


Figure 3.2-4. Nuiqsut Wind Rose (2008 – 2012)

3.2.3.2 Air Quality

A comprehensive discussion of air quality is provided in BLM (2012, § 3.2.2) and BLM (2004, § 3.2.3), including classification areas, existing emissions, air pollutant concentrations, and air quality-related values and issues. These sections are incorporated by reference, with additional analysis of local air quality performed for this GMT1 SEIS.

The NPR-A is in attainment of current National Ambient Air Quality Standards (NAAQS) and the Alaska Ambient Air Quality Standards (AAAQS), which are generally the same for all criteria pollutants. The State has updated regulation 18 AAC 50 to revise the annual standard for fine particulates ($PM_{2.5}$) to be consistent with the federal standard. The NPR-A is in attainment of the $PM_{2.5}$ standards.

Air quality in the project area is generally good, due to the few sources of both man-made and naturally occurring emissions and the dispersion by prevailing winds. Naturally occurring windblown particulate matter emissions occur from river banks, sandbars, dirt and gravel roads, and occasional tundra fires. West of the Colville River, existing emission sources consist mainly of diesel-fired generator engines, heaters, and vehicle traffic in Nuiqsut. The majority of homes in Nuiqsut are heated by natural gas.

East of the Colville River, emission sources exist primarily at oil and gas production facilities, including gas-fired turbines, diesel-fired generator engines, incinerators and flares, and vehicle traffic. A description of emission sources in the ADP area, Nuiqsut, and potential emission sources other than Alpine Satellite sources is provided in BLM (2004, § 3.2.3.2). Arctic haze, generated in Europe and Russia is periodically observed. Precipitation pH, an indicator of wet atmospheric deposition, and visibility are in the early stages of study, with no data available for or near the North Slope. Visibility is addressed through optical and chemical analyses at Integrated Monitoring of Protected Visual Environments (IMPROVE) network sites. The IMPROVE station closest to the project area is located in Bettles, approximately 200 miles south of GMT1 (BLM 2012, § 3.2.2.4).

Criteria pollutant ambient monitoring data have been collected by CPAI in Nuiqsut since 1999. The Nuiqsut Monitoring Program operates in accordance with an ADEC-approved Quality Assurance Project Plan (QAPP). During permitting actions for a modification to the Alpine CDF and the CD5 wellsite, ADEC reviewed the Nuiqsut Monitoring Program data for the years 2000 through 2004 (ADEC 2003, 2005). Nuiqsut data are reviewed by ADEC as needed to support permitting activities.

For the GMT1 Air Quality Impact Analysis, background concentrations were selected to represent emission contributions from existing stationary sources, mobile source activity, urban, biogenic and non-industrial emission sources, and from transport into the region. Values were developed from the most recent 3 years of measurements collected at the Nuiqsut Ambient Air Quality and Meteorological Monitoring station (calendar years 2010 through 2012), consistent with recommendations of the air quality working group formed for this project. Given that the Nuiqsut Station is downwind from and nearer to major Alaskan North Slope stationary sources than the GMT1 Project area, these measurements are conservatively representative of background concentrations in the GMT1 Project impact area.

The background ambient air quality concentrations selected for the Nuiqsut area are shown in Table 3.2-6.

Table 3.2-6. Background Ambient Air Quality Concentrations in the Nuiqsut Area

Pollutant	Averaging Period	Measured Background Concentration[1]	
		(ppm)	($\mu g/m^3$)
Carbon Monoxide (**CO**)	1-hour	1.3	1,488
	8-hour	1.1	1,259
Nitrogen Dioxide (**NO_2**)	1-hour	0.020	38
	Annual	0.002	2.9
Particulate Matter <10 microns[1] (**PM_{10}**)	24-hour	-	48
Particulate Matter <2.5 microns (**$PM_{2.5}$**)	24-hour	-	7.1
	Annual	-	2.2
Sulfur Dioxide (**SO_2**)	1-hour	0.003	7.7
	3-hour	0.007	18
	24-hour	0.003	6.8
	Annual	0.000	0.3

[1] From measurements collected at the Nuiqsut ambient air quality monitoring station during calendar years 2010 through 2012.

$\mu g/m^3$ – micrograms/cubic meter

ppm – parts per million

3.2.3.3 Noise

Noise in the project study area is discussed in BLM (2004, § 3.2.3.3, p. 197) and summarized in the following discussion.

Sound is defined as a particular auditory effect produced by a given source, for example the sound of rain on a rooftop. Noise, in the context of potential effects, is generally described as unwanted sound. The ambient noise level can be defined as the cumulative effect from all noise-generating sources in an area and constitutes the normal or existing level of environmental noise at a given location.

Discussions regarding environmental noise do not focus on pure tones because commonly heard sounds have complex frequency and pressure characteristics. Accordingly, sound measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, correction factors are employed. The correction factors de-emphasize the very low and very high frequencies of sound in a manner similar to the response of the human ear. The resulting A-weighted decibel (dBA) correlates well to the subjective reaction to noise by a human (Harris 1991).

Although the discussion of noise is largely correlated to human receptors, it is also known that noise may cause disturbances to birds, mammals, and fish. In general, the level of disturbance will be the result of several factors including the species of bird, mammal, or fish; the time of year in which the disturbance occurs; the nature of the disturbance; the location of the disturbance; and the distance of the receptor from the disturbance. Resource-specific noise-related effects are discussed in Section 4 of this SEIS.

The propagation of noise is a function of several environmental factors that might enhance or attenuate sound propagation, the most important being the distance from the noise source, the presence or absence of terrain that may inhibit sound propagation, and wind. The distance between a noise source and a receiver influences the perceived noise intensity. As the distance between a source and a receiver doubles, noise intensity decreases by a factor of four (Harris 1991). Terrain features, such as hills and dense vegetation, may attenuate sound propagation. Alternately, sound may be enhanced by reflection from natural features such as valleys. Sound is best propagated in the same direction the wind is blowing. Stable air conditions and calm winds between 2 and 11 miles per hour (1 and 5 meters per second) are most conducive for sound propagation (Harris 1991).

The following is a discussion of noise levels common to most people in small communities and rural areas. For a comparison to a normal human activity, the noise level experienced during a normal conversation between two people 5 feet apart is 60 dBA. Table 3.2-7 shows examples of commonly experienced noise levels and the relative strength (loudness) compared to normal conversation.

Table 3.2-7. Common Noise Levels

Noise Source	Average Noise (dBA)	Loudness[1]	Range of Noise (dBA)
Ambulance siren at 100 ft	100	16	95-105
Motorcycle at 25 ft	90	8	85-95
On a typical construction site	85	6	80-90
Single truck passing at 25 ft	80	4	75-85
Compressor station at 50 ft	75	3	70-80
Urban shopping center	70	2	65-75
Single car passing at 25 ft	65	1.5	60-70
Average highway noise at 100 ft	60	1	55-65
Normal conversation 5 ft apart	60	1	57-63
Residential area during day	50	50%	47-53
Recreational area	45	37%	40-50
Residential area at night	40	25%	37-43
Rural area during day	40	25%	37-43
Rural area at night	35	18%	32-37
Quiet whisper	30	12%	27-33
Threshold of hearing	20	6%	17-23

[1]Compared to normal conversation.

dBA = A-weighted decibel(s)

% percent

Source: Harris (1991)

There are two primary types of noise-generating activities in the project study area: stationary and mobile. Within the GMT1 project study area, the operation of equipment during exploration, drilling, facility construction (including mining activities), and production and the use of aircraft for transportation of personnel and materials would contribute noise to the environment. The area is remote and sparsely populated with few existing sources of man-made noise. Existing sources of noise include (BLM 2004, § 3.2.3.3, p. 197, as updated):

- Vehicle operations (vehicles, off-road vehicles [ORVs], and snowmobiles) and community noise (e.g., generators and other small equipment motors) within the village of Nuiqsut;
- Vehicles, ORVs, and snowmobiles used for subsistence hunting and travel among villages and between villages and hunting camps;
- Boat operations (outboard motors);
- Aircraft operations at Nuiqsut;
- Vehicle operations at CD1, CD2, and CD4;
- Equipment operations at CD1, CD2, CD3, and CD4;
- Aircraft operations into CD1;
- Incidental aircraft and boat operations into the regional by recreationists and scientific researchers;
- Incidental aircraft operations transiting the project study area;
- Equipment operations and vehicle traffic at the ASRC Mine Site; and
- Winter exploration activities (e.g., seismic, ice road/pad construction, drilling).

Additional noise will be generated by construction activity at CD5 and the proposed Nuiqsut Spur Road during the winters of 2013-14 and 2014-15.

Background noise in Nuiqsut, the only community located within the project study area, is limited to general community noise (including power generation and other utilities), vehicle operations, and aircraft. The primary non-manmade noise source is wind (BLM 2004, § 3.2.3.3, p. 197). Nuiqsut is approximately 9.5 miles from CD1 (which includes the processing facility, APF, and Alpine airstrip). See Section 2.3.8.1 for aircraft use.

Table 3.2-8 lists typical noise emissions from a variety of equipment typically found in North Slope oil field operations. These noise levels are attenuated as distance from the noise source increases. Equipment noise emission of 85 to 110 dBA are likely to be 70 dBA or less at 1,000 feet away and would attenuate to background levels within the 9.5 miles to Nuiqsut.

Residents of Nuiqsut are periodically exposed to aircraft noise both from aircraft operations at the Nuiqsut airstrip and from overflights of the community. A passing fixed-wing aircraft (single-engine) emits a noise level of 66 to 76 dBA (flying at 1,000 feet elevation). Twin-engine planes, typically used in the region, at 1,000 feet elevation would emit a noise level of 69 to 81 dBA. Helicopters typically have noise emissions between 68 and 78 dBA (flying at 1,300 feet elevation). During takeoff and landing aircraft, especially jet aircraft, have much higher noise emissions; however, these higher noise levels occur for a shorter period of time (BLM 2004, § 3.2.3.3, p. 198).

While there is little ambient noise in areas away from oil production facilities and population centers, residents of Nuiqsut and other North Slope communities who undertake subsistence harvest activities have expressed concern about the disturbance of subsistence resources (e.g., caribou and birds) in response to noise generated by construction activities, facility operations, and aircraft operations. As noted previously, noise emissions from fixed-place facilities attenuate rapidly with distance from the facility.

Noise from aircraft operations may occur anywhere in the project study area, but is concentrated near Nuiqsut, APF, and CD1 where airstrips are located.

Table 3.2-8. Typical Oil Field Noise Sources

Source	Noise Level (dBA)	Distance from Source (ft)
Drill Rig	82–92	82
Production Module	88–105	0
Pickup truck	67–75	0
Semi truck	73–85	0
Gravel truck	93–102	0
Helicopter (206B)	115	33

Source: BLM (2004, § 3.2.3.3, p. 200)

In summary, the only community receptor of noise within the project study area is remote and the primary source of naturally occurring noise is wind. Subsistence resources used by the residents of Nuiqsut, such as caribou and birds, could be disturbed by noise related to the GMT1 project; these resources occur throughout the project study area. There are few existing sources of manmade noise, including community operations (e.g., generators) at Nuiqsut and industrial sources at existing Alpine facilities, vehicles, boat traffic, and aircraft traffic (BLM 2004, § 3.2.3.3, p. 198).

3.2.4 Climate Change

Climate change is discussed in BLM (2004, § 3.2.3.1) and BLM (2012, § 3.2.1.1). Supplemental information is taken from recent reviews of this subject including the USGS Circular 1379, *The United States National Climate Assessment – Alaska Technical Regional Report* (Markon et al. eds. 2012) and *Arctic Report Card: Update 2012* (Jeffries et al. 2012).

3.2.4.1 Climate Change in the Arctic

Climate change momentum has developed in the Arctic environmental system due to the effects of a persistent warming trend that began more than 30 years ago (Jeffries et al. 2012). A major source of this momentum is the change in sea ice cover, snow cover, glaciers, and the Greenland ice sheet that have reduced the overall surface reflectivity of the Arctic region in the summer, when the sun is ever-present. In other words, bright, white surfaces that reflect summer sunlight are being replaced by darker surfaces (e.g., ocean and land) which absorb sunlight. These conditions increase the capacity to store heat within the Arctic system, which enables more melting - a positive feedback. Changes are predicted to continue to occur in the Arctic in years to come, particularly in the face of projections that indicate continued warming effects (Jeffries et al. 2012).

Changes in the Arctic marine environment are affecting the foundation of the food web in both terrestrial and marine ecosystems (Epstein et al. 2012). An example is the direct link between increases in Arctic tundra vegetation productivity and earlier peak productivity in many parts of the Arctic on one hand, and the increasing duration of the open water season and decreasing summer sea ice extent in the Arctic Ocean on the other (Svoboda 2012). Information from long-term, ground-based observations indicates that, in addition to increasing air temperatures and loss of summer sea ice, widespread greening is also occurring in response to other factors. Over the past 30 years (1982-2011), the Normalized Difference Vegetation Index (NDVI), an index of green vegetation, has increased 15.5 percent in the North American Arctic and 8.2 percent in the Eurasian Arctic. In the more southern regions of Arctic tundra, the estimated aboveground plant biomass has increased 20 percent to 26 percent (Epstein et al. 2012).

During 2012, a number of record or near-record events occurred in relation to the Arctic terrestrial snow cover. Snow cover duration was the second shortest on record and new minima

were set for snow cover extent in May over Eurasia and in June (when snow still covers most of the Arctic region) over the Northern Hemisphere. The rate of loss of June snow cover extent between 1979 and 2012 (the period of satellite observation) set a new record of -17.6 percent per decade, relative to the 1979-2000 mean (Jeffries et al. 2012).

3.2.4.2 Climate Change on the North Slope

According to the USGS, *"Alaska's climate appears to be in a state of flux. Some patterns of change and associated consequences may be clear, such as the losses in sea ice, glaciers, and permafrost, whereas others are more subtle, such as the foothold that some invasive species have found in various parts of the State. … Of principal importance is 'Arctic Amplification' whereby surface temperatures in the Arctic are increasing faster than elsewhere in the world."* (Markon et al. eds. 2012, pp. 3, 73)

In 2011, the Scenarios Network for Alaska Planning (SNAP) predicted increases in average summer temperatures in the NPR-A by 3 ^{0}F by the 2040s and 6 ^{0}F by the 2090s, and increases in average winter temperatures by 11 ^{0}F by the 2040s and as much as 18 ^{0}F by the 2090s (BLM 2012, § 3.2.1.1, p. 143).

Increased temperature on the North Slope is resulting in a decreased period of frozen ground conditions. Historical trends in tundra travel open season on the North Slope were depicted in *Managing for the Future in a Rapidly Changing Arctic: A Report to the President* (Clement et al. 2013) showing that average tundra travel season has decreased from approximately 200 days in 1969 to approximately 120 days in 2004 (Clement et al. 2013, p.12). During the last 10 years in the northern NPR-A, the average tundra travel winter season was approximately 134 days (BLM 2012, § 4.2.1.2, p. 22).

Trends in precipitation show more variability than temperature. There was an approximately 10 percent increase in statewide average precipitation in Alaska during the period 1949 through 2005. Throughout much of the state, greater increases in precipitation were recorded during winter. An exception to the increasing annual winter precipitation trend is the Arctic (Markon et al., eds. 2012, p. 12-13). Climate model projections vary. SNAP predictions for the NPR-A include summer precipitation increasing 1.2 inches by the 2040s and 1.6 inches by the 2090s, and winter precipitation increasing 1.6 inches by the 2040s and 2.7 inches by the 2090s (BLM 2012, § 3.2.1.1). In Alaska, the snow cover duration dropped by 15 days from 1980 to 2009. Projections for Alaska include a shift in snowfall patterns to a later date of first snowfall and an earlier snowmelt (Clement et al. 2013, p. 9). Rising river levels from climate change could also result in increased frequency and intensity of flooding (BLM 2004, § 3.2.3.1, p. 193).

Substantial amounts of organic carbon are stored in permafrost due to the slow rate of plant material decomposition under frozen conditions. Approximately 1700 petagram (Pg) of soil carbon are stored in the northern circumpolar permafrost zone, more than twice as much carbon than in the atmosphere (Schuur et al. 2013). As permafrost thaws, this organic carbon is released to the atmosphere as carbon dioxide (CO_2) or methane (CH_4). These emissions are currently small, especially compared to manmade emissions, but could increase due to increased permafrost thaw in the future, causing accelerating feedback in the climate system (Markon et al. eds. 2012, p. 69).

3.2.4.3 Potential Climate Change Effects in the Project Study Area

The project study area is located within the Arctic Coastal Plain (ACP) and dominated by features and processes driven by permafrost. This area has the potential to change greatly with

the anticipated degradation and thaw of permafrost. As near-surface permafrost melts and thaws, it creates an irregular landscape referred to as patterned ground resulting from the action of thermokarst. Results of modeling permafrost in the planning area forecast that the mean annual thickness of the active layer of permafrost within the ACP will increase from 0.380 meters (15 inches) thick in the 1980s to 0.453 meters (18 inches) thick in the 2040s (BLM 2012, § 3.2.4.4, p. 154).

Climate change is predicted to cause alterations to the environment and habitats of the project study area that could adversely affect paleontological resources, although the degree to which this might happen remains unclear. Past episodes of climate fluctuation in Arctic Alaska have caused changes in vegetation coverage and type as well as the physical structure of the landscape itself. The deepening of the active layer and the thawing of near-surface permanently frozen ground may cause mass down-slope movement resulting in the erosion of hillsides, bluff faces, river banks and terraces, which, if they recur due to future climate change, could result in the partial or total destruction of paleontological sites located on those land forms. In addition, even when erosion does not occur, the deepening of the active layer and/or thawing of permanently frozen ground could result in decreased preservation of subsurface organic paleontological materials, particularly Pleistocene fossils. In less dynamic circumstances erosion has exposed most of the known paleontological deposits in the NPR-A and this type of natural impact is viewed as positive rather than negative, as it reveals the presence of sites usually with few negative results. The potential climate change impacts are not expected to be universal across the ACP as there are a myriad of factors involved that control the degree to which climate change can affect a specific location, region, habitat or ecosystem. Some locales may not be affected at all (BLM 2012, § 3.2.7.2., p. 183).

There are predictions that climate change will continue to warm and dry the NPR-A region more than historically recorded ranges. Warmer temperatures are not likely to accelerate the soil forming processes significantly enough to measure the change during the period of construction and operations addressed in this SEIS. Soil formation is a very slow process. The climate will remain relatively cool with long periods of freezing and low solar angles. As soils dry, there is also a reduction in the chemical reactions that aid in soil formation. Climate change may affect the depth of permafrost in the soil profiles, as described above (BLM 2012, § 3.2.8.4, p. 189).

Structurally, the increase in the depth of the active layer is expected to have a negative effect on the ability of the soils to carry loads. Any traffic over the surface during non-frozen periods would be expected to create more damage than under the present conditions. This could result in deep ruts and severe channeling of water into the vehicle tracks. Such concentration of water would be likely to accelerate erosion and create new drainage channels that drain water from the surrounding areas. It also would be likely to accelerate the subsidence of the permafrost in the track areas. Similar subsidence has been observed in tracks from early exploration of the region in the 1960s in many other areas of the tundra (BLM 2012, § 3.2.8.4, p. 190). Traffic is restricted on unfrozen ground in the NPR-A.

As the active layer deepens, there are more opportunities for plants to send roots deeper into the profile. This may allow plant communities to begin migrating further north within their ranges. In some instances, the lowering of the water table may result in a gradual shift in plant communities to species that are better suited to a dryer site and away from those species that are tolerant of high water content in the soil profile. These processes are not expected to occur rapidly and may take a hundred years or more to shift the ecological composition appreciably.

These changes in vegetation will promote soil formation through greater root development and contribution of additional organic matter to the soil profile (BLM 2012, § 3.2.8.4, p. 190).

Warming of the climate will have major effects on the ecosystems of the North Slope and the project study area. The climate change scenario for the rest of this century suggests that climate will get warmer, with greater precipitation, but that longer, warmer summers will increase evapotranspiration so that there will actually be less moisture available to plants. (Grimm et al 2013). Increases in winter precipitation may have little impact on available soil moisture during the growing season, as most snowmelt runs off the land immediately during the spring thaw. In summer, some precipitation will be lost through evaporation and some through transpiration by plants. In longer, warmer summers, both of these amounts would increase. However, due to the increase in summer precipitation, available soil moisture is predicted to be fairly stable throughout the century (BLM 2012, § 3.3.1.4, p. 217).

The overall result of climate change on vegetation appears to be that growing season will be longer, and soils will be warmer and actually drier. These differences have the potential to drive significant changes in plant communities of the NPR-A, leading to significant acreages of *boreal cordillera*, with vegetative cover ranging from open to closed forest canopies; *western tundra*, which is similar but with a moist, sub-polar climate, patches of stunted trees, and a greater presence of tall shrub communities; and *boreal transition* with boreal forests in valleys and lowlands, and scattered pockets of permafrost. These changes have already been observed to some extent on the North Slope. The overall result of climate change on vegetation appears to be that growing season will be longer, and soils will be warmer and actually drier (BLM 2012, § 3.3.1.4, p. 217).

Modeled future climate trends show increasing mean air temperatures during the winter and summer (SNAP 2011), which could drive a multitude of projected physical environmental changes that could have an effect on Arctic aquatic habitats and, subsequently, Arctic fish species. Implicit to warming air temperatures is a warming of water temperatures. Warmer water temperatures alone can increase susceptibility to diseases and parasites, increase the effects of contaminants, and decrease biologically available DO. Conversely, it can increase biological productivity and fish growth, although for each fish species an upper limit would be reached that leads to negative effects (e.g., stress and mortality) due to excessive energetic demands. However, the precise effect that warmer water temperatures could have on Arctic fish is complicated beyond these simplified examples since fish largely thermoregulate behaviorally, depending on habitat accessibility (BLM 2012, § 3.3.4.5, p. 241).

Bird habitats worldwide are threatened by climate change, though species for which breeding is restricted to the Arctic regions may be the most vulnerable to climate change. Many bird species present in the NPR-A have circumpolar distributions with breeding ranges that vary from high latitude tundra only, to widely distributed across Alaska, to those with associated sub-Arctic and temperate breeding areas for which the NPR-A is the northern extension of their breeding range. The abundance and distribution of surface water is of crucial importance to Arctic birds as the aquatic and semi-aquatic habitats of the planning area support very large numbers of birds. Increased summer temperatures could lead to the conversion of aquatic habitats into dryer habitat types resulting in a loss of not only habitat quantity but also habitat quality in terms of potential decrease in food resources (invertebrate and plant). This loss of quantity and quality would likely lead to changes in bird distributions which might in turn lead to increased competition for limited resources and associated decreases in productivity (BLM 2012, § 3.3.5.9, p. 279).

Impacts to the bird community may occur if warmer spring temperatures advance snowmelt, which is closely associated with insect emergence, and result in changes in the timing and patterns of insect emergence and peak abundance to which the birds may not be able to compensate.

A number of hydrologic shifts related to climate change will affect water resources, including seasonal flow patterns, ice-cover thickness and duration, and the frequency and severity of extreme flood events. The geomorphic features (e.g., sinuosity of drainages, bars, beaches, bends, ox bows, cut banks, pools, riffles) are determined by the slopes, discharge volumes, frequency, intensity, timing, obstructions, sediment loading, etc., all of which will continue to change over a period of changing climate. The effects of these climatic and hydrologic changes will result in river systems that increasingly move or migrate over the landscape compared to a period of relatively stable climate, thus, causing potential disruptions to infrastructure (such as roads and bridges), changes in fish and wildlife habitat, and possible hazards to shoreline communities, fish camps, and recreational users (BLM 2012, § 3.2.10.5, p. 201).

In the NPR-A, 44 percent of the precipitation falls during winter months as accumulated snowpack and contributes to water storage across the landscape. Some of this winter storage is lost due to sublimation, but the majority remains until the spring snowmelt converts it to runoff that serves to recharge rivers, lakes, and soils. Warmer temperatures will advance the spring warming period, which means that snowmelt will occur during a period of lower solar radiation, which could lead to a more protracted melt and less intense runoff. Given a scenario of increased temperature and snowfall, effects on the timing of spring melt may be offsetting to some extent — increasing air temperatures facilitate earlier snowmelt, while increasing snow depth retards it (BLM 2012, § 3.2.10.5, p. 203).

The effects of early and less intense spring melt will be most dramatic for catchments within the ACP, where snowmelt forms the major flow event of the year. Reductions in the spring peak will be accentuated where the loss of permafrost through associated warming increases the capacity to store runoff. Increasing soil storage capacity and more rapid moisture export through evapotranspiration may also lead to decreased hydrologic response to summer storms. Reduced surface storage (e.g., lower lake levels) and drier soils will require greater rainfall recharge before significant surface runoff to streams can occur. If the surface and near-surface water storage deficit is high due to dry conditions in the previous summer, then a larger volume of snowmelt the following spring will go directly to recharge surface waterbodies and soils and reduce the severity of spring flooding. Overall, the magnitude and frequency of high flows will decline while low flows will increase, thereby flattening the annual hydrograph (BLM 2012, § 3.2.10.5, p. 203).

By the 2090s, based on the projected dates of thaw and freeze, breakup is expected to occur about 7 days earlier in the ACP than at present. Presently, freezeup is fairly uniform across the NPR-A. Freezeup is expected to arrive 2 to 4 weeks later by the 2090s on the ACP. The latest freezeup dates would occur along the coastline (BLM 2012, § 3.2.10.5, p. 202).

The impacts of climate change may affect the numerous freshwater lakes of the ACP and the project study area. While some investigations of abundance or net surface area change in lakes have found lake expansion and growth, others have found lake shrinkage or disappearance. Lake expansion can result from thermokarst landscape development (BLM 2012, § 3.2.4.4, p. 154).

Suspended sediment and nutrient loading of lakes and rivers will increase as thermokarsting, land subsidence, slumping, and landslides increase with permafrost degradation. With expected warming, degrading ice wedges may progressively integrate into drainage channels with a lower base elevation resulting in increased frequency of lake-tapping (sudden drainage) events. Drainage rates of lakes on the entire North Slope, in cold continuous permafrost, were found to be 1 to 2 lakes per year, but will likely increase in frequency (BLM 2012, § 3.2.10.5, p. 217).

Climate change will not affect the existence or location of the mineral material deposits within the project study area. The Naval Petroleum Reserves Production Act withdrew the NPR-A from hardrock and coal mining, extending withdrawals that President Harding put in place when he established the Reserve in 1923; thus, this discussion is limited to the mining of gravel. Techniques for accessing and extracting those resources would have to take into consideration gravel mine development in a changing climate. Gravel mining in the project study area involves the use of ice roads, snow trails, and ice pads for transportation of equipment to and from the material source, usually during the exploration and mine development phase. As the climate changes, the methods of mining and exploration might change as well. A warmer climate could lengthen the mining season while a cooler climate could shorten the mining season, or force a change in the mining methods to allow mining during the winters. A longer or warmer summer season may increase the volume of materials needed to maintain infrastructure. Depending on the type of material and the mining method used to extract that material, a changing climate could make the excavation easier, due to the melting of the permafrost, or more difficult when attempting to develop deposits in areas with melted permafrost, which may necessitate removing water, or the need to excavate in swampy conditions (BLM 2012, § 3.2.9.3, p. 192).

Some have predicted that climate warming will lead to more wildfires in the arctic tundra. The largest wildfire (256,000 acres) in history on the North Slope occurred during the summer of 2007 in an area about 25 miles east of the NPR-A (BLM 2012, § 3.3.3.2, p. 223).

3.3 Biological Resources

The following description of the biological environment in the project study area is structured and organized to match the 2004 ASDP EIS. The biological environment remains essentially as described in the 2004 ASDP EIS, with subsequent listing and candidacy of several species under the ESA that may be found in or near the project study area, as described in Section 3.3.5.

3.3.1 Vegetation and Wetlands

Vegetation and wetlands are described for the entire NPR-A in BLM (2012, § 3.3.2.1); for the Northeast NPR-A, (including the project study area) in BLM (2008, §§ 3.3.2-3.3.3); and for much of the project study area in BLM (2004, § 3.3.1). The location of the project study area, NPR-A, is shown in Figure 3.1-1.

A summary of the prior assessments is presented along with new information relevant to this topic and focuses on the conditions within the project study area and at the proposed project facilities. A project study area is incorporated that defines a geographic extent of all the action alternatives and allows for a defined area for detailed evaluation. The project study area includes all proposed facilities and the land within 2.5 miles from the perimeter of the facilities. The project study area is used in the analysis of potential impacts to vegetation and wetlands by the project alternatives. A summary of the vegetation types occurring within the bounds of the project study area is provided in Table 3.3-1.

Key points about vegetation and wetlands in the project study area include:

- The vegetation classification of the project study area is dominated by wet sedge meadow tundra (26 percent), ponds and lakes (20 percent), and tussock tundra (18 percent), all of which are potential jurisdictional wetlands that are regulated under the Clean Water Act;
- The sedge species that dominate the vegetated landscape are tolerant of cold soil and high-moisture conditions. The vegetation canopy is low and individual species are mostly less than one foot tall;
- Permafrost maintains the freeze/thaw cycles of the upper, active layer of soil that influences the type of vegetation that can survive the arctic climate of the study area;
- No federally listed threatened or endangered plants are known to occur in the project study area, the Northeast NPR-A, or elsewhere on the ACP. There are nine species of plants known to occur within the NPR-A that meet the criteria for BLM sensitive species; one of these, Alaskan bluegrass (*Poa hartzii ssp. Alaskana*) was found within the project study area, but more than 2 miles from any proposed project alternative facilities (BLM 2004, p. 203);
- The vegetation cover classes most commonly found in the project study area are wetlands, water bodies, and uplands. Wetlands occupies the most land area (more than 75 percent), followed by water bodies (20 percent), and uplands (less than 5 percent); and
- Important hydrologic, water quality, ecologic, and sociologic functions are performed by wetlands and waters.

The vegetation classification used in this analysis is the same used in BLM (2004, § 3.3.1). Descriptions of the classifications of habitat, vegetation, and geomorphology are provided in Appendix D.

Information on vegetation and wetlands for the entire NPR-A is provided in BLM (2008, § 3.3.2) and BLM (2012, § 3.3.1). A vegetation classification map of the project study area is presented in Figure 3.3-1. Twenty-three vegetation map unit types corresponding to National Wetlands Inventory (NWI) wetland classes occur within the project study area, as listed in Table 3.3-1.

Waters and potential wetlands occupy approximately 97 percent of the project study area; water bodies account for 20 percent of this total (Table 3.3-1). Areas not classified as water bodies or wetlands include gravel fill in the Nuiqsut area and sand dunes; these are considered uplands and occupy less than five percent of the project study area. When a cover type could be wetland or upland, it is assumed to be wetland for this EIS analysis, so the listed acreages of wetlands in the study area may overestimate the total value. The map unit types, NWI classifications, and descriptions are further described in Appendix E.

Water bodies include areas of open water as lakes, ponds, streams, and rivers, as well as adjacent barren areas consisting of river gravels and beaches. For information about water bodies in the study area, see Section 3.2.2 Aquatic Environment.

The dominant wetland cover classes in the study area include wet sedge tundra (26 percent), moist tussock tundra (18 percent), and sedge-shrub tundra (17 percent). Wet tundra is dominated by wet/moist sedges and dwarf shrubs, and occupies wet environments such as drained lake basins and poorly drained river terraces. Sedges (e.g., *Carex spp.*) dominate this tundra type. Small intermixed patches of aquatic sedges and grasses may occur in flooded areas. Large complexes of wet and moist tundra occur, with interspersed areas of open water. Wet tundra is generally characterized in the NWI classification system as saturated or inundated emergent and scrub-shrub wetland (e.g., PEM/SS1B, PEM1E, PEM1F), with a water regime ranging from saturated to permanently flooded. Moist tundra is characterized in the NWI classification system as saturated wetland, dominated by scrub-shrub and emergent vegetation (e.g., PSS1/EM1B).

Areas of mixed moist and wet tundra occur in the drier parts of drained lake basins and on poorly drained river terraces. Patterned ground is widespread and moist sedges and dwarf shrubs dominate areas with better drainage. Wet sedges dominate lower areas and aquatic sedges and grasses may occur in flooded areas. Mixed high and low centered polygons with extensive thermokarst troughs are interspersed with lakes and ponds. High centered polygons may be dominated by dry, dwarf shrubs and fruticose lichens. Moist/wet tundra complexes are generally characterized in the NWI classification system as saturated or inundated emergent and scrub-shrub wetland, with water regimes ranging from seasonally saturated to permanently flooded. Less than one percent of the study area is upland (non-wetland), consisting of sand dunes (Table 3.3-1).

Table 3.3-1. Vegetation Summary for the Study Area

Vegetation Type[1]	Wetland Type (Cowardin Code)	Area (ac)	Project Study Area (%)
Cassiope Dwarf Shrub Tundra	PSS3B	85.6	<1%
Closed Low Willow	PSS1B	1,898.7	2%
Coastal Complex	*No Data Available*	20.7	<1%
Deep Polygon Complex	PUBH, PEM2H, PEM1F, PEM1/SS1B	278.2	<1%
Dryas Dwarf Shrub Tundra	Upland, PSS3B	96.6	<1%
Fresh Grass Marsh	PEM1H, R2AB3H	438.2	<1%
Fresh Sedge Marsh	PEM1H	969.8	1%
Halophytic Grass Wet Meadow, brackish	PEM1R	350.4	<1%
Halophytic Sedge Wet Meadow, brackish	PEM1R	254.0	<1%
Halophytic Willow-Graminoid Dwarf Shrub Tundra	E2SS1/EM1P, E2SS1P	18.3	<1%
Moist Sedge-Shrub Tundra	PEM/SS1B	15,187.1	17%
Old Basin Wetland Complex	PEM1F, PUBH, PEM1B	5,507.6	6%
Open Low Willow	PSS1B	2,685.2	3%
Open Tall Willow	PSS1B	66.7	<1%
Partially Vegetated	PUSR	959.7	1%
Riverine Complex	R2UBH, R2AB3H	162.5	<1%
Salt-killed Wet Meadow	*No Data Available*	12.1	<1%
Tussock Tundra	PEM/SS1B	15,973.3	18%
Water	PUBH, R2UBH	18,099.6	20%
Wet Sedge Meadow Tundra	PEM1E, PEM1F, PEM1F	23,813.8	26%
Young Basin Wetland Complex	PUBH, PEM2H, PEM1H, PEM1/SS1B,PEM1B	120.6	<1%
Total Water and Potential Wetlands		**86,998.5**	**97%**
Barren[2]	Us (upland)	3,019.0	3%
Dune Complex[2]	Upland, PEM1B, PEM1/SS1B, PSS1B	41.4	<1%
Total Mapped in Project Study Area		**90,058.9**	**100%**

[1] Source: Jorgenson et al. (2004).

[2] Wetland status interpreted as upland based on aerial imagery.

Wetland and waters are known to provide important hydrologic, water quality, ecologic, and sociologic functions (Corps 2009). These functions were evaluated by the Applicant for Alternative A and the resulting report is provided in Appendix E. A corresponding functional assessment for the other action alternatives has been performed. The functions were assessed through a combination of interpreting imagery, reviewing existing maps, and examining local topography. The functions evaluated are summarized below.

Hydrologic functions include the ability of a wetland to interact with surface water and/or groundwater. Two general processes were evaluated:

- Flood flow regulation – detention of surface water flow and consequent moderation of downstream flooding.
- Erosion control and shoreline stabilization – degree to which the wetland can reduce erosion.

Water quality functions include the ability of a wetland to detain sediments, toxicants, and nutrients, and to export organic matter. Two general processes were evaluated:

- Sediment, nitrogen and toxicant removal – retention of suspended sediment and associated toxicants, and the detention and transformation of nitrogen and phosphorus, from surface water entering the wetland.
- Organic matter production and export – production of organic matter (primarily through plant growth) and contribution of organic matter to the food web.

Ecological functions assess the relative ability of a wetland to support fish and wildlife populations and provide species and habitat diversity. Four characteristics of each wetland functional type were assessed:

- General habitat suitability – direct support of mammals and birds.
- Fish habitat – direct support of fish.
- Subsistence/Recreational/Educational/Scientific use – direct support of hunting and gathering activities, travel, and/or education including scientific research.
- Uniqueness and special status –supports federally listed species, high quality habitat, presence of rare features, and/or supports functions not commonly provided within the watershed.

Surveys for rare plant species, which include BLM sensitive species, were performed in 2001 and 2002 within selected areas of the project study area including: (1) the proposed road alignment from the Nigliq Channel to the Tiŋmiaqsiġvik (Ublutuoch) River; (2) areas around the Spark and CD6 proposed drill site locations, and the proposed Clover site; and (3) sections of Fish Creek, Judy Creek, Tiŋmiaqsiġvik (Ublutuoch) River, and adjacent coastal plain (Jorgenson et al. 2004). The proposed locations of some facilities have been revised since the surveys were performed.

There are no plants federally listed under the ESA known or suspected to occur within the NPR-A planning area, which includes the project study area (NPR-A IAP/EIS 2012, p. 316). BLM Sensitive Species are a subset of the BLM Special Status Species category and are designated by the BLM State Director for Alaska. There are nine species of plants known to occur within the NPR-A meeting the criteria for BLM Sensitive Species (NPR-A IAP/EIS, p. 317) as listed below:

- alpine whitlow-grass (*Draba micropetala*);
- Adam's whitlow-grass (*Draba pauciflora*);
- arctic poppy (*Papaver gorodkovii*);
- oriental junegrass (*Koeleria asiatica*);
- Alaskan bluegrass (*Poa hartzii ssp. alaskana*);
- Drummond's bluebell (*Mertensia drummondii*);
- sabine grass (*Pleuropogon sabinei*);
- circumpolar cinquefoil (*Potentilla stipularis*); and
- grassleaf sorrel (*Rumex graminifolius*).

Five of these species have documented occurrences in the greater Colville River basin region which includes the project study area. Alaskan bluegrass (*Poa hartzii ssp. Alaskana*) is a barren ground habitat species reported growing in sand dunes and sparsely-vegetated river bars in the northern part of Fish Creek, at the confluence with the Tiŋmiaqsiġvik (Ublutuoch) River, at the mouth of Fish Creek (ANHP 2013; Jorgenson et al. 2004, p. 29).

There are two locations of Alaskan bluegrass reported in the vicinity of the project study: one location is the confluence of the Tiŋmiaqsiġvik (Ublutuoch) River and Fish Creek, approximately 2.5 miles north of the proposed GMT1 pipeline route. The second location is about 4.5 miles north of the proposed GMT1 site. The dune complex habitat where the Alaskan bluegrass was found is uncommon within the project study area. Alaskan bluegrass is assigned a global conservation rank of G3 (vulnerable; at moderate risk of extinction because of restricted range, relatively few occurrences, small populations, recent and widespread declines, or other factors) to G4 (apparently secure but uncommon; some cause for long-term concern because of declines or other factors); and a state rank of S1 (critically imperiled within the state; at very high risk of extirpation because of very few occurrences, declining populations, or extremely limited range and/or habitat) to S2 (Imperiled within the state; at high risk of extirpation because of few occurrences, declining populations, limited range, and/or habitat).

Oriental junegrass (*Koeleria asiatica*) is widely distributed in the Northeast NPR-A and typically occurs on partially vegetated, active sand dunes adjacent to regularly flooded riverbars (Jorgenson, et al. 2004). *Koeleria asiatica* is ranked globally G4 (apparently secure but uncommon) and state ranking of S3 (rare within the state). The nearest location to the project study area where oriental junegrass was found by Jorgenson et al. (2004) is about 14 miles west of the proposed GMT1 pad site.

Other BLM Sensitive Species found in the region include: Drummond's bluebell (*Mertensia drummondii*), whitlow-grass (*Draba pauciflora*) and circumpolar cinquefoil (*Potentilla stipularis*) reported from the upper Colville River basin more than 60 miles south of the project study area (ANHP 2013).

In addition to the nine species described above, an additional 12 species designated as sensitive by BLM Alaska have been documented on the North Slope (BLM 2012, p. 318). These have not been reported to occur in the NPR-A, but their presence there is possible given their occurrence elsewhere on the North Slope:

- Muir's fleabane (*Erigeron muirii*);
- Bostock's miner's-lettuce (*Montia bostockii*);
- Barneby's locoweed (*Oxytropis arctica* var. *barnebyana*);
- walpole poppy (*Papaver walpolei*);
- hairy lousewort (*Pedicularis hirsuta*);
- Wright's alkaligrass (*Puccinellia wrightii*);
- glacier buttercup (*Ranunculus camissonis*);
- Turner's butter-cup (*Ranunculus turneri*);
- Cape Krause sorrel (*Rumex krausei*);
- Johnson's false candytuft (*Smelowskia johnsonii*);

- pygmy aster (*Symphyotrichum pygmaeus*);
- Siberian false-oats (*Trisetum sibiricum ssp. litorale*).

None of these were reported at sites surveyed by Jorgenson et al. (2004) within the Northeast NPR-A; subsequently, their distribution within project study area is unknown.

Non-native, invasive plant species occurrence in the NPR-A is discussed in BLM (2012, § 3.3.1.3). In summary, there is evidence that non-native, invasive plant species have the potential to spread into the region. The common dandelion (*Taraxacum officinale*) has been found north of the Brooks Range and there has been anecdotal observation of dandelion in the NPR-A (BLM 2012, § 3.3.1.3, p. 216). The mechanisms for spreading of non-native, invasive plants include equipment and vehicles used for construction and aircraft. Despite the documented economic consequences of non-native, invasive species, few quantitative data exist that have measured the ecological impacts of invasive plants, making the prediction of environmental impact of these species difficult (Barney et al. 2013).

Aquatic, non-native, invasive species are of particular concern throughout Alaska because of the potential for floatplanes to carry these into new areas (ADF&G 2013). Infestations of waterweed (*Elodea* spp.) in Fairbanks and Anchorage have raised concerns that this aquatic invasive plant is capable of persisting in southern and interior Alaska lakes. Waterweed can easily cling to rudders and floats, as well as boat propellers and can be deposited in water bodies. Waterweed can easily spread when fragments of the plant are introduced to new locations. Like many invasive species, this plant is adapted to disturbance, can grow rapidly, and can survive when lakes and rivers ice up. Infestations have practical as well as ecological implications, as boats and floatplanes may become entangled and damaged in thick growths of these weeds. No reports of waterweed infestations in the Arctic or the NPR-A were identified.

3.3.2 Fish

Fish resources in the project study area are discussed further in BLM (2004, § 3.3.2) and BLM (2012, § 3.3.4). Additional descriptions of the physical and chemical characteristics of rivers and lakes are in section 3.2.2.1, *Water Resources*, and 3.3.1, *Vegetation and Wetlands*. Information on subsistence fisheries in the project study area is described in section 3.4.3, *Subsistence*. The potential effects of climate change on fish and fish habitat on the North Slope is discussed in Section 3.2.4.

3.3.2.1 Fish Habitat

The following section on fish habitat is summarized from the BLM (2012, § 3.3.4, p. 223-229). The majority of aquatic habitat in the NPR-A exhibits minimal or no impacts as a result of anthropogenic activities. Many of the more important attributes influencing fish habitat, such as stream banks and channels, lakeshores, substrates, water quality and quantity, floodplains, and riparian areas are largely unaltered from their natural condition.

Annual flow regimes in streams and rivers influence the amount of lake habitat that is accessible to fish. The degree to which a lake is connected or in close proximity to channel habitat determines the extent to which it is available for fish use. Lake connections vary greatly and can change throughout the open-water season, with some only occurring during high flows in the spring. Other lakes consistently remain accessible by fish. High flows during spring breakup also flood some lakes with no discernible connecting channel, with lakes in close

proximity to streams and rivers flooding most frequently. These lakes show a gradation of fish use depending on how frequently a lake is inundated by spring flooding.

The 3-4 month Arctic summer is a critical time for fish to find quality feeding habitat, as food is plentiful only during this period. Many of the main river channels are much less productive than small tributaries or connected lakes that are usually warmer. As a result, these peripheral habitats may be more highly utilized for feeding. Particularly early in the summer, shallow lakes that thaw early and are accessible to fish likely provide valuable feeding habitat. Later in the summer, high temperatures may lead some fish to seek out cooler feeding areas in channel habitats or deeper lakes.

Spawning habitat requirements vary for different Arctic fish species and can occur in a wide range of flowing or still waters. Some species can spawn successfully in areas of silt or sand substrate, while many others require gravel of a particular size class and relatively clear water. Except for burbot, which spawn under ice in late winter, Arctic freshwater fish spawn between late May and October.

Overwintering habitat is a major factor constraining fish populations in the Arctic. During the 8-9 month winter period, ice formation reduces stream habitat by up to 95 percent, portions of the low salinity near-shore coastal habitat freeze, and unfrozen coastal waters are supercooled (i.e. $<0^{o}$ C). Lakes and rivers typically freeze to about 5-6 feet in depth and water depths of approximately 7 feet or more are often necessary to support overwintering freshwater fish. Potential and known overwintering habitats within the project study area are shown in Figure 3.3-2.

Migration corridors are an additional habitat requirement for many Arctic fish since feeding, spawning, and overwintering habitat for an individual fish are not always proximate to each other, necessitating seasonal or annual movements. Annual water body connectivity and flow regimes play a major role in determining how much potential habitat is actually accessible. Many fish migrate locally or even extensively between major drainages in order to reach suitable habitat at various life history stages.

The GMT1 Project is located within the NPR-A Fish Habitat Coastal Plain Unit (CPU) of the NPR-A (BLM 2012, Fish Habitat Units Map). The CPU is characterized by extremely low gradient terrain that strongly influences aquatic habitat features and morphology. Rivers and streams are generally slow-moving with many unstable banks, and substrates are dominated by sand and silt with relatively few isolated areas of gravel. A majority of the annual flow occurs during spring breakup when large expanses of land tend to be inundated by water. Flow is reduced significantly by mid to late summer and can even become discontinuous, depending on precipitation. Deep river pools, deep lakes, and deltas provide a majority of overwintering habitat. Outside of the major river corridors, the predominant aquatic habitat type in the CPU consists of complicated networks of lakes and small streams. Most small streams in the project study area are described as “beaded” because deep pools that occur along thermally degraded ice-wedges are connected by narrow channels, resembling beads on a string. These beaded stream/lake complexes represent important, extensive fish habitat in the CPU.

3.3.2.2 Fish Species

Seventeen freshwater, anadromous, and nearshore marine fish species have been documented in the GMT1 project area and surrounding waters (Table 3.3-2). Freshwater fish species largely remain within river, stream, and lake systems year-round while anadromous species breed in fresh water but spend at least part of the life cycle in the ocean. Known anadromous waters in the project study area are shown in Figure 3.3-3. Descriptions of life history traits and general distribution in the NPR-A are included in BLM (2004, § 3.3.2) and BLM (2012, § 3.3.4).

Studies of fish species distribution were conducted by industry in the project study area and contiguous waters prior to BLM (2004) (MJM Research 1998; 2000a,b,c; 2001a,b; 2002a,b,c,d; 2003a,b,c,d,e; 2004) and have continued to provide additional information since that time (MJM Research 2005a,b; 2007a,b,c; 2008a,b; 2009; 2013). Ongoing research within the project study area being conducted by the BLM in cooperation with the University of Alaska Fairbanks has also provided further data on fish use (Heim 2013; McFarland 2013). Arctic grayling, broad whitefish, and ninespine stickleback are the most prevalent fish in the project study area. Alaska blackfish, burbot, least cisco, humpback whitefish, round whitefish, and slimy sculpin are also relatively common, but to a lesser extent. The remaining fish species are only occasionally encountered in the greater surrounding area. Fish distribution in the project study area is shown in Figure 3.3-4.

Table 3.3-2. Fish species found in the lower Fish Creek watershed and vicinity.

Common Name	Scientific Name	Iñupiaq Name
Freshwater Species		
Alaska blackfish	*Dallia pectoralis*	Iłuuqiniq
Arctic grayling	*Thymallus arcticus*	Sulukpaugaq
Burbot	*Lota lota*	Tittaaliq
Ninespine stickleback	*Pungitius pungitius*	Kakalisaauraq
Round whitefish	*Prosopium cylindraceum*	Savigunnaq
Slimy sculpin	*Cottus cognatus*	Kanayuq
Anadromous Species		
Arctic cisco	*Coregonus autumnalis*	Qaataq
Bering cisco	*Coregonus laurettae*	Tiipuq
Broad whitefish	*Coregonus nasus*	Aanaaqłiq
Chinook salmon	*Oncorhynchus tschawytscha*	—
Chum salmon	*Oncorhynchus keta*	Iqalugruaq
Dolly Varden	*Salvelinus malma*	Iqalukpik
Humpback whitefish	*Coregonus pidschian*	Piquktuuq
Least cisco	*Coregonus sardinella*	Iqalusaaq
Pink salmon	*Oncorhynchus gorbuscha*	Amaqtuuq
Rainbow smelt	*Osmerus mordax*	Iłhauġniq
Coastal Marine Species		
Fourhorn sculpin	*Myoxocephalus quadricornus*	Kanayuq

The Tiŋmiaqsiġvik (Ublutuoch) River and Igalliqpik (Fish Creek) channels are used by most fish species found in the area (Table 3.3-2). Although the full extent of fish use in these higher-order streams is not known, these are known to function as migratory corridors that allow fish to access a variety of tributary habitats. Fish use of these smaller stream-lake complexes in the project study area is largely dependent on degree of connectivity. The well-connected stream and lake habitats (e.g. Crea Creek and Lower Blackfish Creek) have the greatest fish use and are especially utilized by Arctic grayling and broad whitefish. On the contrary, many of the

shallow, less-connected systems (e.g. Barely Creek) are either fishless or often contain only ninespine stickleback.

Fish research projects conducted in Crea Creek (Heim 2013; McFarland 2013) have provided additional information about the ecological importance of beaded stream/lake complexes and site-specific habitat use in the GMT1 area. Arctic grayling begin to enter Crea Creek during spring runoff in early June and fish of various size classes utilize the system throughout the summer, with most departing prior to freeze-up in late September. In addition to many fish that remain in the channel to feed, the shallow, warm habitat in Lake CC3 is also heavily utilized. Lake L9819 is used to a much lesser extent by Arctic grayling, as the outlet connection begins to recede early in the summer, and Lake L9820 is largely inaccessible since it freezes to the bottom each winter and becomes disconnected rapidly after spring breakup. Diet analyses demonstrate the importance of invertebrate and ninespine stickleback productivity as food sources for Arctic grayling. Other similar clearwater tributaries (e.g., Bill's Creek) also likely provide critical summer feeding habitat for many fish species.

A radio telemetry project conducted by the State examining Arctic grayling, broad whitefish, and burbot movements in the Fish Creek drainage documented extensive movements by all species (Morris 2003). This included use of both channel and lake habitat in the project study area. Most notably, individuals of all species utilized the lower Tiŋmiaqsiġvik (Ublutuoch) River for overwintering, in a section beginning a short distance upstream of the proposed bridge site down to the confluence with Fish Creek. It is likely other fish species also use this portion of the Tiŋmiaqsiġvik (Ublutuoch) River in the winter, as bathymetric mapping identified numerous deep areas with maximum depths greater than 8 feet (MJM Research 2005a).

3.3.2.3 Essential Fish Habitat

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species from overfishing. Along with reauthorizing the Magnuson-Stevens Fishery Conservation and Management Act Reauthorization (16 U.S.C. 1801-1882), one of those added measures is to describe, identify, and minimize adverse effects to EFH. Arctic freshwater EFH only includes habitat utilized by Pacific salmon. The EFH Assessment for the project study area is in Appendix F.

3.3.3 Birds

About 90 species of birds are expected to occur annually in the NPR-A and adjacent Beaufort and Chukchi sea habitats (BLM 2012, § 3.3.5, p. 242). Approximately 80 of these species are likely to occur in the Alpine Satellite Development Plan (ASDP) Area (see BLM 2004, Figure 1.1.1-1, Plan Area Vicinity and Location Map) or in nearshore waters of Harrison Bay. Common, scientific, and Inupiaq names and status of avian species in the ASDP Area are presented in Table 3.3-3. Data to support avian species occurrence within the project study area is not available at this time. Life history and general biology of avian species in the ASDP Area and within the NPR-A is provided in BLM (2004, § 3.3.3) and in BLM (2012, § 3.3.5), which are incorporated by reference.

Table 3.3-3. Common, Scientific and Inupiaq Names and Status of Avian Species Found in the ASDP

Common Name	Scientific Name[a]	Inupiaq Name[b]	Status[c]	Occurrence[d]
Waterfowl (Tinmiagruich) and Waterbirds				
greater white-fronted goose	*Anser albifrons*	niglik	-	C/B
snow goose	*Chen caerulescens*	kanuq	-	U/B, C/M
Canada goose	*Branta canadensis*	iqsragutilik	-	C/B
brant	*Branta bernicla*	niglingaq	SS	C/B
tundra swan	*Cygnus columbianus*	kugruk	-	C/B
gadwall	*Anas strepera*	-	--	Acc
American wigeon	*Anas americana*		-	U/B
mallard	*Anas platyrhynchos*	kurugaktak	-	R/B
northern shoveler	*Anas clypeata*	alluutaq	-	R/B
northern pintail	*Anas acuta*	kurugak	-	C/B
green-winged teal	*Anas crecca*	qaiffiq	-	U/B
canvasback	*Aythya valisineria*		--	Acc
greater scaup	*Aythya marila*	qaqluktuuq	-	U/B
lesser scaup	*Aythya affinis*	kaklutuk	-	R/B
Steller's eider	*Polysticta stelleri*	igniqauqtu	T	R/B
spectacled eider	*Somateria fischeri*	kavaasuk	T	U/B
king eider	*Somateria spectabilis*	qinalik	SS	C/B
common eider	*Somateria mollissima*	amauligruaq	-	C/B
surf scoter	*Melanitta perspicillata*	aviluktuq	SS	U/B
white-winged scoter	*Melanitta fusca*	killalik	-	U/B
black scoter	*Melanitta nigra*	tuungaagrupiaq	SS	Acc
long-tailed duck	*Clangula hyemalis*	ahaaliq	SS	C/B
red-breasted merganser	*Mergus serrator*	aqpaqsruayuuq	-	R/B
Loons (Malgitch) and Grebes				
red-throated loon	*Gavia stellata*	qaqsraupiagruk	BCC, SS	C/B
pacific loon	*Gavia pacifica*	qaqsrauq	-	C/B
yellow-billed loon	*Gavia adamsii*	tuullik	BCC, SS	U/B
red-necked grebe	*Podiceps grisegena*	aqpaqsruayuuq	-	U/B
horned grebe	*Podiceps auritus*	subliq	--	Acc
Ptarmigan				
willow ptarmigan	*Lagopus lagopus*	nasaullik	-	C/B
rock ptarmigan	*Lagopus mutus*	niksaaktun	-	U/B
Cranes				
sandhill crane	*Grus canadensis*	tatirgak	-	U/B
Raptors and Owls				
bald eagle	*Haliaeetus leucocephalus*	tinmiaqpak	-	R
northern harrier	*Circus cyaneus*	papiktuuq	-	U/B
rough-legged hawk	*Buteo lagopus*	qixbiq	-	U/B
golden eagle	*Aquila chrysaetos*	tingmiak	-	U/B
merlin	*Falco columbarius*	tinmiabruum kirbavia	-	R
gyrfalcon	*Falco rusticolus*	aatqarruaq	-	U/B
peregrine falcon	*Falco peregrinus*	kirgavik	BCC	B/M
snowy owl	*Bubo scandiacus*	ukpik	-	C/B
short-eared owl	*Asio flammeus*	nipailuktaq	-	C/B

Table 3.3-3. Common, Scientific and Inupiaq Names and Status of Avian Species Found in the ASDP (Continued)

Common Name	Scientific Name[a]	Inupiaq Name[b]	Status[c]	Occurrence[d]
Shorebirds				
black-bellied plover	*Pluvialis squatarola*	tullikpak	-	C/B
American golden-plover	*Pluvialis dominica*	tullik	-	C/B
semipalmated plover	*Charadrius semipalmatus*	kurraquraq	-	U/B
whimbrel	*Numenius phaeopus*	sigguktuvak	BCC	U/B
bar-tailed godwit	*Limosa lapponica*	turraaturaq	BCC	U/B
red knot	*Calidris canutus*		BCC, SS	R
ruddy turnstone	*Arenaria interpres*	tullignaq	-	C/B
black turnstone	*Arenaria melanocephala*	-	-	Acc
sanderling	*Calidris alba*	kimitquilaq	-	R/B
semipalmated sandpiper	*Calidris pusilla*	livalivakpauruk	-	C/B
western sandpiper	*Calidris mauri*	-	-	R/B
least sandpiper	*Calidris minutilla*	livalivaurak	-	R/B
white-rumped sandpiper	*Calidris fuscicollis*	-	-	R/B
Baird's sandpiper	*Calidris bairdii*	puviaqtuuyaaq	-	U/B
pectoral sandpiper	*Calidris melanotos*	puviaqtuuq	-	C/B
dunlin	*Calidris alpina*	kayuttavak	BCC	C/B
stilt sandpiper	*Calidris himantopus*	-	-	C/B
buff-breasted sandpiper	*Tryngites subruficollis*	puviaqtuuq	BCC, SS	U/B
long-billed dowitcher	*Limnodromus scolopaceus*	kilyaktalik	-	C/B
Wilson's snipe	*Gallinago delicata*	-	-	U/B
red-necked phalarope	*Phalaropus lobatus*	qayyiuun	-	C/B
red phalarope	*Phalaropus fulicarius*	auksruaq	-	C/B
Seabirds				
pomarine jaeger	*Stercorarius pomarinus*	isunngluk	-	U/B; C/M
parasitic jaeger	*Stercorarius parasiticus*	migiaqsaayuk	-	C/B
long-tailed jaeger	*Stercorarius longicaudus*	isunnaq	-	C/B
herring gull	*Larus argentatus*	nauyavvaaq	-	R/S
thayer's gull	*Larus thayeri*	-	-	R/M
glaucous-winged gull	*Larus glaucescens*	-	--	Acc
glaucous gull	*Larus hyperboreus*	nauyak	-	C/B
Sabine's gull	*Xema sabini*	iqirgagiaq	-	U/B
black-legged kittiwake	*Rissa tridactyla*	-	-	R/S
arctic tern	*Sterna paradisaea*	mitqutailaq	BCC	C/B
black guillemot	*Cepphus grylle*	-	SS	U/B
Passerines				
common raven	*Corvus corax*	tulugaq	-	C/B
arctic warbler	*Phylloscopus borealis*	sonakpalutuniq	-	R
bluethroat	*Luscinia svecica*	-	-	R
yellow wagtail	*Motacilla flava*	iksriktaayuuq	-	U/B
American tree sparrow	*Spizella arborea*	misapsaq	-	U/B
Savannah sparrow	*Passerculus sandwichensis*	okpisioyuk	-	C/B
Lapland longspur	*Calcarius lapponicus*	qupaluk, putukiiluk	-	C/B
snow bunting	*Plectrophenax nivalis*	amautlgaq	-	U/B
common redpoll	*Carduelis flammea*	saksakiq	-	C/B
hoary redpoll	*Carduelis hornemanni*	saksakiq	-	U

Table 3.3-3. Common, Scientific and Inupiaq Names and Status of Avian Species Found in the ASDP (Continued)

Acc = Accidental	B = Breeding bird
BCC = USFWS BIRDS OF CONSERVATION CONCERN	C = COMMON
E = ENDANGERED	M = MIGRATION
R = RARE	S = SUMMER
SS = BLM SENSITIVE SPECIES	T = USFWS THREATENED
U = UNCOMMON	W = WINTER

[a] Scientific names from List of the 2,031 Bird Species (with Scientific and English Names) Known from the A.O.U. Check-list Area (http://www.aou.org/aou/birdlist.html). The list incorporates changes made in the 42nd, 43rd, and 44th supplements to the check-list, as published in The AUK 117:847-858 (2000); 119:897-906 (2002); 120:923-932 (2003). Subspecies designations are presented where relevant.

[b] Inupiaq names as presented in PAI (2002a), Appendix B, Table B-3 and in Birds of Central Beringia, a taxonomic List in English, Russian, Inupiaq, Siberian Yupik, and Latin (http:/www.nps.gov/akso/beringia/berinotesnov97.htm).

[c] NOAA 2013 and USFWS 2008.

[d] Occurrence information from C.B. Johnson, pers. comm. (2003); Johnson and Herter (1989), Armstrong (1995), and USFWS (1999).

The majority of wildlife studies available for this region cover a large geographical area. For the purposes of this SEIS, a project study area (see Section 3.1.1 of this SEIS) is used to delineate a defined area for analysis of the affected environment and potential impacts from the proposed GMT1 development. Avian surveys in the ASDP Area have been conducted by the Applicant and its predecessors since 1992. Federal and state agencies have been conducting avian studies for similar time periods in response to resource development activities. USFWS's Migratory Bird Management estimated onshore density data has been analyzed for the project study area as well as estimated annual population growth rates using aerial survey index data.

The Applicant's (CPAI) contractor for avian studies, ABR Inc. (ABR), conducts studies that survey both the Colville Delta, termed ABR Colville Delta Study Area (CDSA) in this document, and the northeastern NPR-A, termed ABR NPR-A Study Area (NASA) in this document. Table 3.3-4 lists the avian study areas, further divided by study subareas, and provides a reference to the location of the project study area. Figure 3.3-5 shows the location of the project study area and the CDSA and NASA Subareas.

Table 3.3-4. CDSA and NASA Subareas in Relation to the GMT1 Project Study Area

ABR Colville Delta Study Area (CDSA)	
CD North Subarea	Not in project study area
Northeast Delta Subarea	Not in project study area
CD South Subarea	Includes GMT1 pipelines from CD1-CD4, and a portion of existing pipe from CD4N to CD5
ABR NPR-A STUDY AREA (NASA)	
Fish and Judy Creek Corridor Subarea	Overlaps with 2011-2012 Development Subarea
Fish Creek Delta Subarea	Not in project study area
Alpine West Subarea	Includes portion of road and pipeline from CD4 to CD5
2011-2012 Development Subarea[a]	Includes road and pipeline from CD5 to GMT1 pad and Clover site

Source: Johnson et al., 2013

[a] The 2011-2012 Development Subarea is a portion of a larger Development Subarea that was studied in previous years.

The Applicant engaged in consultation with resource agencies and local communities to select a focal group of avian species to study using annual aerial surveys in the CDSA and NASA.

Surveys collect data on distribution, abundance, and habitat use of species in this focal group. Each of the species or species groups surveyed meet one or more of the following criteria: 1) threatened or sensitive status, 2) indications of declining populations, 3) restricted breeding range, 4) importance to subsistence hunting, or 5) concern of regulatory agencies for development impacts. The focal group included the following species: spectacled eider (*Somateria fischeri*), king eider (*Somateria spectabilis*), tundra swan (*Cygnus columbianus*), brant (*Branta bernicla*), snow goose (*Chen caerulescents*), greater white-fronted goose (*Anser albifrons*), and Canada goose (*Branta canadensis*). Data was also collected on the glaucous gull (*Larus hyperboreus*) and Sabine's gull (*Xema sabini*) due to their predatory associations with eggs of ground nesting birds (Johnson et al. 2009). Three additional species that share similar conservation concerns as the focal species group and may occur in the project study area, red knot (*Calidris canutus roselaari*), short-eared owl (*Asio flammeus*), and golden eagle (*Aquila chysaetos*), are described in BLM (2004, § 3.3.5, pp. 242-280) and BLM (2012, § 3.3.8.2, pp. 318-337). Passerines, raptors, ptarmigan, and shorebirds are species groups discussed in this SEIS that have been noted regularly (ptarmigan, shorebirds, and passerines) or on an infrequent basis (raptors) during CPAI avian surveys in the ASDP Area (Johnson et al. 2013).

Habitat maps were used in conjunction with wildlife survey data to describe habitat selection and preference by birds and mammals on the North Slope (Johnson et al. 2013). This approach, known as the ecological land survey approach, is described in BLM (2004, § 3.3.1.2, pp. 202-204). Figure 3.3-6 depicts habitat classes delineated within the project study area. A description of habitat classification units is provided in Appendix D.

Generally, on the ACP of Alaska's North Slope, the following habitat characteristics are attractive to shorebirds, geese, ducks, and loons: availability of large deep lakes with ice floes, shoreline with low relief, peat or mud substrate for resting, graminoid meadows with moss, low predator and human population or disturbance, and proximity to coastal staging areas (BLM 2004, § 3.3.3.1, p. 239). The most common habitat types in the project study area include, in decreasing order: patterned wet meadow, ponds, lakes, moist tussock tundra, and moist sedge-shrub meadow (Figure 3.3-6 and Table 3.3-1 with cross reference in Appendix D).

The following sections describe the focal avian species occurring in the project study area. Steller's eider, spectacled eider, and yellow-billed loon are addressed in Section 3.3.5, *Threatened and Endangered Species*.

3.3.3.1 Gulls

The summary presented below provides information from data collected on glaucous and Sabine's gulls throughout the ACP, as well as limited site-specific data regarding glaucous gulls and Sabine's gulls in the project study area. This summary is supplemental to information provided in BLM (2012, § 3.3.5.1) and BLM (2004, § 3.3.3.7), which are incorporated by reference.

Due to the potential for an increase in gull populations, resulting from their attraction to industrial development, and their known ability to predate ground nesting birds and nests, CPAI and its predecessors have been collecting data for over 11 years (since 2002) on glaucous gulls and Sabine's gulls in the CDSA and the NASA. The project study area lies within these avian survey areas (see Figure 3.3-5).

Over the entire ACP, the average annual population growth rates (total bird index) from 1986 to 2012 for the glaucous gull and the Sabine's gull were 1.020 and 1.044, respectively, indicating a positive population growth trend for these species across the ACP (Stehn et al. 2013).

Estimated density indices of glaucous gulls across the ACP are presented in BLM (2012, Vol 7, Map 3.3.5-1). Estimated densities within the project study area were selected by using a GIS analysis of density contour data. The nearest high-density concentration of glaucous gulls is located outside of the project study area on the Beaufort Sea coast (Colville River delta), approximately 13 miles to the northeast of the GMT1 drill site location. Density index contours within the project study area range from 0-0.051 to 0.42-0.98 birds per km^2 (Table 3.3-5).

Table 3.3-5. Estimated Density Contours of Glaucous Gulls within the Project Study Area (2007 – 2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 – 0.051	25089	22%
0.052 - 0.419	57802	50%
0.420 - 0.980	33564	29%
0.980 – 1.991	0	0%
1.992 – 4.033	0	0%

Source: USFWS, 2010 – Migratory Bird Management.

Estimated density indices of Sabine's gulls across the ACP are presented in BLM (2012, Vol 7, Figure 3.3.5-2), and have been interpreted for the project study area. The nearest high-density concentration of Sabine's gulls is outside of the project study area, approximately 5.3 miles west of the GMT1 drill site location. Density index contours within the project study area range from 0-0.03 to 0.309-0.664 birds per km^2 (Table 3.3-6).

Table 3.3-6. Estimated Density Contours of Sabine's Gull within Project Study Area (2007 - 2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 – 0.030	30823	26%
0.031 - 0.309	77235	66%
0.310 - 0.664	8409	7%
0.665 – 1.310	0	0%
1.311 – 2.926	0	0%

Source: USFWS, 2010 – Migratory Bird Management.

Glaucous gulls and Sabine's gulls were observed as part of aerial loon nesting surveys on selected lakes within the CDSA and the NASA. Aerial loon nesting surveys did not include lakes located within the project study area. (A total of 73 glaucous gull nests were observed in the CDSA in 2012, with the highest number reported (37 nests) in the CD South Subarea (see Figure 3.3-7). The largest colony of glaucous gulls observed within the CDSA in 2012 was in the CD South Subarea and supported 17 nests; a range of six to 19 nests have been historically observed over the last 11 years for this particular colony. No Sabine's gull nests were observed in the CDSA in 2012, although between the years 2003 - 2010, a range of one to 16 nests were observed. Over the study period, obvious nest occurrence trends were not discernible for either glaucous gulls or Sabine's gulls (Johnson et al. 2013).

Lakes surveyed for gulls in the NASA were located in the Alpine West Subarea and the 2012 survey portion of the Fish and Judy Creek Subarea. The area around the proposed GMT1 pad was not included in these searches. Of a total 25 glaucous gull nests recorded in the NASA, 17 were found in the Alpine West Subarea (see Figure 3.3-7). Five Sabine's gull nests were observed in the NASA, all of which were in the Fish Creek Delta Subarea (outside of the project study area) (Johnson et al. 2013).

Habitat use by glaucous gulls in the CDSA included deep open water with islands or polygonized margins, patterned wet meadow, on islands within tapped lakes with high-water connections, or on islands or complex shorelines of six other habitats (Johnson et al. 2013). Deep open water with islands or polygonized margins and patterned wet meadow habitats occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4). In the NASA, the majority of the glaucous gull nests (20 nests, or 80 percent) occurred on islands in shallow open water with islands or polygonized margins, with the remaining nests on islands or complex shorelines of three other aquatic habitats; only one nest was observed in a terrestrial habitat (Johnson et al. 2013). Sabine's gulls were also observed utilizing shallow open water with islands or polygonized margins, as well as patterned wet meadow and sedge marsh (Johnson et al. 2013). All three of these habitat types occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6).

3.3.3.2 Passerines

A discussion of passerine species distribution, nesting habitats, foraging, and surveys on the ACP, as well as in the project study area, is included in BLM (2004, § 3.3.3.8 pp. 257-258 and 2012, § 3.3.5.7, pp. 276-277). Information in these documents is summarized below. Most passerines found in the NPR-A generally arrive on the North Slope from late May to early June and remain until mid- to late August (Johnson and Herter 1989). Passerines breeding in the project study area are generally tundra or shrub-nesting species. Savannah sparrow, redpoll, snow bunting, lapland longspurs, common raven, and yellow wagtail are expected to occur in the project study area (BLM 2012, § 3.3.5.8, p. 276). Nesting and foraging habitats used by passerines that are likely to occur in the project study area are summarized in BLM (2004, Table 3.3.3-8, p. 257). This section will address only Lapland longspurs due to the lack of localized data on other ground nesting passerines and will address ravens due to their known association with industrial development and their potential for predating nests and nesting birds.

Lapland longspurs are the most common species nesting across the NPR-A (BLM 2012, § 3.3.5.8, p. 276). Lapland longspurs were present in all of the 24 breeding-bird plots (31.3 nests per km^2) in the NASA reported by Johnson et al. (2005). Over a three-year period, Lapland longspurs were found to be the highest density nesting passerine species (40.0 to 42.5 nests per km^2) in an area near Teshekpuk Lake, which is located outside of the project study area (BLM 2012, § 3.3.5.8, p. 276).

Other passerine bird nests observed included those of Savannah sparrows (infrequent; 2 of 24 plots; 0.8 nests per km^2), eastern yellow wagtail (in 2004), American tree sparrows, and common redpolls nesting along the channels of the Colville River.

Common raven, though not abundant, is the only permanent resident passerine in the NPR-A, and is commonly found only where nesting opportunities are available, such as along the Colville River bluffs, the foothills and mountains of the Brooks Range, and often, where man-

made structures provide nesting platforms (BLM 2012, § 3.3.5.8, p. 277). Data for population status of the common raven on the ACP is not available; however, there is an inferred increase in the population connected to higher counts of ravens in Prudhoe Bay associated with the NSB landfill and reports of nesting in the Alpine field (BLM 2012, § 3.3.5.8, p. 278). Human sourced nesting habitats include pipelines, antenna towers, drill rigs and other tall structures. Common ravens were reported to use buildings as roosting sites at CD1, with nests confirmed in 2000 and 2001 (Johnson et al. 2003a).

Common ravens are successful egg predators of passerines, shorebirds, loons, and waterfowl on the ACP (BLM 2012, §3.3.5.8, p.277), but no study has quantified the impact of common ravens to local populations.

3.3.3.3 Ptarmigan

Two species of ptarmigan, the willow and rock ptarmigan, occur in the NPR-A (BLM 2012, § 3.3.5.8, p. 276). Ptarmigan are ground-nesting birds in the grouse family that remain in the NPR-A year-round and are a species utilized for subsistence. Rock ptarmigan may conduct local migrations during the fall to obtain willow forage (Johnson and Herter 1989), and nest in dry rocky habitats and in hummocky areas of wet sedge meadows (Holder and Montgomerie1993). During surveys, willow ptarmigan have been found nesting in dense vegetation, although they are also found on open tundra (Hannon et al. 1998, Johnson and Herter 1989). Specifically, ground-based nest searches in 2002 found willow ptarmigan nests in three habitat types at a study site approximately 1 mile northwest of the project study area (patterned wet meadow, moist sedge-shrub meadow, and moist tussock tundra; Burgess et al. 2003). Over 44 percent (12 of 21 nests) of the nests occurred in moist tussock tundra (Burgess et al. 2003).

Although no research studies targeting this species were identified, both species of ptarmigan have been recorded in various large waterbird nest searches conducted in areas representative of the project study area. In 2002, ptarmigan nested at a study location titled Lookout (approximately 1 mile northwest of GMT1 proposed pad location) in higher densities than any other ground-search area in the NPR-A at 1.15 nests per km2 (Burgess et al., 2003). Similar high nesting densities (compared to the rest of NPR-A for the survey period) were found in the CD South Subarea at a three year average of 1.62 nests per km2 (Burgess et al. 2003). More recently, ptarmigan were reported within the project study area during eider surveys, but no individuals or nesting sites were found within 400 meters of the proposed GMT1 drill site location (Seiser and Johnson 2011).

3.3.3.4 Waterfowl

Waterfowl are among the most populous avian groups in the ACP and the project study area. Waterfowl are present on the ACP in a migratory capacity. The following section summarizes information for select species of waterfowl (tundra swan, brant, snow goose, king eider, greater white-fronted goose, and Canada goose) and is supplemental to information provided in BLM (2012, § 3.3.5 and 2004, § 3.3.3), incorporated by reference here.

Tundra Swan

The summary presented below provides information from data collected on tundra swans throughout the ACP and limited site-specific data in the project study area. This summary is supplemental to information provided in the BLM (2012, § 3.3.5.5) and the BLM (2004, § 3.3.3.2), incorporated by reference here.

CPAI and its predecessors have been conducting aerial surveys of nesting and brood-rearing tundra swans in the NASA for 10 years (2001-2006, 2008-2009, and 2011-2012) and in the CDSA for 19 years (1992-2012) (Johnson et al. 2013). The survey areas and survey coverage differed among years. The project study area lies within these avian survey areas (see Figure 3.3-5).

Tundra Swans are common along the Arctic coast of Alaska, and are present in the project study area. The average annual population growth rate (total bird index) from 1986 to 2012 for tundra swans was 1.046, indicating a positive population growth trend for this species across the ACP (Stehn et al. 2013). The overall trend in counts of pairs, nests, and broods in the CDSA has been one of slow increase. Due to variation of study areas between years, an overall trend for pairs, nests, and broods is not available for the data collected on tundra swans in the NASA (Johnson et al. 2013).

Estimated density indices of tundra swans are presented in BLM (2012, Figure 3.3.5-7). Densities within the project study area were selected by using a GIS analysis of density contour data. The nearest high-density (0.705 – 1.777 birds per km2) concentration of tundra swans is located outside of the project study area along the Beaufort Sea coast, approximately 5.3 miles north of the GMT1 drill site location. Moderately high densities (0.217 - 0.417 to 0.418 - 0.705 birds per km2) of tundra swans are also present along the north-western extent of the Colville River Delta (BLM 2012, Figure 3.3.5-7). Onshore density index contours that fall within the project study area range from 0-0.05 to 0.705-1.777 birds per km2 (Table 3.3-7). Table 3.3-7 shows that 66 percent of the project study area contains high to moderately high densities of tundra swans when compared to the entire ACP population.

Table 3.3-7. Estimated Density Contours of Tundra Swans within Project Study Area (2007 – 2010)

Density Index Contour (birds per km2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 – 0.050	6156	5%
0.051 - 0.216	32577	28%
0.217 - 0.417	33914	29%
0.418 - 0.705	23806	20%
0.705 – 1.777	20029	17%

Source: USFWS, 2010 – Migratory Bird Management.

Within the CDSA, the 19-year average density of tundra swan nests was reported at 0.06 nests per km^2 (34 nests) while surveys conducted in 2012 show a total of 40 nests and a density of 0.07 nests per km^2 The majority of the nests found in 2012 occurred north and east of the project study area, with 14 nests occurring in the CD South Subarea (see Figure 3.3-7). In 2012, productivity in the entire CDSA was below average, with 58 percent nesting success, a total of 23 broods at 0.04 broods per km^2, smaller brood size of 2.2 young, and overall production of 51 young; these numbers compare to a 19 year average of 73 percent nesting success, 25 broods, 2.5 young, and 62 young, respectively. Productivity data at the subarea level was not available for the CDSA (Johnson et al. 2013).

Within the NASA, 19 nests (0.06 nests per km^2) were observed in 2012 surveys, with four nests in the Alpine West Subarea and nine nests in the Development Subarea (see Figure 3.3-7). A total of 12 broods were recorded in the NASA (0.04 broods per km^2) with an average brood size

of two. Three of the broods occurred in the Alpine West Subarea and five occurred in the Development Subarea (Johnson et al. 2013).

The habitat preferred by nesting tundra swans was evaluated using 19 years of aerial survey data in the CDSA and 11 years of aerial survey data in the NASA. Nesting tundra swans in the CDSA utilized 19 of 24 available habitats, preferring eight (Johnson et al. 2013). Of these eight preferred habitats, seven (deep open water with islands and polygonized margins, sedge marsh, patterned wet meadow, salt marsh, deep polygon complex, grass marsh, and moist sedge-shrub meadow) occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6). Tundra swans in the CDSA utilized 20 of 24 available habitats for brood-rearing, preferring nine. Of these nine preferred brood-rearing habitats, eight occur in the project study area (deep open water with islands or polygonized margins, deep open water without islands, grass marsh, shallow open water without islands, brackish water, tapped lake with low water connection, salt marsh, and salt killed tundra) (Johnson et al. 2013). Of these eight, six habitats (tapped lake with low water connection, salt marsh, deep open water with islands or polygonized margins, grass marsh, shallow open water without islands, and deep open water without islands) occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6).

Nesting tundra swans in the NASA utilized 21 of 26 available habitats, preferring four. Of these four preferred nesting habitats, only three occur in the project study area (grass marsh, salt marsh, and shallow open water with islands or polygonized margins; see Figure 3.3-6). Tundra swans in the NASA utilized 22 of 26 available habitats for brood-rearing, preferring five. All five of these preferred habitats (river or stream, grass marsh, deep open water without islands, deep open water with islands or polygonized margins, and tapped lake with low water connection) occur within the impact zone of the proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6) (Johnson et al. 2013).

Brant and Snow Goose

The summary presented below provides information from data collected on brant and snow geese throughout the ACP, and site-specific information collected in the project study area. This is supplemental to information provided in BLM (2012, § 3.3.5.5 and 2004, § 3.3.3.2), incorporated by reference here.

Ground-based nest searches documented nesting, brood-rearing, and fall staging of various bird species along a previously proposed road corridor between CD2, CD5, and the GMT1 pad area have been conducted (Johnson et al. 2005). These surveys were conducted one kilometer around proposed pad footprints for CD5 and CD6 (now known as GMT1), as well as 200 meters from the previously proposed road centerline between CD2, CD5, and the GMT1 pad area. Aerial surveys for brood-rearing and fall staging geese were also conducted in the NASA. In 2009, ground-based nest searches were conducted in a 400-meter buffer around the proposed GMT1 and CD5 pads as well as a 200 meter buffer surrounding the proposed road route between CD4 and GMT1 (Seiser and Johnson 2011).

Brant

Estimated onshore density indices of brant are presented in BLM (2012, Volume 7, Figure 3.3.5-8) and have been interpreted for the project study area. The nearest high density concentration of brant is northwest of the project study area, approximately 8.4 miles from the proposed GMT1 pad. Estimated density index contours within the project study area range from 0-0.029 to 0.988-2.291 birds per km^2 (BLM 2012, Vol 7, Figure 3.3.5-8), and are represented in Table 3.3-8.

Table 3.3-8. Estimated Density Contours of Brant within Project Study Area (2007 -2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 - 0.029	75578	64%
0.030 - 0.366	23778	20%
0.368 - 0.988	13929	12%
0.989 - 2.291	3181	2%
2.292 - 5.448	0	0%

Source: USFWS, 2010 – Migratory Bird Management.

The average annual population growth rate (total bird index) from 1986 to 2012 for brant was 1.095, indicating a positive population growth trend for this species across the ACP (Stehn et al. 2013).

In 2004, large waterbird searches documented a total of eight nests (1.9 nests per km^2) at the CD5 proposed drill site. No nests were observed at the CD6 survey location (now referred to as GMT1). Within the road corridor study plots, 13 brant nests (1.3 nests per km^2) were observed. Nesting success for all NASA study plots was moderate to high, with 76 percent of brant nests successful (Johnson et al. 2005). In 2009, two brant nests were recorded along road corridor searches (Seiser and Johnson 2011).

Ground-based nest search data was used to determine habitat use during nesting for brant in 2004. In the NASA, nesting brant utilized shallow open water with islands or polygonized margins, and young basin wetland complex within the search areas (Johnson et al. 2005). Brood-rearing and staging brant were observed in brackish water, open near-shore water, salt marsh, and tidal flat barrens (Johnson et al., 2013). Of these habitats, only salt marsh is present within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6). In the CDSA, brant were observed in brackish water, salt marsh, tidal flat barrens, and salt-killed tundra. Of these habitats, only salt marsh is present within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6).

Snow Goose

The average annual population growth rate for snow geese from 1986 to 2012 was 1.249 (total bird index), indicating a positive population growth trend for this species across the ACP (Stehn et al. 2013). Snow geese represented the most rapid growth rate among all species surveyed on the ACP. The last 10-year estimated population growth rate (from 2003 to 2012) for snow geese is 1.237 (total bird index). If this rate continues, the population of 6,171 total birds (in 2008) could potentially number 50,000 individuals by 2018.

Snow geese nest in small numbers on the Colville River delta (Johnson et al. 2005). During ground nest searches at CD3 (outside of the project area) three successful snow goose nests (0.2 nests per km^2) were found around the proposed pad location in 2004; although, no brood-rearing snow geese were observed near CD3 in that year (Johnson et al. 2005).

Aerial brood-rearing and fall staging surveys in the NASA observed 60 brood-rearing snow geese (0.10 birds per km^2) and 96 staging snow geese (0.16 birds per km^2) in 2004 (Johnson et al. 2005).

Ground-based nest search data was used to calculate snow goose nesting habitat selection in 2004. In the NASA, nesting snow goose utilized shallow open water with islands or polygonized margins, and young basin wetland complex within the search areas (Johnson et al. 2005). Of these two habitats, only one (shallow open water with islands or polygonized margins) is present in the project study area. The single present preferred habitat type does occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6).

King Eider

Information presented below provides available site-specific and ACP-wide information regarding pre-nesting and nesting king eiders, including on-shore densities, population growth rates, and habitat selection of king eiders relevant to the project study area. This is supplemental to information provided in BLM (2012, § 3.3.5.5) and BLM (2004, § 3.3.3.2), incorporated by reference here.

CPAI and its predecessors have been conducting aerial surveys of pre-nesting eiders in the CDSA for 19 years (1993-1998, 2000-2012) and the NASA for 14 years (1999-2012; Figure 3.3-5). The survey areas and survey coverage differed among years.

King eiders breed along the Arctic coast of Alaska and are present in the project study area. The average annual population growth rate (total bird index) from 1986 to 2012 was 1.031, indicating a positive population growth trend for this species across the ACP (Stehn et al. 2013). Within the CDSA and the NASA, Johnson et al. (2013) estimated a population growth rate of 1.003 (1992 - 2012) and 1.091 (2000 - 2012) respectively. Population growth rates in the NASA have shown positive growth over the last 11 years (Johnson et al. 2013).

Estimated onshore density indices of king eiders are presented in BLM (2012, Figure 3.3.5-19). Densities within the project study area were selected by GIS analysis of the data. The nearest high density concentration of king eiders is located outside of the project study area along the Beaufort Sea coast, approximately 9.6 miles north of the proposed GMT1 drill site location. Estimated density index contours within the project study area range from 0-0.032 to 0.728-1.31 birds per km^2 (BLM 2012, Figure 3.3.5-19), and are represented in Table 3.3-9.

Table 3.3-9. Estimated Density Contours of King Eiders within Project Study Area (2007 -2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 - 0.032	16252	14%
0.033 - 0.337	42743	37%
0.338 - 0.728	41193	35%
0.728 – 1.310	16300	14%
1.311 – 2.367	0	0%

Source: USFWS, 2010 – Migratory Bird Management.

Within the CDSA, the average indicated density for pre-nesting king eiders over a 19-year period (1993-1998 and 2000-2012) was reported at 0.08 birds per km^2. In 2012, the majority of the 25 total king eiders observed in the CDSA occurred outside of the project study area in the CD North Subarea. (Johnson et al. 2013)

Within the NASA, pre-nesting king eider density was 13 times greater than recorded densities in the CDSA, with an average indicated density of 0.38 birds per km^2 (study period spanning

1999-2012). Surveys conducted in 2012 show a total of 27 birds observed in the Development Subarea (0.44 birds per km^2), and a total of 13 birds observed in the Alpine West Subarea (0.33 birds per km^2). (Johnson et al. 2013)

In 2009, ground-based nest searches were conducted in a 400 meter buffer around the proposed GMT1 and CD5 pads, as well as a 200 meter buffer surrounding the proposed road route between CD4 and GMT1. During these searches, five king eider nests were found (1.38 nests per km^2) (Seiser and Johnson 2011).

The habitat preferred by pre-nesting king eiders was evaluated using 19 years of aerial survey data in the CDSA, and 11 years of aerial survey data in the NASA. Pre-nesting king eiders in the CDSA utilized 19 of 24 available (preferring six) (Johnson et al. 2013). Of these six preferred habitats, four (salt marsh, river or stream, deep polygon complex, and grass marsh) occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6). In the NASA, king eiders utilized 21 of the 26 available habitats and were found to prefer ten (Johnson et al. 2013). Of these ten preferred habitats, nine (tapped lake with low-water connection, salt marsh, deep open water without islands, deep open water with islands or polygonized margins, shallow open water without islands, shallow open water with islands or polygonized margins, river or stream, sedge marsh, and old basin wetland complex) occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6).

Greater White-Fronted Goose and Canada Goose

The greater white-fronted goose and Canada goose are common species along the arctic coast of Alaska and are present in the project study area. The summary presented below provides information from data collected on geese throughout the ACP and limited site-specific data in the project study area. As of 2004, the Canada goose was split into two species: Canada goose (*Branta Canadensis*) and cackling goose (*Branta hutchinsii*) (Banks et al. 2004). The cackling goose (*branta hutchinsii*) is the common Canada goose species present in the project study area (Stehn et al. 2013). For the purpose of this section, "Canada goose" refers to both Canada goose and cackling goose. This summary is supplemental to information provided in the BLM (2012, § 3.3.5.5) and BLM (2004 § 3.3.3.2), incorporated by reference here.

CPAI and its predecessors have been conducting aerial surveys of nesting and brood-rearing geese in the ASDP and Colville River Delta Areas since 1999 and 1992, respectively (Johnson et al 2005). The greater white-fronted goose was included in the ASDP wildlife study surveys because of their importance as a subsistence species (Johnson et al. 2005). The survey areas and survey coverage have differed among years. The project study area lies within these survey areas (Johnson et al. 2005).

Average annual greater white-fronted goose population growth rates of the greater white-fronted goose and Canada goose on the ACP from 2003 to 2012 were reported at 1.137 and 1.045 (total bird index) respectively, indicating a positive trend in population growth for both species (Stehn et al. 2013, Table 5).

Estimated density indices of greater white-fronted goose across the ACP are presented in BLM (2012, Figure 3.3.5-13). Densities within the project study area were selected by GIS analysis of the data. Density index contours within the project study area range from 0.119 – 2.303 to 8.782 – 15.846 birds per km^2 (Table 3.3-10). Moderate to high densities of greater white-fronted goose

encompass more than 90 percent of the project study area; similar to densities that are exhibited across the entire ACP.

Table 3.3-10. Estimated Density Contours of Greater White-Fronted Goose within Project Study Area (2007 -2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 - 0.118	0	0%
0.119 – 2.303	10364	9%
2.304 – 5.001	44877	39%
5.002 – 8.781	27747	24%
8.782 – 15.846	33462	29%

Source: USFWS, 2010 – Migratory Bird Management.

Estimated density indices of Canada goose across the ACP are presented in BLM (2012, Volume 7, Figure 3.3.5-16). Densities within the project study area were selected by GIS analysis of the data. Density index contours within the project study area range from 0 to 1.293 birds per km^2, encompassing the lower three density contours present on the ACP (Table 3.3-11). The highest density contours, for comparison, range from 1.294 to 8.104 birds per km^2 and are concentrated along the Beaufort Sea coast, north of Teshekpuk Lake as shown in BLM (2012, Vol 7, Figure 3.3.5-16).

Table 3.3-11. Estimated Density Contours of Canada Goose within Project Study Area (2007 – 2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 - 0.029	25089	22%
0.030 - 0.460	57802	50%
0.460 – 1.293	33564	29%
1.294 – 2.972	0	0%
2.973 – 8.104	0	0%

Source: USFWS, 2010 – Migratory Bird Management.

In 2009 ground-based nest searches were conducted in a 400 meter buffer around the proposed GMT1 and CD5 pads as well as a 200 meter buffer surrounding the proposed road route between CD4 and GMT1. Within the CD5 nest survey area, eight greater white-fronted goose nests were reported and no Canada goose nests while within the GMT1 nest survey area, no nests were found for either species. Along the proposed road segments, a total of 55 greater white-fronted goose nests were reported, with approximately 73 percent found along the segment of proposed road between CD4 and the NPR-A boundary (Seiser and Johnson 2011).

The most recently-collected site specific density data available for greater white-fronted goose and Canada goose is presented in Johnson et al. (2004). Ground-based nest searches were conducted in a one kilometer radius around the proposed CD3, CD4, CD5, CD6, and CD7 pad locations. For the purpose of this summary, only results from CD5 and CD6 nest surveys will be discussed, as they are both within the project study area for GMT1 (CD6 was surveyed at its former location, but it remains representative for the project study area). At CD5, 33 greater white-fronted goose nests were reported at a density of 8.0 nests per km^2 and twenty Canada goose nests were reported at a density of 5.0 nests per km^2 (Johnson et al. 2005). At CD6, three

greater white-fronted goose nests were reported with a density of 0.7 nests per km^2 and no Canada goose nests were reported (Johnson et al. 2005).

Brood-rearing adults and young were also surveyed for at CD5 and CD6 (which is now known as GMT1) with no individuals of either species detected (Johnson et al. 2005).

3.3.3.5 Shorebirds

The summary presented below provides information from data collected on shorebirds throughout the ACP and limited site-specific data regarding nesting densities, nesting success, population growth rates, and habitat selection for shorebirds that occur in the project study area. This information is supplemental to BLM (2012, § 3.3.5.6) and BLM (2004, § 3.3.3.6), incorporated by reference here.

The average annual population growth rate for all shorebird species (shorebirds were not identified to the species level in this survey) was 1.094 (total bird index) from 1986 to 2012 (Stehn et al. 2013), indicating a positive population growth trend for shorebirds in general along the ACP.

A number of species of shorebirds were observed during ground-based nest searches conducted in a portion of the project study area (Burgess et al. 2003, Johnson et al. 2004, Johnson et al., 2005). Ground-based nest searches collected observations of shorebird nest occurrence within breeding bird study plots and within large waterbird survey corridors along a previously proposed road corridor between CD2 and the GMT1 pad area. During the period 2001-2004, pectoral sandpiper (24 nests, 10 nests per km^2) and semipalmated sandpiper (19 nests, 7.9 nests per km^2) were among the three most common breeding species (also lapland longspur) detected in the survey (Burgess et al. 2003, Johnson et al. 2004, Johnson et al. 2005). Between 2002 and 2004, the five most abundant shorebird species within these same study plots were the pectoral sandpiper, semipalmated sandpiper, long-billed dowitcher, red-necked phalarope, and red phalarope. Also observed were American golden plover, stilt sandpiper, dunlin, and bar tailed godwit (Johnson et al. 2005). Overall shorebird nest density for all study plots in 2004 was 38.3 nests per km^2, with nesting success estimated at 63 percent (64 percent and 60 percent in 2002 and 2003 respectively) (Burgess et al. 2003, Johnson et al. 2004, Johnson et al. 2005). A bar-tailed godwit nest was also observed in 2009 along a study corridor between CD4 and the NASA boundary (Seiser and Johnson 2011).

Habitat selection for shorebirds varies depending on species and life stage. The project study area consists of habitats known to be preferred by breeding, nesting, and brood-rearing shorebirds, these include coastal areas, wet sedge and grass meadows, aquatic sedge and grass marshes, well drained and dry tundra, and upland areas (Johnson et al. 2005). Of these preferred habitat types, five (patterned wet meadow, moist sedge-shrub meadow, sedge marsh, grass marsh, and river or stream) occur within the impact zone of proposed infrastructure for the action alternatives (discussed in Section 4; Figure 3.3-6).

3.3.3.6 Raptors

Raptors are birds of prey that include falcons, hawks, eagles, and owls. Raptors that occur on the ACP, and therefore may be present within the project study area, are discussed in BLM (2012, § 3.3.5.7, pp. 270-275) and BLM (2004, § 3.3.3.5 pp. 252-253), incorporated by reference here.

The snowy owl and gyrfalcon are the only raptors known to occasionally overwinter in the NPR-A; all other species (as well as many snowy owl and gyrfalcon) migrate south to overwinter (Johnson and Herter 1989). Arctic peregrine falcon, gyrfalcon, golden eagle, and rough-legged hawk are regular breeders on the cliffs along the Colville River and other rivers in the NPR-A. Merlins also nest in small numbers along larger rivers in the southern portion of the NPR-A. Although, the bluffs along the Colville River and adjacent wetlands are important raptor nesting habitat, they are well outside of the project study area. The snowy owl, short- eared owl (a BLM sensitive species), and northern harrier are widely dispersed and nest irregularly throughout the NPR-A (BLM 2012, § 3.3.5.7, p. 270).

Results of ground-nesting raptors have been reported in ground-nest search results for large waterbirds. One short-eared owl nest was located in the Alpine search area in 1996, which was the only nest found in six years of nest searches (1996-2001; Johnson et al. 2003b).

3.3.3.7 Other BLM Sensitive Species

The red knot is a medium-sized shorebird that is listed as a BLM Sensitive Species. The breeding range in Alaska is only generally known. Within the NPR-A the red knot is a rare migrant on both the Chukchi Sea and Bering Sea coasts, but has been recorded breeding in small numbers near Barrow (BLM 2012, § 3.3.8.2, p. 331). Nest surveys in both the Colville River delta and NPR-A found no evidence of this species in the area (BLM 2004, § 3.3.3.6, p. 256). Red knots were not surveyed in 2011 studies (Johnson et al., 2012).

The golden eagle occurs in NPR-A as a migratory species and is listed as a BLM Sensitive Species. The northern distribution limit of the breeding range for the golden eagle is the northern foothills of the Brooks Range. However, subadult golden eagles have been reported in the ACP during spring and summer seasons. There is no area-wide systematic survey of golden eagles that can be linked to the ASDP Area and they are considered rare within the ASDP Area (BLM 2012, § 3.3.8.2, pp. 334-335). The BLM (2012) and BLM (2004) do not provide population densities or occurrences of golden eagles relevant to the project study area or the Clover site.

3.3.4 Mammals

This section presents information about terrestrial mammals that occur in the project study area. More than ten species of terrestrial mammals are reported to occur in the area, as indicated in Table 3.3-12.

The project study area is entirely onshore, with all facilities and pipelines on or located more than 4 miles from the Beaufort Sea Coast line in Harrison Bay (see Figure 2.4-1). Essentially all mammals with the potential of impact are terrestrial, with the exception of the polar bear, a marine mammal (discussed in Section 3.3.5). In the unlikely event of a very large oil spill reaching coastal open water, some individual marine mammals could be present in the affected area. A brief discussion of marine mammals is provided in Section 3.3.4.2.

3.3.4.1 Terrestrial Mammals

Terrestrial mammals and their habitats are discussed in BLM (2004, § 3.3.4.1, pp 259-271; BLM 2008, § 3.3.7.1, and BLM 2012, § 3.3.6, pp 280-306), incorporated by reference here. A summary of supplemental information for the proposed GMT1 development follows.

Table 3.3-12. Abundant, Common, and Uncommon Mammal Species known or suspected to occur in the region of the Colville River delta, Alaska

Common Name	Scientific name	Inupiaq name	Abundance
Large Mammals			
caribou	*Rangifer tarandus*	Tuttu	Abundant
grizzly (brown) bear	*Ursus arctos*	Akjaq	Common
moose	*Alces alces*	Tiniikaq/tuttubak/titiniika	Uncommon
muskox	*Ovibos moschatus*	Umifmak/imummak	Common
Arctic fox	*Alopex lagopus*	Tibiganniaq	Common
red fox	*Vulpes vulpes*	Kavviaq/kayuqtuq	Uncommon
wolverine	*Gulo gulo*	Qavvik/qapvik	Uncommon
Small Mammals			
Arctic ground squirrel	*Spermophilus parryii*	Siksrik	Abundant
barren-ground shrew	*Sorex ugyunak*	Ugrugnaq	Common
brown lemming	*Lemmus trimucronatus*	Aviffaq	Uncommon
collared lemming	*Dicrostonyx groenlandicus*	Qixafmiutauraq	Common
ermine (short-tailed weasel)	*Mustela ermine*	Itibiaq/tibiaq	Common
least weasel	*Mustela nivalis*	Naulayuq	Uncommon
singing vole	*Microtus miurus*	--	Common
tundra shrew	*Sorex tundrensis*	Ugrfnaq	Uncommon
tundra vole	*Microtus oeconomus*	Avieeaq	Uncommon

Source: This table was modified from Table 3.3.4-1 of BLM (2004) and Table 3-19 of BLM (2012)

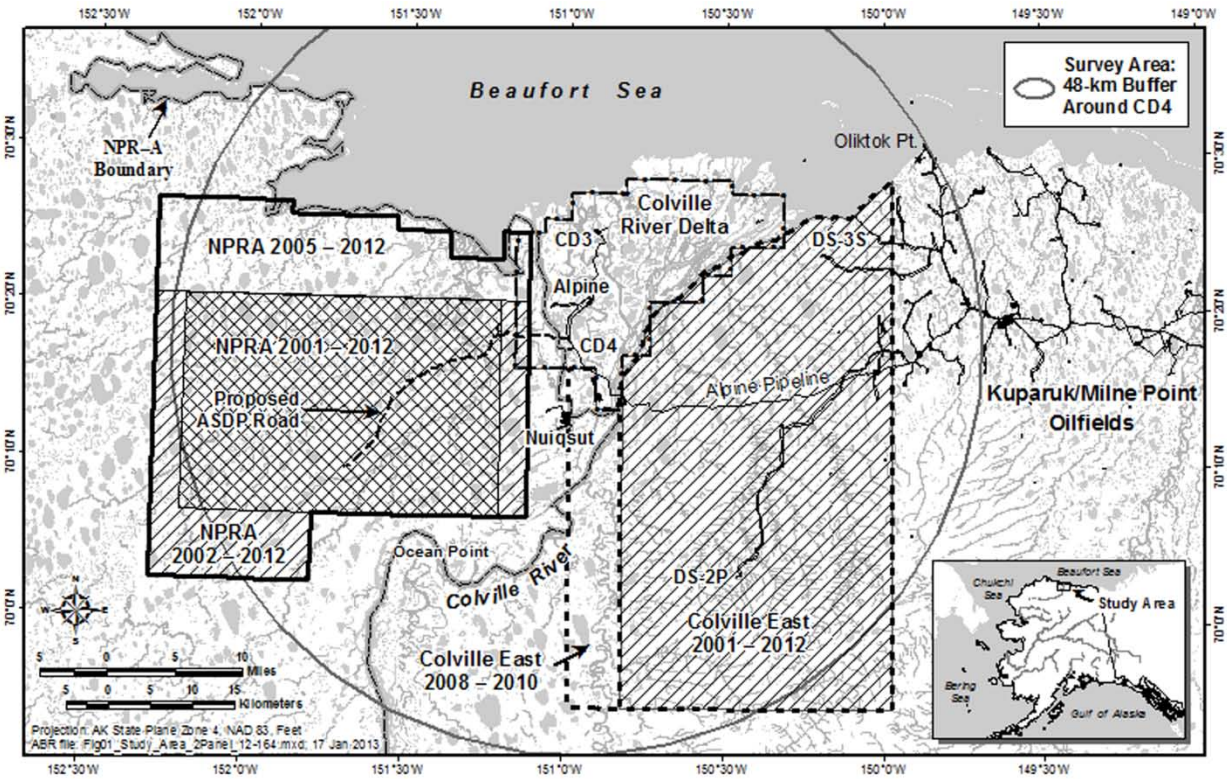
None of the terrestrial mammals reported to occur within the proposed GMT1 development are currently listed under the ESA, or occur on the federal or State of Alaska Endangered Species Act lists. The BLM has identified the Alaska hare (*Lepus othus*) and the Alaska tiny shrew (*Sorex yukonicus*) as sensitive mammal species in Alaska that may occur in the NPR-A. There have been no reports of the Alaska hare on the North Slope since 1951 and no report of the Alaska tiny shrew in the NPR-A (BLM 2012 § 3.3.8.3, pp. 337 and 338). Neither species are known to occur in or near the project area.

Caribou

Caribou biology, population status, seasonal ranges and distribution, migration patterns, calving, and harvest in the NPR-A are described in BLM (2012, § 3.3.6.1, pp. 280-292). Localized information on the ASDP plan is included in BLM (2004, § 3.3.4.1, pp. 260-266). These documents are incorporated by reference. Additionally, caribou research is reported for the project study area by CPAI and ADF&G. A discussion of the information in these documents and references are summarized below.

In its approval for construction of CD4 (the first ASDP development), the NSB included the permit stipulation that a 10-year study of effects on caribou distribution and movements be conducted within a 30-mile (48 km) radius of CD4 and is referred to as the ASDP caribou monitoring study area (Figure 3.3-8). Details of the stipulation were later adjusted to account for additional development in the ASDP area and, at the request of Nuiqsut residents, wording regarding the 30-mile radius was dropped (Lawhead et al. 2013). Since 2004, CPAI has continued a caribou monitoring study associated with development of the Alpine satellites, including GMT1. As part of this ongoing monitoring program, caribou calving and post-calving distribution between the Colville and Kuparuk Rivers has been surveyed annually between 1993 and 1995-2013.

The ASDP caribou monitoring study combines results from aerial surveys of caribou locations, radio, and satellite telemetry of caribou locations. As of 2013, the study is in its ninth consecutive year (with results presented for eight years). The study area encompasses the CD3, CD5, GMT1 and GMT2 development areas, as well as the original Alpine Project infrastructure. Data collected under the CD4 permit stipulation builds upon previously collected research on caribou that began in the early 1980s (Lawhead et al 2013). Within the 30-mile radius three aerial survey areas were established: NPR-A, Colville River Delta, and Colville East (Figure 3.3-8). The southeastern portion of the NPR-A survey area contains most of the proposed elements of the ASDP, including the proposed pipeline and road corridor to GMT1 (Lawhead et al 2013). This portion of the survey area was selected for detailed analysis of potential impacts to caribou from the proposed GMT1 development.



Source: Lawhead, et al. 2013, Figure 1

Note: Proposed ASDP Road shown in the ASDP study area is the road to GMT2 (formerly CD7), as planned in 2004. It extends approximately 6 miles beyond the currently proposed GMT1 drill site.

Figure 3.3-8. Location of the ASDP Caribou Monitoring Study Area (2001 – 2012)

Caribou is an important species in the project study area and across the North Slope because it is harvested for subsistence by all North Slope communities. Four caribou herds populate Alaska's North Slope: Teshekpuk Herd (TH), Central Arctic Herd (CAH), Western Arctic Herd (WAH), and Porcupine Caribou Herd (PCH). The TH and the CAH are the primary herds in the project study area. Information on these herds is discussed in BLM (2012, § 3.3.6.1, pp 282-287 relevant to the TH; and pp 291-292 relevant to the CAH; BLM 2004, § 3.3.4.1, pp 260-266). Historical and current data indicate that the TH generally ranges to the west of the Colville River delta and the CAH ranges to the east of the project study area (Lawhead et al. 2013). The ASDP Area is used as both winter and summer range by the TH and as summer range for the CAH. Seasonal ranges of the TH and the CAH were depicted by BLM (2004, Figure 3.3.4.1-1) and were updated in BLM (2012, Maps 3.3.6-2 and 3.3.6.3). The ASDP Area and proposed GMT1 road are located at the interface between the annual ranges of the TH and the CAH (Lawhead et al. 2013). The ASDP Area and proposed GMT1 road are in the peripheral range, if not further, for the PCH and WAH and these herds are therefore not discussed further in this document (BLM and MMS 2003; Lawhead et al 2013) (Figure 3.4-18).

Arctic caribou distribution and movements are influenced heavily by annual events: calving, mosquito harassment, oestrid fly harassment, and migration to and from wintering grounds. Caribou distribution, habitat preferences, and movement rates differ for each event. Examples include preference for newly emerged high-quality vegetation in calving areas, movements to coastal areas during mosquito harassment, and use of riverine habitats and barren unvegetated areas in response to oestrid-fly harassment.

Habitat Use

Caribou utilize various habitat types throughout their range dependent upon their annual life cycle (Table 3.3-13). During winter and early spring, the caribou diet is dominated by lichens, which are present throughout their winter range. In spring and early summer, caribou begin to migrate north as vascular plants become available. The timing is dependent upon annual snowmelt and temperatures. Spring migration to traditional calving grounds provides highly nutritional forage to lactating females (during calving and nursing periods). The availability of high quality and high quantity desired forage species (apparently influenced by temperature and snow cover) probably affects specific calving locations and calving success (BLM 2012, § 3.3.6.1, p. 283). Caribou groups in the NPR-A survey area generally showed selection for areas with high vegetative biomass, although there was seasonal and annual variation (Lawhead et al 2013). During late June to August, and during insect relief seasons, caribou migrate to riparian areas, sand dunes, and coastal plains in response to insect harassment.

Patterns of selection varied through summer, but caribou consistently avoided patches of flooded vegetation and selected areas with a high density of sedge-grass meadow. When insect harassment was low, caribou primarily selected the areas around Teshekpuk Lake but when it was high, caribou used areas where insect abundance was lower such as coastal margins and gravel bars (Wilson et.al 2012). For the years 2002-2012 combined, caribou in the NPR-A survey area used flooded tundra significantly less than expected (based on availability) during calving, postcalving, and fall, whereas riverine habitats were used more than expected (based on availability) from postcalving through late summer, possibly for forage availability and oestrid-fly relief (Lawhead et. al 2013).

Table 3.3-13. Caribou Forage Habitats within the GMT1 Project Study Area

Caribou Life Cycle Stage	Habitat Type
Summer Forage/Calving Habitat	Moist Tussock Tundra
	Moist Sedge-Shrub Meadow
Caribou Insect Relief Habitat	Riverine
	Barrens
Caribou Winter Forage Habitat	Lichen-Bearing Habitats

Source: BLM 2012 and Lawhead et al 2013.

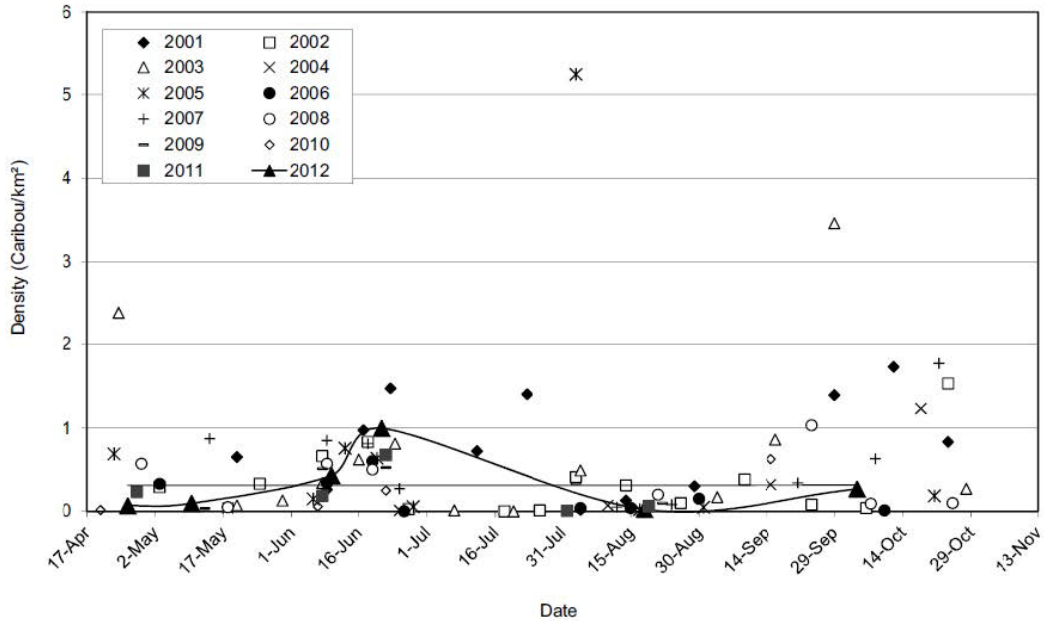
Caribou Densities and Distribution

Caribou densities in the NPR-A survey area in 2012 were low in the spring, moderately high during calving, high in late June, and low in August (Figure 3.3-9). In October, densities were moderate. Research conducted by CPAI during 2001 through 2011 indicate that the project study area, which is used mainly by TH caribou, is not a high density calving area, in contrast to the Colville East survey area, which is used mainly by CAH caribou (Lawhead et al. 2013). The project study area is on the eastern edge of the TH range, and a west-to-east gradient of decreasing density throughout the year. Caribou density is lowest in the southeastern section of the NPR-A Survey Area (compared to other survey areas within the 30 mile radius), where the project study area is located (Lawhead et al, 2013).

The TH typically calves in the northeastern portion of the NPR-A near Teshekpuk Lake. Predicted use by parturient females during calving was almost entirely restricted to the area surrounding Teshekpuk Lake, where there is a concentration of sedge-grass meadow habitat (Wilson et al. 2012). In the 2012 study period, the estimated density of caribou in the NPR-A survey area ranged from a high of 0.99 caribou per km2 on 21 June to a low of 0.02 caribou per km2 on 18 August (Lawhead et al. 2013). The density of caribou during calving (0.43 caribou per km2 on 10-11 June) was in the middle of the range of densities observed during 2001-2011 (0.06 – 0.87 caribou per km2 for 6-9 June) (Lawhead et al. 2013). Although some calving occurs in the western half of the ASDP Area, where the project study area is located, it is not a concentrated calving area for the TH (Lawhead et al. 2013) (Figure 3.4-19).

The project study area is utilized by the TH in winter, but there is variation in the amount of utilization from year to year possibly due to their winter presence being a result of migration routes (BLM 1998a; Lawhead et al 2013). During most years, TH winter on the ACP, including the project study area, and high densities have been recorded occasionally in the NPR-A survey area during late winter (2.4 caribou per km^2 in April 2003) (Lawhead et al. 2013).

Survey results from 2003 to 2012 have reported several herds exhibiting shifts from typical seasonal use areas. Such as the TH, which have shown increased movements to the east (2003-2004) and southeast (2004-2005) during winter (Lawhead et al. 2013). Since 2012, the TH herd have consistently utilized a larger area of land (further west) for calving grounds than previously observed (Lawhead et al. 2013).



Source: Lawhead et al. 2013, Figure 6

Figure 3.3-9. Caribou Density Observed on 100 Surveys of the NPR-A Survey Area

Caribou use of and distribution throughout the Project Study Area have been studied by CPAI and ADF&G through aerial surveys, GPS tracking, and satellite tracking since the 1980s. Figure 3.3-10 presents the distribution and size of caribou groups within the project study area during the monitoring period of April-October 2012. Presence and movement of satellite and GPS collared caribou are presented in Figure 3.3-10 and Figure 3.3-11. In recent years, large portions of the TH have calved further west between Atqasuk and the Ikpikpuk River (Lawhead et al. 2013; Parrett 2011). Selection of calving grounds appears to be correlated with annual snowmelt and availability of vegetation (BLM 2012, §3.3.6.1, p 283). TH caribou use the project study area throughout the year, although usually at low densities. From the onset of the caribou monitoring study in NPR-A in 2001, the highest densities of caribou in the NPR-A survey area typically have occurred during the mosquito and oestrid fly harassment periods in mid to late summer, and from mid-September through late October during fall migrations (Lawhead et al. 2013). Riverine habitat along Fish Creek and Judy Creek, include sand dunes, barrens, and sparsely vegetated areas, provide habitat for relief from oestrid-fly harassment (Lawhead et al. 2013).

While the TH utilizes much of the area around Teshekpuk Lake in the summer during calving, the herd will also utilize habitats in the ASDP area, such as the Colville River Delta, sand dunes, and ridges (BLM 2004, § 3.3.4.1, p. 261; BLM 1998a; Wilson et al. 2012). Since 2005, the only large group of mosquito-harassed caribou observed during aerial surveys in the NPRA survey area was in August 2006 (Lawhead et al. 2013).

The majority of the CAH remains to the east of the Colville River (BLM 2004, §3.3.4.1, pp 262). Aerial surveys conducted in July 2001 documented approximately 6,000 CAH caribou moving west across the Colville River Delta into the NPR-A in the summer, however this was reported as a rare event and CAH movements into the NPR-A are uncommon (Lawhead and Prichard 2001). The ASDP Area contains areas of high-density utilization by the CAH (east of the

Colville River Delta) and low-density calving areas for the TH. In recent years, however, range use by both herds has changed somewhat. CAH caribou have shown a tendency to move farther east into the Arctic National Wildlife Refuge and even crossing the Canadian border during the insect harassment season than in former years (Lawhead et al. 2013).

In documenting the 2011 survey, Lawhead et al. (2013) reported:

> *"There was little evidence for selection or avoidance of specific distance zones within 6 km of the proposed ASDP road alignment. Fewer groups than expected (assuming a uniform distribution for statistical testing) occurred around the corridor during the oestrid-fly season, probably due to increased use of riparian habitats along Fish and Judy Creeks by fly-harassed caribou. Although radio-collared TH caribou have crossed the proposed ASDP road alignment in the NPR-A occasionally (primarily during fall migration), the data collected thus far indicate that the proposed road and pipeline corridor is in an area of low-density use by caribou."*

In general, within the NPR-A study area, more caribou are likely to occur in the western portion than the southeastern section where ASDP infrastructure exists and more is proposed. ABR states that, "Whatever the reason(s), it is important to recognize that this pattern of distribution exists before construction of the proposed ASDP pipeline/road corridor" (Lawhead et al. 2013).

Muskoxen

The history, sightings in the project study area, and habitat preferences of muskoxen are included in BLM (2012, § 3.3.6.2, pp 293-294) and BLM (2004, § 3.3.4-1, pp. 266-267), incorporated by reference here. Muskoxen historically occurred throughout northern Alaska, but no longer occupy what is now the NPR-A. Their population was re-established by translocation to Barter Island and the Kavik River in 1969 and 1970. As their numbers on the ACP increased, their range continued a westward expansion to the Colville River and an eastward expansion to Babbage River. Small numbers of muskoxen have occasionally been observed west of the Colville River; however, they are not considered to be abundant in the project study area. Muskoxen have been noted in the Colville River Delta area since 1993. In 2012, one group was reported moving west into the NPR-A. In previous years (2005, 2006, and 2007) a group of muskoxen was observed near the Kalikpik River and west of the Fish Creek delta (Lawhead et al. 2013). While their population numbers are reported as stable or in slight decline (Arthur and Del Vecchio 2013), the population could expand into the project study area.

Moose

A discussion of moose occurrence on the Arctic Coastal Plain, as well as in the project study area, is included in BLM (2004, § 3.3.4.1, p. 267) and BLM (2012, § 3.3.6.3, pp. 295-296). A summary of this information and limited site-specific information follows.

Moose occur at low densities on the Arctic Coastal Plain, which is at the northern limit of their range in Alaska (BLM 2004, § 3.3.4.1, p. 267). Moose are widely distributed during the summer, ranging from the northern foothills of the Brooks Range to the Arctic Coast. As snow accumulates during fall, moose move to riparian corridors of large river systems, where they concentrate in winter. The largest winter concentrations of moose occur in the inland portions of the Colville River drainage (BLM 2004, § 3.3.4.1, p. 267).

As noted in BLM (2004, § 3.3.4.1, p. 267), in eight years of observations by the Helmericks family (at Colville Village; 1992-1998 and 2001), only five moose were seen. To the southwest, moose have been noted sporadically in the general project study area near Fish Creek (Lawhead et al. 2009).

Grizzly Bear

There are relatively low densities of grizzly bears (0.5 to 2.0 bears per 1,000 km^2) on the ACP, as compared to densities of grizzly bears in the mountains and foothills of the Brooks Range. A discussion on the factors that influence grizzly bear presence throughout the NPR-A is discussed in BLM (2012, § 3.3.6.5; and 2004, § 3.3.4.1).

Studies carried out between 1999 and 2004 found 25 marked grizzly bears and their dens in the Colville River Delta, the Fish Creek and Judy Creek Delta, and other riparian areas in and near the project study area (BLM 2004, § 3.3.4.1; Figures 3.3.4.1-10 and 3.3.4.1-11). In general, the project study area and adjacent areas of the NPR-A are considered to be better grizzly bear habitat, with proportionally more well-drained potential denning habitat and ground squirrel habitat than areas of the coastal plain east of the Colville River (BLM 2004: Shideler 2004, personal communication).

Fox

Arctic fox is the most common furbearer in the Colville River delta and adjacent coastal plain. A discussion on their population status, diet, habitat and denning is presented in BLM (2004, § 3.3.4.1) and BLM (2012, § 3.3.6.6). Populations of fox fluctuate with the availability of prey species (e.g., lemmings and voles). They prefer well-drained soils (e.g., riparian or upland shrub habitat), including banks of lakes, streams, drained lake basins, and pingos. During fox den surveys conducted in 2001-2004 (BLM 2004, Figure 3.3.4.1-12; Johnson et al., 2005), arctic fox were routinely reported to be observed in the project study area. Red fox are also found in the project study area, but according to local knowledge, the number of red fox has increased recently, corresponding with the warmer winters (BLM 2012, § 3.3.6.6). Red fox utilize denning habitat similar to the Arctic fox. The red fox is aggressive towards Arctic foxes, and will displace them from feeding areas and den sites (Johnson et al 2005).

Wolf

Wolves may occur in the project study area, but are uncommon (Lawhead et al., 2013; Johnson et al., 2005; BLM 2012, § 3.3.6.6). Wolf distribution and abundance data for the project study area is not available. The discussion below is provided to summarize general information about wolves in the area.

In general, wolves are more abundant in the Brooks Range than on the Arctic Coastal Plain. This could be because of better prey availability and denning habitat in the Brooks Range, and rabies outbreaks and hunting pressure on the coastal plain (BLM 2004, § 3.3.4.1, pp 268). In 1993, the population estimate was 240 to 390 wolves in 32 to 53 packs (BLM 2012, § 3.3.6, pp 300). The highest wolf densities in the NPR-A are reported along the Colville River. Surveys near Umiat showed that the density of wolves increased from 2.6 wolves per 1,000 km^2 in 1987 to 4.1 wolves per 1,000 km^2 in 1994 (Bente 1998 in BLM, § 3.3.4.1, pp 268).

Wolverine

Wolverines may occur in the project study area, but are uncommon (Lawhead et al. 2013; Johnson et al. 2005; BLM 2012, § 3.3.6.6). BLM (2004, § 3.3.4.1, pp 269) provides a discussion of the rare accounts of wolverines in the ASDP Area.

Wolverines occur throughout the Arctic Coastal Plain but are more common in the mountains and foothills of the Brooks Range (Bee and Hall 1956; BLM 1998a). In 1984, Magoun estimated a fall population size of 821 wolverines for game management unit 26A (includes the NPR-A), based on a density 1 wolverine per 54 square miles (BLM 2004, § 3.3.4.1, pp 269). Wolverines require large territories and utilize a broad range of habitats, frequently occurring in tussock meadow, riparian willow, and alpine tundra habitats (BLM 1998b).

Small Mammals

Small terrestrial mammals such as those listed in Table 3.3-12 are important prey for predatory birds and mammals in the region and birds of prey. Arctic ground squirrels hibernate during winter, while lemmings, voles, and shrews are active throughout the year. Many small mammal species have cyclical population fluctuations. Arctic ground squirrels, lemmings, voles, and shrews are ground-dwelling and utilize a variety of habitat types for burrowing and dens. (BLM 2004, § 3.3.4.1) and BLM (2012, § 3.3.6)

Distribution and abundance data for small mammals in the project study area are not available, but all species mentioned listed in Table 3.3-12 are likely to be present.

3.3.4.2 Marine Mammals

Marine mammals are described in BLM (2012, § 3.3.7) and BLM (2004, § 3.3.4.2), incorporated by reference here. Marine mammals with a status listed under the ESA, are discussed in Section 3.3.5.

Polar Bear

Polar bears occur in the NPR-A in terrestrial and marine habitats, but they are considered marine mammals (regulated under the Marine Mammal Protection Act) and have been listed as a threatened species under the ESA (USFWS 2009a). Polar bears are described in Section 3.3.5.

Spotted Seal

The spotted seal (*Phoca largha pallas*), may be seasonally present along the coast of Harrison Bay and in the Colville River Delta (BLM 2012, § 3.3.7.1). Spotted seals are generally distributed along the continental shelf, where their seasonal habitats include pack ice and land-based haul outs. When sea ice melts during the summer and suitable ice floes are not available, spotted seals may be found closer to shore, using isolated land-based haul outs such as mud, sand bars, gravel beaches, or barrier islands close to shore (BLM 2012, § 3.3.7.1; Boreng et al. 2009). There is documentation of spotted seals regularly occurring (during summer and fall) in the Colville River, as far upstream as Ocean Point (BLM 2004, Figure 3.3.4.2-1).

Historically, as many as 400 spotted seal individuals were estimated to utilize the Colville River, but this number fell to 150-200 in the 1970s (post establishment of the village of Nuiqsut), and more recently in 1996 and 1998, Johnson and PAI observed up to 24 individuals on haulouts in the main channel of the Colville River (BLM 2004, § 3.3.4.2). A reliable stock assessment for spotted seal in Alaska is not available, but the most recent estimates (1993, 2009, and 2010) ranges in size from 59,214 to 100,000 individuals (BLM 2012, § 3.3.7.1, pp. 308).

Beluga Whale

The Beaufort Sea stock of beluga whale may be seasonally present along the coast of Harrison Bay in rare occasions. Available evidence suggests that beluga whales show a preference for deeper waters (600 feet to 6,500 feet depth) during spring and fall migrations to and from

summer grounds in the north and eastern Beaufort Sea (BLM 2008, § 3.3.7.2, pp 3-77). However, belugas do occasionally occur in coastal shallow water (brackish and marine) for periods of molting, thermal benefits for calves, or in pursuit of prey items (BLM 2012, §3.3.7.3, pp 313). Northeast of the project study area, off the coast of and within the Colville River Delta, reports of beluga whales have been made by the Helmericks family, a survey conducted by Seaman et al., and several hunters from the Village of Nuiqsut (BLM 2008, § 3.3.7.2, pp. 3-78).

These rare instances of belugas involve only a small proportion of the remaining population which migrates far off-shore along the shelf break in the Beaufort Sea (BLM 2004, § 3.3.4.2, pp 276). The last population estimate of the Beaufort Sea beluga stock ((39,358 individuals) is considered an artificially low estimate by the National Marine Fisheries Service (BLM 2012, §3.3.7.3, pp 313). A reliable and widely-accepted stock assessment is not available at this time.

Other Marine Mammals

Other marine mammals that occasionally occur in the Beaufort Sea include ribbon seal, gray whale, minke whale, narwhal, harbor porpoise, and killer whale. The coastline of Harrison Bay, north of the project study area, is either too shallow or well outside the range limits of these mammals. They are not expected to occur.

3.3.5 Threatened and Endangered Species

Six species listed as endangered or threatened under the Endangered Species Act (ESA) are reported to occur or have the potential to occur in the project study area or in marine waters of Harrison Bay north of the project study area: spectacled eider (*Somateria fischeri*); Steller's eider (*Polysticta stelleri*); polar bear (*Ursus maritimus*); bowhead whale (*Balaena mysticetus*); ringed seal (*Phoca hispida*); and bearded seal (*Erignathus barbatus*). In addition, the yellow-billed Loon (*Gavia adamsii*) is an ESA candidate species, with a range that includes the project study area. Threatened and Endangered species are discussed in BLM (2004, §§ 3.3.3.3, 3.3.4.2, and 3.3.5) and BLM (2012, §§ 3.3.7 and 3.3.8), incorporated by reference here.

The Pacific walrus (*Odobenus rosmarus divergens*) is the only subspecies of walrus occurring in Alaskan waters and is an ESA candidate species that is considered extralimital in the Southern Beaufort Sea (*Marine Mammals; Incidental Take During Specified Activities: Final Rule*, 76 FR 47010-47054, August 3, 2011, p. 47040). Accordingly, due to the extremely low potential for pacific walrus to be near the project study area, they are not considered further in this analysis.

Bowhead whale, ringed seal, and bearded seal may be found near shore in Harrison Bay. All project facilities and the project study area are entirely inland, with no facilities, pipelines, or activities related to the project occurring on or immediately adjacent to the marine coastal zone.

In the 2011 Programmatic BO for Polar Bears, Polar Bear Critical Habitat, and Conference Opinion for the Pacific Walrus on Beaufort Sea Incidental Take Regulations, the USFWS notes that the probability of a large spill to marine waters is considered to be "very unlikely to occur and cannot be said to be reasonably expected to occur" (USFWS 2011a, p. 31). The action area covered by the proposed regulations includes the GMT1 project (USFWS 2011a, pp. 14-15, 17).

The 2012 NMFS ESA Section 7 informal consultation for the Point Thomson Project states, "historically, spills from offshore or coastal oil and gas facilities or barges in the Chukchi and Beaufort seas have involved only small amounts (less than 100 gal [2.4 bbl.]) of oil. The probability of a large or very large spill is very low (approaching zero); therefore we conclude that the effects from a large to very large oil spill associated with the proposed drilling and

production operations are discountable and thus not likely to adversely affect bowhead whales, bearded seals, ringed seals, their prey, and/or their habitats…" (NMFS 2012, p. 20). As a result, the risk of impact to bowhead whales, bearded and ringed seals is very small, but due to their protected status, these species are included in this SEIS.

The seven sensitive or ESA-listed species described in this section are listed in Table 3.3-14. The following sections describe the general ecology, including occurrence or likelihood of occurrence in the proposed project study area of those seven species. Additional information is provided in BLM (2004, §§ 3.3.3.3, 3.3.4.2, and 3.3.5; BLM 2012, §§ 3.3.7 and 3.3.8), incorporated by reference here.

Table 3.3-14. Threatened, Endangered, or Candidate Species Documented or Potentially Occurring in or Near the Project Study Area

Common Name	Scientific Name	Likely to Occur in Project Study Area	Conservation Status	Potential for Effects[b]
spectacled eider	*Somateria fischeri*	Yes	Threatened	H, P
Steller's eider	*Polysticta stelleri*	No	Threatened	U
yellow-billed loon	*Gavia adamsii*	Yes	Candidate	H, P
polar bear[a]	*Ursus maritimus*	Yes	Threatened	H, P
bowhead whale	*Balaena mysticetus*	No	Endangered	U
bearded seal (Beringia DPS[c])	*Erignathus barbatus*	No	Threatened	U
ringed seal (Arctic subspecies)	*Phoca hispida hispida*	No	Threatened	U

[a] ESA status refers only to the Beaufort Sea populations of the species

[b] H = potential effects on habitat P = physical or noise disturbance/deterrent effect; U = unlikely effect;

[c] DPS = Distinct Population Segment

3.3.5.1 Spectacled Eider

The spectacled eider (*Somateria fischeri*) was listed as a threatened species under the ESA in May 1993. The listing was prompted by declines in the western Alaska breeding population and indications of a decline on the North Slope of Alaska. There is no critical habitat designated for spectacled eiders on the North Slope; all designated critical habitat is in western Alaska and in nearshore and offshore areas in Norton Sound, Ledyard Bay and the Bering Sea between St. Lawrence and St. Matthew Islands (66 FR 9146 9185). The status of the North Slope spectacled eider population prior to the start of the ACP aerial survey in 1992 is unknown. An estimate of 3,000 pairs (6,000 birds) was made for the pre-1993 ACP population based on data from limited migration and ground studies (Dau and Kistchinski 1977). Since 1992, aerial surveys for many birds, including spectacled eider, have been conducted on the ACP each year. Aerial surveys have been conducted within the ABR's avian study series in the CDSA for 19 years (1993-1998, 2000-2012) and in the northeastern NASA for 13 years (1999-2006 and 2008-2012; no survey conducted in 2007; see Figure 3.3-5 and Figure 3.3-7).

The following summary provides data collected throughout the ACP, and limited site-specific data available for on-shore densities, population growth rates, and site-specific habitat selection, and nesting locations, for spectacled eiders in the project study area. This discussion is supplemental to information provided in BLM (2012, § 3.3.5.5) and BLM (2004, § 3.3.3.2), which are incorporated by reference.

The estimated population (total index)for spectacled eider on the ACP for the period 1992 through 2012 is 7,158 birds with a slightly negative long-term (0.990 for 1986 to 2012) and short-term (0.976 for 2003 to 2012) average annual population growth rate (Stehn et al. 2013). The confidence interval around both of these growth rates includes positive values and they do not indicate a decline. Spatial distribution of eiders during the 2007 – 2010 survey period was similar to the previous four-year period and to the distribution when all data are combined (1993 -2010); showing the highest concentrations of birds occurring within approximately 40 miles of the coast between Barrow and Wainwright, and north and northeast of Teshekpuk Lake (BLM 2012, Map 3.3.8-1). Onshore density index contours from the ACP-wide surveys that fall within the project study area range from 0-0.034 to 0.147-0.225 birds per km^2 (BLM 2012, Map 3.3.8.1), and are represented in Table 3.3-15 below. Most of the project study area (67 percent) is contained within the lowest density band; and none of the project study area lies within the highest density contour, suggesting that spectacled eiders are not found in high densities within the project study area.

Table 3.3-15. Estimated Density Contours for Spectacled Eiders within Project Study Area (1993 -2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 - 0.034	77801	67%
0.035 - 0.146	24234	21%
0.147 - 0.225	13978	12%
0.226 - 0.409	452	0%
0.410 – 1.409	0	0%

Source: USFWS, 2010- Migratory Bird Management

The overall population growth trends for spectacled eiders found within the CDSA and the NASA are slightly positive at 1.003 and 1.02 respectively. Within the CDSA, the estimated density for pre-nesting spectacled eiders over a 19 year study period (1993-1998, 2000-2012) is 0.10 birds per km^2. Surveys conducted in 2012 indicate a total of five birds in the CD South Subarea, corresponding to 0.01 birds per km^2. Surveys conducted in 2012 indicate a density of spectacled eiders in the CD North Subarea (49 birds, 0.24 birds per km^2) was twice that in the entire CDSA (59 birds. 0.12 birds per km^2), including 5 birds found outside the project study area. The density of spectacled eiders in the NASA has been consistently low (0.03 indicated birds per km^2), averaging only 38 percent of the density found in the CDSA. The NASA is estimated to be used less than the CDSA to pre-breeding spectacled eiders. (Johnson et al. 2013)

Pre-nesting spectacled eiders within the NASA occurred at less than 20 percent of the densities recorded in the CDSA, with an average density of 0.03 birds per km^2 (study period spanning 1999-2012). Spectacled eiders were found only in the Fish Creek Delta Subarea of the NASA, which is outside of the project study area. (Johnson et al. 2013).

Habitat preference for pre-nesting spectacled eiders was evaluated with 19 years (1993-1998 and 2000-2012) of aerial surveys in the CDSA, and 11 years (2001 – 2006 and 2008 – 2012) of aerial surveys in the NASA. Pre-nesting spectacled eiders in the CDSA utilized 17 of 24 available habitats, preferring seven (Johnson et al. 2013). Of the seven preferred habitats, (brackish water, salt marsh, salt killed tundra, deep open water with islands or polygonized margins, shallow open water with islands or polygonized margins, grass marsh, and deep polygon complex), all but brackish water type are present in the project study area. Of these habitats, only shallow open water with islands or polygonized margins occurs within the impact

zone of proposed infrastructure for action alternatives (discussed in Section 4). In the NASA, spectacled eiders utilized 12 of the 26 available habitats (preferring four, three of which were preferred in the CDSA) (Johnson et al. 2013). Of the four preferred habitats (brackish water, shallow open water with islands or polygonized margins, grass marsh and shallow open water without islands), all but brackish water occur within the project study area. Of these habitats, only two (shallow open water with islands or polygonized margins and shallow open water without islands) occur within the impact zone of proposed infrastructure for action alternatives (discussed in Section 4). Due to the low numbers of spectacled eiders found in the NASA there is low power in the selection analysis thus it is expected that additional habitats will become preferred as more spectacled eiders are added to the selection analysis.

In 2009, pre-nesting aerial surveys and ground-based nest searches for eiders were performed around three Alpine satellites: CD5, GMT1 (formerly CD6), and Fiord West (Seiser and Johnson 2011 Figure 1). Aerial surveys were conducted as part of a broader study of the CDSA and the NASA (Johnson et al. 2010), but the ground-based work was designed specifically to support the permit process for the three proposed Alpine satellites. Nest search areas included proposed pads, proposed road routes, and their alternatives. The majority of the area where the ground-based work took place in 2009 lies within the project study area, except the roads and facilities north of where the road to Fiord West forks (Seiser and Johnson 2011, Figure 1).

The 2009 pre-nesting aerial survey detected one pair of spectacled eiders within the GMT1 project study area, occupying patterned wet meadow habitat along the road alignment between CD5 and CD4 on the west side of the Colville River.

Six spectacled eider nests have been found on nest searches in the NASA in previous years (Seiser and Johnson 2011). During the 2009 nest survey, no spectacled eider nests were found within the bounds of the project study area, a single nest was found occupying nonpatterned wet meadow habitat in the Fiord West survey area that lies outside of the project study area (Seiser and Johnson 2011).

3.3.5.2 Steller's Eider

The Alaska breeding population of Steller's eider (*Polysticta stelleri*) was listed as threatened under the ESA in June 1997. There is no critical habitat designated on the North Slope for Steller's eiders; the designated critical habitat is located in western Alaska and along the Alaska Peninsula.

The size of the Steller's eider breeding population is highly variable and is densest near Barrow, extending in very small numbers, southwest to Point Lay and east to Nuiqsut (BLM 2012, Vol. 7, Figure 3.3.8-2). Historically, Steller's eider have utilized both the ACP and the western coast of Alaska as breeding grounds. At this time, the area of the ACP near Barrow is the only area in Alaska known to be regularly used for breeding by the Steller's eider. There are only two records of Steller's eider breeding east of Barrow in the last three decades (on the Colville River in 1987 and in Prudhoe Bay in 1994; USFWS, 1997).

Stehn et al. (2013) calculated a negative growth of 0.946 for Steller's eiders using aerial survey data collected between 1989 and 2012. Due to the very small numbers of birds detected on these aerial surveys Stehn et al. (2013) importantly notes that although declining, the trend was very imprecisely estimated and that these data do not support a definitive conclusion on population trend. The population size of Steller's eiders on the ACP is approximately 680 birds (Stehn et al. 2013). Since 1992, aerial and ground-based nest searches have been conducted in multiple

locations within adjacent to the project study area and over almost 2 decades, no nests or indications of breeding by Steller's eiders have been observed (Johnson et al. 2013). The only sightings of Steller's eider in or near the project study area have been a few single males (seen in 2001 and 2007) and one pair seen on the ground in the CD North study area in 2001 (Johnson et al. 2013).

3.3.5.3 Yellow-Billed Loon

The yellow-billed loon (*Gavia adamsii*) was designated as a candidate for protection under the ESA in March of 2009. The USFWS plans to announce either a proposal to list the species or a finding that the species is not warranted for protection under the ESA by the end of 2014 (Center for Biological Diversity v. Salazar, 10-cv-0230, July 2011). The yellow-billed loon population is considered vulnerable due to combination of a small population size range wide, low reproductive rate, and very specific breeding habitat requirements (USFWS 2009b).

Yellow-billed loon are discussed in BLM (2012, § 3.3.5.5) and BLM (2004, § 3.3.3.2), which are incorporated by reference here.

Earnst (2004) estimated the worldwide population of yellow-billed loons to be 16,000 individuals, with approximately 3,300 individuals breeding in Alaska's two known breeding locations; the North Slope and the area surrounding Kotzebue Sound in northwest Alaska. The estimate of the population index for yellow-billed loons on the ACP for the period 1986 – 2012 is 2,122 birds with an increasing annual population growth rate of 1.014 (total bird index; Stehn et al. 2013). The population growth rate indicates a positive trend over both the long term (last 27 years) and most recent 10-year period (Stehn et al. 2013). Spatial distribution of loons during the 2007 – 2010 survey period was similar to the previous 4 year period in that it showed high densities of loons between the Mead and Ikpikpuk rivers and in the Fish and Judy creek area (BLM 2012, Vol. 7, Map 3.3.8-4). There are also some notable differences between the 2 survey periods with the most recent survey period showing an increase in the number of loons close to and south of Nuiqsut and a decrease in numbers of loons on the Colville River Delta (BLM 2012, Map 3.3.8-1). Onshore density index contours within the project study area range from 0-0.03 to 0.322-0.516 birds per km^2 (BLM 2012, Figure 3.3.8-4), and are represented in Table 3.3-16 below. Twenty-one percent of the yellow-billed loons found in the project study area were within the two highest density categories, while 41 percent were found in the lowest density category; high numbers of yellow-billed loons are not expected to occur in the project study area.

Table 3.3-16. Estimated Density Contours for Yellow-billed Loons within Project Study Area (2007 -2010)

Density Index Contour (birds per km^2)	Acreage within Project Study Area	Percent of Project Study Area
0.000 - 0.030	47994	41%
0.031 - 0.102	19256	17%
0.103 - 0.203	25528	22%
0.204 - 0.321	11332	10%
0.322 - 0.516	12404	11%

Due to the variable coverage of subareas during the different years that the survey was conducted, a population trend was not calculated but instead a surrogate comprised of territory occupancy of adults and nests (number of nests found divided by the number of territories surveyed) was calculated. Using data collected during the nesting survey conducted by helicopter during the period of 2000-2012 an estimate of population trend was made for the

CDSA (Johnson et al. 2013). Within the CDSA, territory occupancy was between 41 and 60 percent for the first eight years of the study while during the last ten years territory occupancy was between 63 and 90 percent and the average of all years was reported at 63.1 percent of territories were occupied (Johnson et al. 2013). In the NASA during 2012, territory occupancy by nests was 86 percent, which is the highest occupancy recorded for this study area and much higher than the 11 –year average of 64.2 percent (Johnson et al. 2013). Due to the variability in areas surveyed in the NASA, an estimate of the population trend was not made.

The project study area was included in the first four years of conducting aerial surveys (2001 – 2004), with no yellow-billed loon nests and broods observed within one mile of the proposed roads or facilities for Alternative A (BLM 2004, Figure 3.3.3.3-5; Johnson et al. 2005). After 2004, surveys within the NASA focused on the Fish and Judy creek areas (partially includes the project study area) and the Alpine West Subarea (partially includes the project study area). The CD South Subarea, which includes a portion of the project study area, has been surveyed annually since 1993 and yellow-billed loon nests and broods have been recorded as present every year (Johnson et al. 2013).

In 2012, 11 nests (0.07 nests per km^2) were found in the CD South Subarea within the CDSA and of the 18 nests (0.07 nests per km^2) found in the NASA only one nest (0.01 nests per km^2) was found in the Alpine West Subarea while the remainder were found in the Fish Creek Delta and Fish and Judy Creek Corridor Subareas. All of these 2012 nest counts and densities are very close to the long term averages for each subarea. (Johnson et al. 2013)

During brood-rearing surveys in 2012, four broods were found in the CD South subarea (out of a total of 17 in the entire CDSA) and one brood was found in the Alpine West Subarea (out of a total of 12 for the entire NASA). Densities of adults and broods in the CD South Subarea (0.16 birds per km^2 and 0.03 broods per km^2) and the Alpine West Subarea (0.03 birds per km^2 and 0.01 broods per km^2) were both very similar to their long-term averages. (Johnson et al. 2013)

The habitat preferred by nesting yellow-billed loons was evaluated using 18 years of aerial survey data in the CDSA and five years of aerial survey data in the NASA. Habitat preference of nesting and brood-rearing yellow-billed loons was calculated on the scale of the entire CDSA and NASA and not by subarea so it may not be a perfect representation of the habitat preference of loons in the CD South and Alpine West subareas. Nesting yellow-billed loons in the CDSA utilized 11 of 24 available habitats, preferring six (Johnson et al. 2013). All of these six preferred habitats occur within the impact zone of proposed infrastructure (deep open water without islands, deep open water with islands or polygons, sedge marsh, deep polygon complex, grass marsh, and patterned wet meadow) for the action alternatives (discussed in Section 4.0, *Environmental Consequences*; Figure 3.3.6). Yellow-billed loons in the CDSA utilized 4 of the 24 available habitats for brood-rearing, preferring three. Of these three preferred brood-rearing habitats, two occur within the impact zone of proposed infrastructure (deep open water without islands, and deep open water with islands or polygonized margins) for the action alternatives (discussed in Section 4; Figure 4.3.3-6; Johnson et al. 2013).

Habitat selection within the NASA was determined collectively for the three subareas surveyed for loons during 2008 – 2012 (Alpine West, Fish Creek Delta, and Fish and Judy Creek Corridor). Nesting yellow-billed loons utilized 12 of 26 available habitats, preferring four. Of these four preferred nesting habitats, three occur within the impact zone of proposed infrastructure (deep open water with islands or polygonized margins, sedge marsh, and deep polygon complex) (Johnson et al. 2013). Yellow-billed loons in the NASA utilized 3 of the 26 available habitats for brood-rearing, preferring two. Of these two preferred brood-rearing

habitats, one occurs within the impact zone of proposed infrastructure (deep open water with islands or polygonized margins) for the action alternatives (discussed in Section 4; Figure 4.3.3-6; (Johnson et al. 2013).

Apparent nesting success of yellow-billed loons was also calculated on the scale of the entire CDSA and NASA and not by subarea, and so may not fully represent the true nest success of loons in the CD South and Alpine West Subareas. Apparent nesting success within the CDSA for an 8 year period (2005 – 2012) was 58.7 percent with an average of 31.3 nests, an average of 0.86 chick per nest at hatch and 0.55 chicks per nest in mid-September (Johnson et al. 2013). For the NASA apparent nesting success, calculated over a 5 year period (2008 – 2012; not all subareas were surveyed in all years) was 46.3 percent, with an average of 0.73 chick per nest at hatch and 0.55 chicks per nest in mid-September (Johnson et al. 2013).

Cameras placed at yellow-billed loon nests have documented egg predation by a variety of predators including glaucous gull, parasitic jaeger, red fox, golden eagle, grizzly bear within the CDSA while within the NASA, only avian predators have been documented. After camera monitoring was begun in 2008 in CDSA, 42 percent of monitored nests have been predated and 47 percent of identified predators were glaucous gulls and parasitic jaegers. Within the NASA where camera monitoring began in 2010, 52 percent of the monitored nests have been predated, exclusively by avian predators. The results of this study also highlight the importance of minimizing disturbance to nests due to the majority of predation occurring in unattended nests. (Johnson et al. 2013)

3.3.5.4 Polar Bear

The polar bear (*Ursus maritimus*) was listed as threatened under the ESA in May 2008 in response to sea-ice habitat loss associated with climate change (USFWS 2009). Dependent on sea ice for survival, climate change-induced reductions in sea ice is the bear's largest overall threat (Corps 2012). In addition to climate change, anthropogenic threats include the accumulation of persistent organic pollutants, impacts from tourism and human-bear conflict, and increased development across potential terrestrial habitats (Corps 2012).

Two distinct stocks of polar bears occur in Alaska, the Chukchi/Bering Seas Stock and the Southern Beaufort Sea Stock. While occurrences of animals from the Southern Beaufort Sea Stock are more likely, animals from the Chukchi/Bering Seas Stock also occur in the region. The Chukchi/Bering Seas Stock was estimated at 2000 animals in 2002 and 2006 (Lunn et al. 2002; IUCN 2006). A population of 1,800 animals is the current population estimate for the Southern Beaufort Sea stock (Allen and Angliss 2011). A combination of declining survival, recruitment, and body size (Regehr et al. 2006, Regehr et al. 2010, Rode et al. 2010), and low population growth rates during years of reduced sea ice (2004 and 2005), combined with an overall declining population growth rate of 0.3 percent per year from 2001 to 2005 (Hunter et al. 2007) suggest that the Southern Beaufort Sea stock is in decline (Corps 2012).

Polar bears occur in maritime and coastal zones throughout the year, with specific life cycle events dictating location and timing. Reliant on sea ice for the majority of their hunting habitat, polar bear populations are sensitive to sea ice loss in optimal habitat locations (Durner et al. 2009). Polar bears utilize sea ice for hunting, feeding, breeding, maternity denning, resting, and long-distance movement (Corps 2012). Additionally, polar bears use terrestrial habitats for maternity denning, scavenging, resting, and travel between marine habitats (Regehr et al. 2010). During late autumn to early spring, polar bear range is extensive and includes pack ice, landfast ice, and land (BLM 2004; BLM 2012). Denning and birthing periods occur from late

October through early April. Suitable terrestrial denning habitat is defined as having topographic features with ≥8◦ slope and ≥ 1.3 meters in height (Durner et al. 2013). The majority of maternal dens located between the Kavik River and Barrow were found to occur within 5 miles of the coast (Amstrup and Gardner 1994). A study by Schliebe et al. (2008) found Barter Island to have the highest on-shore concentration of polar bears, followed by Barrow and Cross Island, all located outside of NPR-A and the project study area. On-shore polar bear densities are greatly influenced by the presence of whale carcasses, as they provide an increasingly important protein source as sea ice extent diminishes (Bentzen et al. 2007).

Critical habitat for polar bears was designated December 7, 2010. While the majority of critical habitat involved sea ice, 14,652 km^2 of terrestrial denning habitat was declared in a band along the coast from the Canadian border to Barrow (USDOI and BOEM 2012). Within the NPR-A, the critical habitat was identified as extending 5 miles inland from the coast. However, as of January, 2013, polar bear critical habitat designation was vacated and remanded by the court back to USFWS for further consideration. Potential denning habitat, sightings, and den locations in relation to the proposed project study area are shown in Figure 3.3-12. No polar bear den locations have been observed near the proposed project study area (USGS 2011). The nearest den locations reported are more than 3 miles (3.7 miles and 3.9 miles) from infrastructure associated with the proposed GMT1 development, which are outside the project study area (USGS 2013; Durner et al. 2013). While females may change den locations, it is important to note that the proposed location of the drill pad and most of the road and pipelines are outside the area previously considered critical habitat for denning; and all proposed GMT1 facilities are outside of the area previously considered for feeding.

3.3.5.5 Bowhead Whale

The bowhead whale (*Balaena mysticetus*) has both ecological and cultural importance in the Alaskan Arctic. The bowhead whale was listed as endangered under the ESA in 1973, but no critical habitat has been designated. In 2004, the population was estimated to be 12,631 animals (BLM 2012, § 3.3.8.4). The Western Arctic stock of bowhead whale increased at an annual rate of 3.2 percent from 1984 to 2003 (NMFS 2013, p. 22).

Bowhead whales are not expected to occur within the project study area.

3.3.5.6 Beringia DPS Bearded Seal

The bearded seal has a circumpolar distribution and is the most populous species of Arctic ice seal. In Alaskan waters, bearded seals occur over the continental shelf waters of the Bering, Chukchi, and Beaufort Seas (Burns 1981) and from nearshore waters out at least as far as the shelf break (Allen and Angliss 2011). Bearded seals are strongly ice-associated, meaning that sea ice plays an important role as a platform to breed, give birth, raise young, molt, and rest. The Alaska stock of bearded seals is believed to be greater than 155,000 animals (NMFS 2010) and may be as large as 250,000 to 300,000 animals (Popov 1976; Burns 1981; MMS 1996), however a reliable estimate of bearded seal abundance is not available for the Beaufort Sea or Chukchi Sea (Allen and Angliss 2012; Cameron et al. 2010).

Although bearded seals may be present throughout the year in the Beaufort Sea, the population in Alaskan waters is largely migratory, with most individuals overwintering in the Beaufort Sea (Allen and Angliss 2013). Their most important habitat during winter and spring is active ice or offshore leads. Farther north, they are restricted to areas in the pack ice where conditions create persistent openings such as leads, polynyas (areas of open water in the pack ice), and flaw zones. These conditions become progressively more limited north of the Bering Strait,

especially in the Beaufort Sea (Burns 1967; Burns and Frost 1979; Kelly 1988), hence fewer bearded seals will overwinter in the Chukchi and Beaufort Seas where conditions are less favorable. As the ice recedes in the spring, bearded seals migrate through the Bering Strait (mid-April to June) and summer either along the margin of the multi-year ice in the Chukchi Sea or in nearshore areas of the central and western Beaufort Sea (Kelly 1988).

The Beringia DPS of bearded seal was designated as threatened under the ESA in 2012. The main conservation concern associated with the listing is modification of ice habitat by climate change, with a secondary concern related to habitat modification by ocean acidification, which could alter prey populations (NOAA 2012a). Bearded seals are not expected to occur within the project study area.

3.3.5.7 Arctic Subspecies of Ringed Seal

Ringed seals have a circumpolar distribution (King 1983) and are year-round residents in the Beaufort, Bering and Chukchi Seas (King 1983; Allen and Angliss 2011). These are the most common seal in the Beaufort Sea (Frost et al. 1988; Kelly et al. 2010). At this time there is no reliable population estimate available for the entire Alaskan stock (Allen and Angliss 2013). Historic ringed seal population estimates in the Bering-Chukchi-Beaufort area ranged from 1 to 1.5 million (Frost 1985) to 3.3 to 3.6 million (Frost et al. 1988). Frost and Lowry (1999) estimated 80,000 ringed seals in the Beaufort Sea during summer and 40,000 during winter, indicating that half of the population moves into the Chukchi and Bering Seas in winter.

The Arctic subspecies of ringed seal, *Phoca hispida hispida*, was designated as threatened under the ESA in 2012. Climate change induced modification of ice habitat is the main conservation concern. Ocean acidification induced habitat modifications, which have the potential to alter prey populations and availability, are a secondary concern (NOAA 2012). The density of ringed seals during winter and spring in nearshore Harrison Bay likely depends on a variety of factors, including food availability, water depth, ice stability, and ice topography. Ringed seals prefer nearshore stable landfast ice, where they maintain breathing holes throughout the winter in areas where the water depth is generally more than 10 feet (3 meters) deep (Moulton et al. 2002). Ringed seals are unlikely to occur in the project study area.

3.4 Social Systems

Social systems associated within the project study area were described in BLM (2004, § 3.4) and updated in BLM (2012, § 3.4). This section tiers to and incorporates by reference relevant information, while placing emphasis on the proposed GMT1 Project location and potential socioeconomic impacts on a narrower scale.

3.4.1 Sociocultural Systems

This section describes the affected environment for sociocultural resources potentially affected by the Project. The proposed GMT1 Project has previously been evaluated and addressed within earlier NEPA documents: (BLM 2004) and (BLM 2012). Therefore, this section is tiered off of those documents and focuses on information that is new or updated since those previous EISs. This section includes a general overview of sociocultural systems on the North Slope, particularly for Nuiqsut, including history, social organization, economic organization, community institutions, community health and welfare, and population and employment. There are two distinct populations found in the general project area: local permanent residents, a majority of whom are Iñupiaq Eskimos indigenous to the area, and oil and gas industry workers

who rotate on a shift schedule and are temporary residents. This discussion focuses on the sociocultural systems of the permanent residents of the North Slope with a particular focus on the Iñupiat and on the community of Nuiqsut. Nuiqsut, located on the western bank of the Nigliq Channel of the Colville River delta, is the closest residential community to the proposed project, approximately 13 miles southeast of the proposed GMT1 drill pad.

3.4.1.1 History

Archaeological research indicates that humans have occupied northern Alaska for roughly 14,000 years. This rich cultural history is described in detail in BLM (2012, § 3.4.2). The BLM (2008b) also provides a summary of the Northeast NPR-A cultural resources, which is incorporated by reference and summarized below as it relates to the proposed GMT1 Project area.

The cultural history of the NPR-A mirrors that of the rest of Arctic Alaska. The earliest people entering the North American Arctic were the bearers of the Paleoindian and Paleo-Arctic Traditions. Archaeological data suggest that these early humans traveled across a land bridge that once existed between Siberia and Alaska, when world-wide sea levels were as much as 300 feet lower than today. Over thousands of years different cultures came to occupy Arctic Alaska and various parts of the NPR-A region, subsisting on resources available to them, and developing various tools for survival. The Thule people, whose culture emerged about 1,000 years ago, are the direct ancestors of the Iñupiat living on the North Slope today. Initial contact between the Iñupiat of the North Slope and non-Iñupiaq people occurred in the early nineteenth century with the arrival of European explorers, and increased beginning in the mid 1800s, with the introduction of commercial whaling. Commercial whaling was followed by various other developments on the North Slope including military activity and the construction of the DEW line sites, reindeer herding, fur trapping, missionary work, and geological and ethnographic research. A summary of ancestral cultures and the history of the North Slope is provided in Sections 3.4.5.3 and 3.4.5.4.

Although the Colville River delta and the proposed GMT1 Project area were no doubt frequented by many, if not all, of these cultures, the archaeological record here consists primarily of sites representing twentieth century Iñupiaq use of the land (Table 3.4-15). Five archaeological sites with sod houses were once found along the Nechelik (*Nigliq*) Channel of the Colville River, but two of these have now been lost to riverbank erosion. One of these sites, *Nigliq*, is still seasonally used for subsistence. *Nigliq* is one of the most important archaeological sites along the Beaufort Sea coast because it was the setting of an annual trade fair between coastal Iñupiat and the Nunamiut of the Brooks Range. Sites along the *Nigliq* channel were winter camps used for hunting and fishing, but also, in the first half of the twentieth century, for reindeer herding and trapping. These sites, together with information on traditional land use gathered by the NSB from Elders in the 1970s, provide a rich account of life in the first half of the twentieth century. In many cases the names of individuals living at these sites from the 1920s to the 1940s are known, providing a connection between families living in present-day Nuiqsut and places that are now the sod house ruins of their ancestors. The *Nigliq* channel continues to be a central hunting and harvesting ground for the Iñupiat living in Nuiqsut. The project study area overlaps the *Nigliq* channel.

While *Nigliq* was an early location associated with Nuiqsut, the first year-round settlement location for the community was *Nuiqsutpiat,* located on *Nuekshat* Island in the main channel of the *Kuukpik*. A second year-round settlement, *Niglinaat,* was established in the 1930s but abandoned in the 1940s, when most of the earlier inhabitants relocated to Barrow, 150 miles

away, so their children could attend school. The present-day village of Nuiqsut was re-established in 1973 when 27 Iñupiaq families moved from Barrow. This time the village of Nuiqsut was located on the Nigliq Channel of the Colville River to allow easy access to the river's main channel for fishing and hunting. The motivation for this move back to Nuiqsut was to revive traditional Iñupiaq values of hunting and fishing, and to experience Iñupiaq social and cultural life (BLM 2004, § 3.4.1).

3.4.1.2 Social Organization

Iñupiaq social organization traditionally revolved around the bilateral family unit and their extended kin, in addition to trading partnerships and friendships (Hall 1984). Following European and American contact, the social and political organization of the Iñupiat changed. These changes were a result of various factors including compulsory education, which led to the centralization of people into permanent villages; introduction of modern technologies, which altered residents' methods for harvesting and processing subsistence foods; the introduction of a cash economy; the introduction of Christianity; and incorporation of the Iñupiat into new systems of laws and governing systems. Alaska Natives began forming village councils, which were reorganized under the Indian Reorganization Act. The ANCSA was passed in 1971 and resulted in the formation of regional and village corporations, and the North Slope Borough (NSB) formed in 1972.

Despite the changes in social and political organization over time, the core of Iñupiaq social organization is similar on the North Slope today, in that it encompasses not only households and families, but also wider networks of kinship and friends, and individual family groups which depend on the extended family for support. The sharing and exchange of subsistence resources strengthen these kinship ties. In addition, despite the Christianization of the Iñupiat through missionaries, the Iñupiat maintain certain aspects of traditional Iñupiaq belief systems, which revolve around a system oriented to the environment and its animals and require that hunters follow proper hunting rituals to ensure successful harvests. For these reasons, the relationship of the Iñupiat and their natural environment remains the cornerstone of their cultural identity (BLM 2004).

The people of Nuiqsut call themselves "Kuukpikmuit," or the "People of the Lower Colville River." (BLM 2004, § 3.4.1.2; BLM 2008b). Over 400 people reside in Nuiqsut today, the majority of whom are Iñupiat (see Section 3.4.1.6). The Native Village of Nuiqsut is a federally recognized tribe, and the Kuukpik Corporation is the local village corporation. Nuiqsut was incorporated as a second class city in 1975. Nuiqsut residents, along with residents from seven other North Slope communities, are members of the regional federally recognized tribe Iñupiat Community of the Arctic Slope (ICAS) and many are shareholders in the ASRC. The Kuukpik Presbyterian Church is in Nuiqsut.

3.4.1.3 Economic Organization

The Iñupiat traditionally participated in an economy that relied on subsistence resources and utilized trade to acquire goods not readily available in their immediate area. The economy of the North Slope underwent major changes beginning in the mid-19th century, when commercial whaling introduced a new type of economy to the Iñupiat. The whaling industry was followed by other economic developments, including reindeer herding, fur trapping, military development, and oil and gas exploration and development.

Today, the Iñupiat of the North Slope continue to rely on subsistence resources while also participating in the cash economy. Like other communities on the North Slope, Nuiqsut has a

"mixed, subsistence-market" economy, where families invest money into small-scale, efficient technologies to harvest wild foods (BLM 2008b). These investments can include gill nets, motorized skiffs, and snowmachines used to conduct subsistence activities, and are not oriented toward sales or profits, but are focused on meeting the self-limiting needs of families and small communities. The contribution of subsistence harvests toward the mixed subsistence-market economy is substantial, with documented per capita harvests in Nuiqsut ranging from 399 (in 1985) and 742 (in 1993) pounds. Subsistence activities have economic, social, cultural, and nutritional value for Nuiqsut residents.

The primary sources of wage employment in Nuiqsut are the NSB (including the school district), the Kuukpik Corporation, and the City of Nuiqsut (see Section 3.4.1.6). Craft sales are also a small part of Nuiqsut's economy. According to the NSB 2010 census report, 8.4 percent of respondents worked for the oil industry in 2010; the number of residents employed by the oil industry was higher in 2010 than during the last census in 2003.

The Kuukpik Corporation, Nuiqsut's village corporation established in 1973, owns the surface rights to land in the vicinity of Nuiqsut, including portions of the Alpine oil field which is located approximately 8 miles from the community. The corporation receives royalties for the use of their land, and its subsidiaries also provide oil support services. The corporation has over 250 enrolled shareholders who receive dividends. Industrial development in the vicinity of Nuiqsut consists of oil production infrastructure. CPAI operates the Alpine production facilities that include: ongoing drilling and production operations, processing facilities, wells and pipelines, camp facilities, gravel roads and airstrip, communications and power generation, as well as sanitation utilities, warehouses and other oil field support facilities.

The NSB owns and operates a 4,300 feet airstrip in Nuiqsut. For about four months per year (commonly January through April), ice roads connect the Alpine and Nuiqsut to the Kuparuk and Prudhoe Bay road system. This allows residents of Nuiqsut to buy vehicles and other goods in urban centers and drive them to their community; no other community (aside from Prudhoe Bay) on the North Slope has this ability. Snowmachines are also used for local transportation in the winter, and boats and four-wheelers are a source of transportation during the snow-free months. The gravel road being proposed by Kuukpik to connect with Alpine oil facilities is intended to enhance training and employment opportunities for residents, as well as to improve access for subsistence activities.

The Kuukpik Alaska Commercial Company (AC) store provides commercial goods including groceries, general merchandise, propane, diesel, and gasoline. Except for winter access by ice road, the majority of goods are transported to Nuiqsut by air.

Colville Village is the Helmericks' family homestead on Anachlik Island, on the northeast side of the Colville River delta. Established in the mid-1950s, primarily as a commercial fishing operation, this site consists of several homes, a lodge, an airstrip, aircraft hangers, warehouses, barn, workshops, and other outbuildings. While the family still resides at the homestead, the commercial fishing business is no longer operational.

3.4.1.4 Community Institutions

The proposed GMT1 Project is within the NSB. The NSB government offices are in Barrow, the seat of government. The NSB has permit authority relevant to the proposed project. Other federal and state agencies, including BLM who is the land manager for all non-Native land with the NPR-A, have permit authority related to the project. Nuiqsut residents, along with

residents from seven other North Slope communities, are members of the regional federally recognized tribe Iñupiat Community of the Arctic Slope (ICAS) and many are shareholders in the ASRC.

Community institutions in Nuiqsut include the City of Nuiqsut, the Native Village of Nuiqsut (a federally recognized tribe), and the Kuukpik Corporation. In addition, several subsistence-related organizations exist in Nuiqsut. The Kuukpik Subsistence Oversight Panel, Inc. (KSOPI) was established in 1996 in response to development of the Alpine oilfield. The purpose of KSOPI is to provide a method of communication between Nuiqsut residents and industry and to relay concerns to industry regarding impacts on subsistence harvesting activities. KSOPI has also been involved in the establishment of resource-specific panels of experts, such as the Nuiqsut Caribou Panel and the *Qaaktaq* (Arctic cisco) Panel. Another subsistence-related organization is the Nuiqsut Whaling Captains Association.

3.4.1.5 Community Health and Welfare

The BLM (2012) contains a detailed discussion regarding analysis of public health status in the NSB based on demographic and health information through 2010. The following discussion of community health and welfare is tiered to BLM (2012, § 3.4.12, Public Health). The BLM (2012) considers all eight villages of the NSB as well as other villages of the Northwest Arctic Borough. Therefore, the focus was broader than for the proposed GMT1 Project, which is more narrowly focused on the community of Nuiqsut. Conditions in the Alpine Field were also evaluated herein for comparison purposes.

Concurrently, in 2012 the NSB released the Final Baseline Community Health Analysis Report (NSB 2012). The information contained in the Analysis Report was incorporated into BLM (2012), thus the BLM (2012) represents the most current published information on community health in the NSB. The NSB (2012) report provided the basis for the following discussion, which augments BLM (2012, Public Health).

The earlier EIS prepared in BLM (2004) provides a community health and welfare discussion that is brief and of relatively broad scale, yet it provides relevant general information when evaluating trends over time. This discussion is provided in BLM (2004, § 3.4.1.5).

The BLM (2012) relied on three major sources of data:

- 2010 North Slope Borough Economic Profile and Census;
- 2012 Final Baseline Community Health Analysis Report (NSB 2012); and
- Alaska Native Epidemiology Center 2008 Regional Health Profile, Maniilaq service area (Alaska Native EpiCenter 2008).

Based on information in these sources, the population of Nuiqsut is approximately 424, of which 89 percent are Inupiat or other Native Alaskan. The median age of residents of Nuiqsut is 23.8 years, which is younger than all but two North Slope villages, and more than 8 years younger than the median age of Kaktovik residents, the village with the oldest median age (BLM 2012, Table 3-44, page 490).

The BLM (2012) addressed the community health status for each of the eight North Slope villages for many parameters, including:

- Biomedical Health Outcomes

  - general health indicators
  - chronic diseases
  - infectious diseases
  - nutrition
  - injuries
  - social pathologies and mental health
  - maternal and child health
  - health disparities
- Health Determinants
  - income and employment
  - subsistence participation and diet
  - housing
  - education
  - health care services
  - motor vehicle safety
  - public utilities and services
  - alcohol and drug misuse
  - smoking
  - physical activity
  - culture and language
  - environmental contamination
- Public health and climate change.

As stated in BLM (2012, p. 487):

> *"…the main health conditions that burden the population in the affected environment are the same ones that are seen elsewhere in Alaska and the U.S.: cancer, heart disease, respiratory diseases and intentional and unintentional injury, overweight/obesity and diabetes. Overall, the rates of these illnesses are higher in the affected environment than elsewhere in Alaska and the U.S., although conditions have been improving over the last few decades, and gains continue to be made."*

The document makes an important clarification on p. 488:

"what is important to note…is that the factors that are most relevant for disease generation in this population are not necessarily the same as those that apply to populations elsewhere. The unique physical, cultural, and social environment of northern Alaska determines the level of health of the population and of individuals."

The health determinants bulleted above represent those that play a critical role in supporting or undermining the health of the population (NSB 2012).

In both Alaska overall and the NSB specifically, the leading causes of death are cancer, heart disease and accidents/injuries. Among chronic diseases, high blood pressure (20 percent) and arthritis (21 percent) are the most frequently reported across the NSB. This is a lower rate of high blood pressure than across all Alaska (26 percent). Infection rates of sexually transmitted diseases (STDs) have increased recently, and the rates are substantially higher in the NSB than the Alaska average. The rates are higher for Native Alaskans than for non-Natives (BLM 2012, p. 495). Motor vehicle accidents represent the single leading cause of unintentional injury deaths in the NSB, with a rate three times that for all of Alaska (BLM 2012, p. 508). Lung cancer incidence is exacerbated by the high smoking rate in the NSB; 49 percent of adults smoke tobacco compared to 21 percent for all Alaska (BLM 2012, p. 510).

The highlights of this community health status evaluation relevant to the Nuiqsut community are provided below.

- More than three-quarters (79 percent) of Nuiqsut heads of household reported their health to be at least good, with 21 percent reporting fair to poor health, generally consistent with the other North Slope villages. The percentage of Nuiqsut adults reporting to have very good to excellent health (39 percent) was lower than adults statewide (56 percent) (BLM 2012, Table 3-45, p. 492).
- General health status as reported among Nuiqsut children was worse than among children in the other North Slope communities overall, and this difference persisted when looking only at Inupiat children. 16 percent of Nuiqsut children had fair to poor health, relative to the NSB average of 6 percent. The percentage of Nuiqsut children with reported very good to excellent general health (55 percent) was considerably lower than the statewide estimate ([89 percent]; BLM 2012, Table 3-45, p. 492).
- A recent study on air quality in Nuiqsut, the village closest to oil development activity, did not report evidence of air pollution at levels expected to have significant health effects. This information is based on annual data compiled by the USEPA, which lists the air quality index for Nuiqsut of 99 (on a scale of 100). This indicates that air quality in Nuiqsut is extremely good. However, many residents believe that Nuiqsut has higher rates of asthma than other communities due to industry. These data do not support such concerns.

Oil and gas revenues have created jobs, provided money for essential services and infrastructure, and raised the average household income. However, the influx of outsider interests and money can create conflict, alter social structure, and divide communities, affecting community health.

Almost half (44 percent) of Inupiat village residents have reported concerns that fish and animals may be unsafe to eat due to environmental contamination. Regardless of the actual exposure, if any, to environmental contamination, the perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources, with potential changes in nutrition-related diseases as a result. These health effects (perceived or real) arise regardless of whether or not there is any contamination at levels of toxicological significance; the effects are linked to the perception of contamination, not to measured levels. This important discussion (BLM 2012, p. 512) suggests that impacts can occur in the absence of significant chemical release, based only on perception of a potential threat.

The *Final Baseline Community Health Analysis Report* (NSB 2012) provides an extensive discussion of factors that are anticipated to impact the health of NSB residents. These factors are categorized as likely having either positive, negative, or mixed impacts on public health. Those considered to have positive impacts include:

- Participation in subsistence lifestyle and diet;
- Support and promotion of Inupiaq culture and language;
- Availability of health, social, emergency, and public safety services;
- Improvements in water and sanitation infrastructure;
- Self-determination: civic participation and advocacy;
- Restrictive alcohol policies; and
- Tobacco taxes and indoor air quality laws (i.e., second-hand smoke).

The first two bullets above are those health factors most likely to be negatively affected by local development. However, the next two bullets would increase through development, leading to positive impacts on health relative to baseline conditions. The other three bullets are unlikely to be substantially affected by development.

Conversely, several factors are anticipated to negatively impact public health:

- High rates of tobacco use;
- High levels of food insecurity and difficulty accessing food for healthy meals;
- Difficulty accessing health services;
- Historical and multi-generational trauma;
- Drug and alcohol addiction;
- Child neglect and abuse;
- Education: high drop-out and low graduation rates;
- Environmental issues (e.g., climate change, contaminants);
- High consumption of sodas and sweetened beverages;
- Insufficient levels of physical activity;
- Low utilization of safety practices (e.g., helmets, seat belts); and
- Poverty and unemployment.

Almost all of these are cultural, lifestyle, and rural living factors and are not related to development or existing infrastructure.

Climate change has also been shown to have some effects in the NSB, including erosion problems, less reliable ice conditions, and higher risk to hunters and spring whalers. The report (NPR-A IAP/EIS; page 513) concludes that climate change will likely result in rapidly changing physical environmental and health conditions for the NSB population in the coming years.

Finally, the following factors are considered to likely have mixed impacts:

- Oil and gas development;

- Employment opportunities; and
- Income level and distribution.

Specific to oil and gas development, the NSB (2012, p.45) report provides the following commentary:

"The health impacts of oil and gas development in the NSB are complex, as it has touched many aspects of community life in the region. Following the formation of the North Slope Borough, oil and gas revenues have created employment opportunities, provided money for essential services and infrastructure, and raised the average household income. An influx of outside interests and money can also create conflict, alter social structure, and divide communities, affecting community well-being. Real and potential impacts to the environment and subsistence are also ongoing sources of tension and concern. Natural resource development and fossil fuel extraction worldwide has also contributed to the climate change that is disproportionately affecting arctic communities."

Both positive and negative health factors are incorporated into oil and gas development.

As of 2008, 94 percent of NSB households have modern water and sewer service (BLM 2012, Table 3-45, p. 509). This indicates that the great majority of households drink treated water rather than unfiltered surface water, which typically results in better water quality. This is similar to other local communities, such as Kaktovik.

New information not provided in either of the two previous EIS documents was obtained on water quality parameters for water used by the community of Nuiqsut and Alpine population (for comparison). The Alpine population represents a largely non-native workforce that is located near of the project site, and thus provides a relevant comparison with the Nuiqsut community. The data were obtained for post-treated water rather than raw lake water. This treated water is the same quality as the water taken from the taps in homes. This new information was obtained from the ADEC through personal communication (SLR International, 2013). A summary of the new data obtained is provided below.

In the water supply for Nuiqsut, water quality data indicate sporadic samples of a few inorganic parameters (e.g., fluoride) and one metal (mercury) above the lowest relevant Alaska Water Quality Standards (WQS; 18 AAC70). The water quality summary shown on Table 3.4-1 (0.00005 milligrams per liter [mg/L]) is based on the human health consumption of water plus aquatic organisms. This criterion has been revised to reflect the Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of April 8, 1998. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case. (EPA's current fish tissue residue criterion (WQS) for methylmercury for human health is 0.3 mg/kg, which is based on a total fish consumption rate of 0.0175 kg/day.) This WQS assumes mercury is present in its more toxic methylmercury form, which is likely true in aquatic organism, but not in water. Data from analysis of one of 12 samples collected from the water supply for Nuiqsut reported a mercury concentration of 0.0002 mg/L.

In the water supply for Alpine, water quality data indicate sporadic samples of a few inorganic parameters (e.g., alkalinity, color) and copper above the lowest Alaska WQS (WQS; 18 AAC70). These elevated concentrations are limited to one or two samples for the inorganic parameters and five for copper (of five analyses).

Overall water quality for Alpine and Nuiqsut are similar, and with few exceptions meet water quality standards for human consumption.

New information was also reported for fish tissue concentrations of a group of ubiquitous organic pollutants known as polynuclear aromatic hydrocarbons (PAHs). These chemicals are a product of incomplete combustion (e.g., forest fires, barbeques, vehicles) and also are a component of crude and refined oil products. Data were obtained from fish tissue samples collected from the 2012 fall under-ice fishery in the Niqliq Channel and represent only a few (five) fish. The samples were muscle fillets from Arctic cisco obtained from the fishermen as part of an annual study on this subsistence fishery supported by CPAI (Seigle and Gottschalk, 2013). The results of this small sampling event indicate that only two PAHs were detected above minimum detection limits (anthracene and naphthalene). The other reported values were all estimated (i.e., J-qualified) concentrations because they were detected at levels below the practical limit of quantitation. These results indicate that PAHs in Arctic cisco fish tissues are rarely detected in the Niqliq Channel and likely not of consequence to human health. It is difficult to extrapolate from this small sample to fish populations and to other species, but the few samples indicate PAHs are not currently a human health issue for fish from the channel.

No new information was available for the local area with regard to other media, including air quality and wildlife. Descriptions and further information on these two topics is provided in Sections 3.2.3.2 (air quality) and 3.3 (biological resources).

Table 3.4-1. Nuiqsut Drinking Water Quality Summary

Analyte	Frequency of Detection (FOD)[1]	Percent Detected	Range of Detects[2] (Min - Max)	Median of Detected Values	Lowest Alaska Water Quality Standard (WQS)	Number of Samples Exceeding WQS
Gross Alpha						
Combined Uranium	0 / 1	0.0%	0 - 0	--	0.03	1
Gross Alpha, Excl. Radion & U (PCI/L)	1 / 3	33.3%	0.26 - 0.26	0.26	15	--
Gross Alpha, Incl. Radion & U (PCI/L)	1 / 1	100.0%	0.26 - 0.26	0.26	N/A	--
Radium-226 (PCI/L)	1 / 1	100.0%	0.24 - 0.24	0.24	5	--
Radium-228 (PCI/L)	1 / 1	100.0%	0.35 - 0.35	0.35	5	--
Inorganics						
Carbon, Total	0 / 2	0.0%	0 - 0	--	N/A	2
Chloride[3]	1 / 2	50.0%	1.1 - 1.1	1.1	230	--
Color[3] (CU units)	0 / 2	0.0%	0 - 0	--	15	--
Corrosivity[3] (Lang units)	0 / 2	0.0%	0 - 0	--	N/A	2
Cyanide	0 / 12	0.0%	0 - 0	--	0.001	--
Fluoride	7 / 14	50.0%	0.16 - 1.36	0.76	1	2
Foaming Agents (Surfactants)[3]	0 / 2	0.0%	0 - 0	--	N/A	2
Nitrate	2 / 21	9.5%	0.08 - 0.09	0.085	10	--
Nitrate-Nitrite	0 / 14	0.0%	0 - 0	--	10	--
Nitrite	0 / 12	0.0%	0 - 0	--	1	--
pH[3] (pH units)	2 / 2	100.0%	6.1 - 7.1	6.6	5	2
Sulfate[3]	0 / 2	0.0%	0 - 0	--	250	--
TDS[3]	1 / 3	33.3%	602 - 602	602	500	1
Metals						
Antimony, Total	2 / 12	16.7%	0.000171 - 0.004	0.0020855	0.006	--
Arsenic	1 / 21	4.8%	0.000176 - 0.000176	0.000176	0.01	--
Barium	9 / 12	75.0%	0.000434 - 0.05	0.04	2	--
Beryllium, Total	0 / 12	0.0%	0 - 0	--	0.004	--
Cadmium	1 / 12	8.3%	0.0001 - 0.0001	0.0001	0.005	--
Chromium	0 / 12	0.0%	0 - 0	--	0.1	--
Copper, Free[3]	6 / 7	85.7%	0.0031 - 0.119	0.09405	0.0031	6
Iron[3]	0 / 2	0.0%	0 - 0	--	1	--
Mercury	1 / 12	8.3%	0.0002 - 0.0002	0.0002	0.00077	--
Nickel	0 / 12	0.0%	0 - 0	--	0.0082	--
Selenium	1 / 12	8.3%	0.003 - 0.003	0.003	0.005	--
Thallium, Total	0 / 12	0.0%	0 - 0	--	0.0017	--
Zinc[3]	2 / 2	100.0%	0.25 - 0.321	0.2855	0.081	2
Volatile Organic Compounds						
1,1,1-Trichloroethane	0 / 23	0.0%	0 - 0	--	0.2	--
1,1,2-Trichloroethane	0 / 23	0.0%	0 - 0	--	0.005	--
1,1-Dichloroethylene	0 / 23	0.0%	0 - 0	--	0.007	--
1,2,4-Trichlorobenzene	0 / 23	0.0%	0 - 0	--	0.26	--
1,2-Dichloroethane	0 / 23	0.0%	0 - 0	--	0.005	--
1,2-Dichloropropane	0 / 23	0.0%	0 - 0	--	0.005	--
Benzene	1 / 27	3.7%	0.00218 - 0.00218	0.00218	0.005	--

Table 3.4-1. Nuiqsut Drinking Water Quality Summary (Continued)

Analyte	Frequency of Detection (FOD)[1]	Percent Detected	Range of Detects[2] (Min - Max)	Median of Detected Values	Lowest Alaska Water Quality Standard (WQS)	Number of Samples Exceeding WQS
Carbon Tetrachloride	0 / 23	0.0%	0 - 0	--	0.005	--
Chlorobenzene	0 / 23	0.0%	0 - 0	--	0.68	--
cis-1,2-Dichloroethylene	0 / 23	0.0%	0 - 0	--	0.07	--
Dichloromethane	0 / 23	0.0%	0 - 0	--	0.005	--
Ethylbenzene	21 / 27	77.8%	0.00023 - 0.069	0.00867	0.7	--
o-Dichlorobenzene	0 / 23	0.0%	0 - 0	--	0.6	--
p-Dichlorobenzene	0 / 23	0.0%	0 - 0	--	0.075	--
Styrene	3 / 23	13.0%	0.00077 - 0.00198	0.00131	0.1	--
Tetrachloroethylene	0 / 23	0.0%	0 - 0	--	0.005	--
Toluene	4 / 27	14.8%	0.00021 - 0.00123	0.000235	1	--
trans-1,2-Dichloroethylene	0 / 23	0.0%	0 - 0	--	0.1	--
Trichloroethylene	0 / 23	0.0%	0 - 0	--	0.005	--
Vinyl Chloride	0 / 23	0.0%	0 - 0	--	0.002	--
Xylenes, Total	21 / 27	77.8%	0.00041 - 0.2506	0.0415	10	--
Synthetic and Other Organic Compounds						
2,4,5-TP	0 / 3	0.0%	0 - 0	--	0.05	--
2,4-D	0 / 3	0.0%	0 - 0	--	0.07	--
BHC-Gamma	0 / 3	0.0%	0 - 0	--	0.00016	--
Endrin	0 / 3	0.0%	0 - 0	--	0.0000023	--
Ethylene Dibromide	0 / 5	0.0%	0 - 0	--	0.00005	--
Methoxychlor	0 / 3	0.0%	0 - 0	--	0.00003	--
Toxaphene	0 / 3	0.0%	0 - 0	--	0.0000002	--
TTHM and HAA5						
Total Haloacetic Acids (HAA5)	9 / 10	90.0%	0.00338 - 0.0076	0.0055	0.06	--
TTHM	35 / 37	94.6%	0.00201 - 0.279	0.111	0.08	18

[1] Frequency of detection (FOD) = Number of detected samples / total number of samples in data set.

[2] Units of measure are milligrams per liter (mg/L) unless otherwise noted in the analyte column.

[3] Analyte listed as Secondary Compound.

3.4.1.6 Population and Employment

In 2010, the NSB contracted with Circumpolar Research Associates to prepare a NSB 2010 Economic Profile and Census Report. This report updates demographic data for Nuiqsut. The data from this report is considered by the NSB as more reliable than the U.S. Census data and is therefore used in preparation of the SEIS.

Based on the NSB 2010 census data, in 2010, Nuiqsut had a total population of 415 residents with Iñupiaq people making up 87.7 percent of the total. Individuals under the age of 18 made up 30.7 percent of the population while individuals 18 to 64 years of age made up 66.4 percent of the total. The proportion of the labor force to the total population was 55.9 percent. The number of unemployed was approximately 29.3 percent.

The median reported household income (all households) in Nuiqsut in 2010 was $70,000; Iñupiaq household incomes were $64,196, while non-Iñupiaq household incomes were $85,600.

The Nuiqsut Trapper School is a K-12 school that is part of the NSB School District. For the 2011-2012 school year, the Nuiqsut Trapper School had an enrollment of 104 students with a graduation rate of 44 percent, below the graduation rate of 57 percent for the NSB School District (ADEED 2013). Ilisagvik College in Barrow provides for advanced education in the North Slope.

3.4.2 Economy

Oil and gas exploration, development, and production activities on Alaska's North Slope contribute to the economy of the nation, the State, the NSB, and local communities. Oil and gas development in the region supports local and non-local, direct and indirect hires, and induces jobs and generates federal, state, and local government revenues through rentals and royalties from oil and gas leases, income taxes, property taxes, sales taxes, and other payments.

The BLM (2004, § 3.4.2.1) describes the relationship of the oil and gas industry to the North Slope economy, the economy of the State of Alaska, and the nation's economy. BLM (2012, § 3.4.11) provides a more recent and detailed account of the structure of the NSB economy, including the local economies affected by oil and gas development in the NPR-A, as well as the revenues that accrue to the federal, state, and regional, and local governments. Given that the effects to the nation's economy are diluted by resources and activities elsewhere, the U.S. economy is not addressed in this section.

The information provided in the following sub-sections is the most current regarding condition of the affected economies at the state, regional, and local level.

3.4.2.1 State Economy

The oil and gas industry continues to be an important contributor to the state economy. In 2011, oil and gas extraction generated 18 percent of the state's gross state product ($9.15 billion) (Bureau of Economic Analysis). In April 2013, there were 14,100 direct oil and gas jobs in the state (Alaska Economic Trends, 2013, Alaska Department of Labor and Workforce Development). Besides the direct jobs, there are thousands of indirect jobs in security, catering, accommodations, facilities management, transportation, engineering services, and logistics, which support the oil and gas industry, but are not categorized as direct oil and gas jobs. The most recent estimate for total direct, indirect, and induced jobs associated with the oil and gas industry in Alaska, was 44,800 jobs in 2010; these jobs contributed to just under $2.65 billion in

annual payroll to Alaska residents that year (The Role of Oil and Gas Industry in Alaska's Economy, McDowell Group 2011).

Oil and gas industry jobs on the North Slope account for more than 62 percent of the direct oil and gas jobs in the state (ADOLWD 2013b). However, most of these workers commute to the North Slope on a rotational basis, but live outside of the North Slope - in Anchorage, Fairbanks, the Matanuska-Susitna Borough, and other population centers, and therefore contribute to these regions' economies as well, through spending of wages. A recent study on the economic benefits of the oil industry in Alaska estimated that the industry generated 5 direct jobs (oil companies), 165 indirect jobs (oil and gas support sector), and 1,330 induced jobs by residents of the NSB. In total, the industry generated 1,500 jobs held by NSB residents, with an annual payroll of $100 million (McDowell Group 2011).

The Alaska Department of Revenue anticipates that the state government's high level of dependence on oil revenue will continue, with revenues being very sensitive to oil price and oil production. In FY12, state revenues from the oil industry accounted for 65 percent of the total state revenue, and 93 percent (or $8.86 billion) of the General Fund. The general fund pays for almost every state service, including the education system, transportation infrastructure, public health and safety services, and a host of other programs throughout Alaska.

Unrestricted revenue from oil production is anticipated to be $6.9 billion in FY13, and $6.4 billion in FY14, a reduction due to declining expected production levels. In FY12, an average of 579,400 BOPD was produced on the North Slope. The State expects average daily production in FY13 to drop to 538,300 BOPD and to 526,600 BOPD in FY14 (2013 Spring Revenue Sources Book, Alaska Department of Revenue).

With respect to the State of Alaska's 50 percent share of revenues from oil and gas activity in the NPR-A, the latest report indicates that the State's share of rents, royalties, and bonuses received from leases in the NPR-A in FY12 was $4.8 billion (2013 Spring Revenue Sources Book, Alaska Department of Revenue).

3.4.2.2 Regional/Local Economy

The proposed GMT1 development is contained within the NSB jurisdiction. The community of Nuiqsut, the closest community to the proposed development, and the most likely to experience direct impacts, is the focus of the local economic effects analysis. Although there are other communities within the NSB that could experience economic effects as a result of revenues generated from NPR-A activities, the intensity and extent of impacts on these communities have already been discussed or are within the range of effects analyzed in the 2004 ASDP Final EIS and the 2012 NPR-A Final IAP/EIS.

North Slope ANSCA village corporations are also active in the oil and gas sector. Kuukpik Corporation has direct contracts to provide subsistence representatives and ice road monitors to support CPAI as well as other operators in the area. Kuukpik Corporation (Nuiqsut), Ukpeagvik Inupiat Corporation (Barrow), Olgoonik Corporation (Wainwright), Tikagaq Corporation (Point Hope), Cully Corporation (Point Lay), and Kaktovik Inupiat Corporation (Kaktovik) all have service companies providing contract services to the oil and gas industry on the North Slope.

This sub-section incorporates by reference economic information for the NSB and the community of Nuiqsut contained in BLM (2004, § 3.4.2, pp.3-296 – 3-299) and BLM (2012, § 3.4.11, pp. 473 - 486).

Regional Economy: North Slope Borough

Oil and gas exploration and development continues to be the main industry in the NSB and the largest employer of the region's industrial or census area workforce; this includes the non-resident workforce. In 2012, there were 8,459 oil industry jobs on the North Slope; only 69 positions were filled by residents of the North Slope (AK Economic Trends, ADOLWD 2013c). Total employment for all industries in 2012 was 15,247 (Quarterly Census of Employment and Wages, ADOLWD 2013b). Wages from the oil and gas sector accounted for 73 percent of the total wages earned for all industries in the North Slope in 2012. However, most of the earnings go to non-residents and are not spent in the North Slope.

Oil production at Prudhoe Bay, Kuparuk, and Alpine fields, including the satellite fields, account for most of the oil production activities in the region. More recent oil and gas industry activities in (and offshore of) the North Slope include Pioneer Natural Resources' Oooguruk offshore project, ENI's offshore Nikaitchuq project, Shell's offshore exploration drilling efforts in 2012, and ExxonMobil's Point Thomson development project (ADOLWD 2013c). These industry projects have and will continue to contribute to the North Slope economy through taxes, oil field services contracts, and other indirect and induced effects of industry spending in the region. The indirect effects from government and industry spending have expanded the private support sector in the region.

Oil and gas property taxes are still the primary source of revenue for the NSB government. According to the State Assessor's Office, in 2012, the NSB received about $322 million in oil and gas property taxes, accounting for 98 percent of the total property tax collected by the NSB that year. This amount accounts for approximately 90 percent of the total general fund revenues (North Slope Borough Budget Document FY 2013-2014). With significant oil and gas property tax revenues, the NSB has been able to finance construction projects through its Capital Improvement Program. The NSB government also provides a wide range of public services to all of its communities; the NSB's actual operating budget in FY12 amounted to about $365.9 million.

The local government sector (primarily the NSB government) is the largest employer of North Slope residents. In 2012, the local government sector employed 1,944 residents, accounting for 57 percent of the resident workers in the region. The next largest employment sector is trade, transportation, and utilities, accounting for about 9 percent of the resident working population (Table 3.4-2).

The ANCSA regional and the village corporations in the North Slope are also important economic players in the region, employing local residents, participating in the oil and gas service industry, and creating additional wealth in the region.

A portion of the ANCSA corporations' profits goes to shareholders in the form of dividends. ASRC is the regional ANCSA corporation that is owned by, and represents the business interests of, the North Slope Iñupiat. For nearly two decades, ASRC has been the largest Alaskan-owned and operated company based on revenues. The corporation reached a gross revenue of $2.55 billion in 2011 (Harrington 2012).

Table 3.4-2. 2012 North Slope Borough Resident Employment by Industry

Industry	Number of workers	Total Employed (%)
Local Government	1,944	57.4
Trade, Transportation and Utilities	291	8.6
Professional and Business Services	261	7.7
Educational and Health Services	236	7
Construction	217	6.4
Financial Activities	182	5.4
Natural Resources and Mining	82	2.4
Other	69	2
Leisure and Hospitality	52	1.5
State Government	25	0.7
Information	18	0.5
Manufacturing	5	0.1
Unknown	3	0.1

Source: Alaska Local and Regional Information, Alaska Department of Labor and Workforce Development.

ASRC Energy Services, Inc. (AES), a wholly owned subsidiary of ASRC, provides an array of oilfield engineering, operations, maintenance, construction, fabrication, regulatory and permitting, and other services for some of the world's largest oil and gas companies. The company has emerged as one of Alaska's largest oilfield service providers and one of Alaska's largest private-sector employers (Fried et al. 2011; ASRC 2013). Petro Star, Inc., another subsidiary of ASRC, is the only Alaskan-owned refining and fuel marketing operation in the state (ASRC 2013).

Village ANCSA corporations in the NSB also are active in the oil and gas sector. The oilfield service company UMIAQ, LLC, a division of Ukpeagvik Iñupiat Corporation (the village corporation for Barrow), and Kuukpik Corporation, the village corporation for Nuiqsut, for example, provide camp services and catering to CPAI's Alpine development and BPXA's Northstar offshore field.

Local Economy: Community of Nuiqsut

The closest community to the proposed development is Nuiqsut. Nuiqsut is served by scheduled and chartered flights from Barrow; and residents have access to the Dalton Highway four months of the year. Freight arrives year-round by air cargo. (Alaska Department of Commerce, Community, and Economic Development Community Profiles).

Nuiqsut's economy, like other North Slope communities, is primarily based on subsistence hunting, fishing and whaling. More recently, Nuiqsut and its village corporation have benefited economically from close proximity to oil production activities on the North Slope, particularly development of the Alpine field. As noted in the 2004 ASDP (Section 2 page 294), as a result of current development of the Alpine Field, Nuiqsut has received a number of economic benefits and employment opportunities, including contracts to several Kuukpik Corporation joint ventures, including Nanuq (construction); Kuukpik/Arctic Services (camp and catering); Kuukpik/SAE (seismic); Kuukpik/LCMF (Umiaq) (surveying); Kuukpik/Carlisle (trucking), and Kuukpik/Nana Management Services (security). Other businesses that have benefitted include the Kuukpik Hotel, an office space lease from the City of Nuiqsut, and storage of ice road equipment.

The NSB reported that in 2010, there were 14 Nuiqsut residents working in the oil industry (see Table 3.4-3). The nearby Alpine development has also provided seasonal work opportunities to Nuiqsut residents, including environmental monitoring.

The NSB government, Kuukpik Corporation (village corporation/subsidiary), and the NSB school district, are the top employers of Nuiqsut residents (NSB Census 2010).

Table 3.4-3. Total Employment by Employer, Nuiqsut

Employer	Total	Percent
City Government	18	11
NSB Government	49	30
NSB School District	27	16
Oil Industry	14	8
Private Construction	1	1
ASRC/Subsidiary	3	2
Village Corporation/Subsidiary	32	19
Transportation	4	2
Other	18	11
Total	**166**	**100**

Note: The numbers include only those individuals responding to the survey and the question about employment and employer.

Source: Nuiqsut: Economic Profile and Census Report. North Slope Borough 2010 Economic Profile and Census Report. Volume X.

The City of Nuiqsut's FY13 budget is about $1.96 million. Grants, revenue sharing, and mitigation funds account for approximately 76 percent of the City's operating income. Other revenue sources include bed tax receipts, bingo income, and rents (Table 3.4-4).

Table 3.4-4. City of Nuiqsut Fiscal Year 2013 Budget

Income	Amount	Percent
Grant Revenue	$1,107,289	57
Grant Program Income	$23,500	1
State and Local Revenue	$150,000	8
Mitigation Funds	$200,000	10
Rents	$66,000	3
Contributions Income	$17,250	1
Other Income/Bed Tax	$151,500	8
Bingo Income	$145,000	7
USPS Nuiqsut CPU	$95,963	5
Total:	**$1,956,502**	**100**

Source: City of Nuiqsut Fiscal Year 2013 Adopted Budget.

As a result of the most recent NPR-A Impact Mitigation Program fund allocation, the community of Nuiqsut received grants for the following projects: (2013 NPR-A Report to the Legislature).

- Boat Ramp. $461,547 was appropriated to construct a seasonal removable boat ramp on the Nigliq Channel of the Colville River within the city limits of Nuiqsut. This boat ramp is intended to provide better summer and autumn access to subsistence hunting and

fishing grounds; better ability to launch a number of first response Search and Rescue marine vehicles from Nuiqsut; and improved first response capability to mitigate potential oil spills.

- Nuiqsut Power Plant Generator Upgrade ($1,386,000). Installation of a new generator enables the utility to meet current demands for increased power generation during the winter.
- Colville River Road – gravel acquisition ($2,318,988). This project is to acquire the gravel that would be used to extend the existing road constructed and maintained by the NSB, which connects the City of Nuiqsut to Freshwater Lake. The Colville River Road project would extend the road approximately 4 miles to the Colville River. The most critical factor in construction of this road is availability of gravel at the time of construction. The large amount of gravel for this road is not stockpiled and will have to be mined and the excess moisture must be allowed to drain.
- Local Government Operations and Maintenance ($595,000). This project is to continue to fund operations so the city government may continue providing Title 29 governance.

3.4.3 Subsistence

This section describes the affected environment for subsistence resources and traditional land use by the community of Nuiqsut whose residents harvest in and/or rely on resources in the vicinity of the GMT1 development. Because the proposed GMT1 Project has already been evaluated within earlier NEPA documents, namely the BLM (2004), and BLM (2012), this section is tiered off of those documents and focuses on information that is new or updated since those previous EISs. This section includes a general overview of subsistence use patterns for Nuiqsut, including the importance of subsistence, the seasonal round, harvest estimates, and subsistence use areas. Additional detail regarding Nuiqsut subsistence uses, including additional figures and tables, is provided in Appendix G.

3.4.3.1 Study Area

The study area for subsistence includes all areas used by the community of Nuiqsut for subsistence activities because these areas may be directly or indirectly affected by the proposed project. The project study area is defined as a 2.5-mile buffer surrounding the GMT1 Project Footprint and is the area where direct impacts may occur, particularly in overland areas where project components are proposed. Indirect impacts may occur in the project study area but may also extend outside the project study area for impacts related to resource availability or hunter avoidance. Additional North Slope communities including Anaktuvuk Pass, Atqasuk, and Barrow also have subsistence use areas located within or near the project study area; however, these use areas within the project study area are located on the periphery of these communities' overall subsistence use areas and the affected environment and environmental consequences for those communities related to broader development are discussed and analyzed in BLM (2004, §§ 3.4.3 and 4A.4.3) and BLM (2012, §§ 3.4.3, 4.3.13, 4.4.13, 4.5.13, 4.6.13, and 4.7.13).

3.4.3.2 Subsistence Definition and Relevant Legislation

Both BLM (2004, §3.4.3.1) and BLM (2012, § 3.4.3.1) provide an overview of the importance of subsistence, definition of subsistence, and relevant legislation governing the regulatory environment in which subsistence activities are permitted under state and federal regulations. In summary, subsistence is recognized as a central aspect of North Slope culture and life and is the cornerstone of the traditional relationship of the Iñupiaq people with their environment.

Residents of the North Slope of Alaska rely on subsistence harvests of plant and animal resources for nutritional sustenance and cultural and social well-being. Subsistence is not only a source of food for North Slope residents, but the activities associated with subsistence strengthen community and family social ties; reinforce community and individual cultural identity; and provide a link between contemporary Iñupiat and their ancestors. Subsistence customs and traditions encompass processing, sharing, redistribution networks, and cooperative and individual hunting, fishing, gathering, and ceremonial activities. These activities are guided by traditional knowledge based on a long standing relationship with the environment. Both federal and state regulations define subsistence uses to include the customary and traditional uses of wild renewable resources for food, shelter, fuel, clothing, and other uses (ANILCA, Title VIII, Section 803, and AS 16.05.940[33]). The Alaska Federation of Natives views subsistence to not only encompass the practices of hunting, fishing, and gathering, but as a way of life that has sustained Alaska Natives for thousands of years and a set of values associated with those practices (Alaska Federation of Natives 2012). A recent U.S Army Corps of Engineers study (Corps Forthcoming) conducted a literature review of existing subsistence definitions and provided a proposed definition of subsistence, which addressed the economic, social, cultural, and nutritional elements and components of subsistence that have not been emphasized in previous definitions. In part, this definition reads as follows:

> *"Subsistence refers to a way of life in which wild renewable resources are obtained, processed, and distributed for household and communal consumption according to prescribed social and cultural systems and values….*
>
> *…. The subsistence way of life satisfies to various degrees and in various contexts, the economic, social, cultural, and nutritional needs of subsistence-based communities."* (Corps Forthcoming)

The proposed project is located primarily on federal lands within the northeast NPR-A. The pipeline and road components also cross federal and Kuukpik Corporation lands, and the ancillary water pipeline between CD1 and CD4 crosses State and Kuukpik Corporation lands. In addition, resources that migrate through the study area, such as caribou, waterfowl, and migratory fish, may be harvested outside of the study area on other state, federal, or private lands. In Alaska, subsistence hunting and fishing are regulated under a dual management system by the State of Alaska and the federal government. Federal subsistence law regulates federal subsistence uses; state law regulates state subsistence uses. The federal government recognizes subsistence priorities for rural residents on federal public lands, while Alaska considers all residents to have an equal right to participate in subsistence hunting and fishing when resource abundance and harvestable surpluses are sufficient to meet the demand for all subsistence and other uses. Subsistence activities on all lands in Alaska, including private lands, are subject to state and federal subsistence regulations. Because the project is located on federal lands, Section 810 of ANILCA is applicable and requires a subsistence evaluation. This evaluation includes findings on the following:

- The effect of such use, occupancy, or disposition on subsistence uses and needs;
- The availability of other lands for the purpose sought to be achieved; and
- Other alternatives that reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes (16 U.S.C. §3120)

3.4.3.3 Overview of Nuiqsut and Subsistence Uses

Nuiqsut is located on the Nigliq (western) Channel of the Colville River, approximately 35 miles upstream from the Beaufort Sea, in an area that provides abundant opportunities for harvests of fish, land mammals, birds, and other resources. The Nuiqsut area was formerly a place where Iñupiat and Athabascans gathered to trade and fish and was also important for maintaining connections between the Nunamiut of the inland areas and the Taremiut of the coast (Brown 1979). After the passage of the ANCSA, a group of Iñupiat families from Barrow resettled at Nuiqsut to live in a more traditional manner, and many of those who moved there had a family connection to the area (IAI 1990a). Twenty-seven families from Barrow permanently resettled Nuiqsut in 1973. Since its resettlement nearly 40 years ago, Nuiqsut has grown to a population of 402 residents living in 114 households in 2010 (U.S. Census Bureau 2011). Primary sources of employment in the community include the village corporation (Kuukpik Corporation) and its subsidiary companies, the NSB, and the NSB school district (NSB 2013). The Native Village of Nuiqsut is a federally recognized tribe.

Table 3.4-5 presents a summary of the available subsistence harvest, use area, and seasonal round data for the community of Nuiqsut. Both BLM (2004, § 3.4.3.2) and BLM (2012, § 3.4.3.3) provide a description of Nuiqsut subsistence uses including harvest data, subsistence use areas, and seasonal round. Additional subsistence harvest and use area data not addressed in either of the previous EISs include the NSB subsistence harvest data report for the 1995-1996 and 2000-2001 Nuiqsut study years (Bacon et al. 2009) and Stephen R. Braund & Associates' (SRB&A) (2010b, 2011, 2012, and 2013) caribou use area and harvest data from the Nuiqsut Caribou Subsistence Monitoring Project. The following sections summarize the BLM (2004) and BLM (2012) descriptions of Nuiqsut's subsistence use area, harvest, and seasonal round data as well as incorporating new information that were not included in the previous EISs. More detailed information on Nuiqsut subsistence use areas, harvest data, and seasonal round are presented in Appendix G.

Table 3.4-5. Data Sources, Subsistence and Traditional Land Uses

Community	Harvest Data			Subsistence Use Area Data			Seasonal Round
	Study Year	Resource	Source*	Study Year	Resource	Source*	
Nuiqsut	1985	All Resources	ADF&G 2013c	Lifetime to 1979	All Resources	Pederson 1979	Bacon et al. 2009; Brower and Hepa 1998; Brown 1979; EDAW Inc. 2008; Fuller and George 1999; Impact Assessment Inc. 1990a; Libbey et al. 1979; Research Foundation of the State University of New York 1984 SRB&A 2010a
	1992	All Resources	Fuller and George 1999	Early 1970s	All Resources	Brown 1979	
	1993	All Resources	ADF&G 2013c	1973-1986	All Resources	Pederson 1986	
	1994-1995	All Resources	Brower and Hepa 1998	1994-2003	Non-Marine	SRB&A 2003	
	1995-1996	All Resources	Bacon et al. 2009	1995-2006	All Resources	SRB&A 2010a	
	2000-2001	All Resources	Bacon et al. 2009	2003-2007	Caribou	Braem et al. 2011	
	2003-2007	Caribou	Braem et al. 2011	2008-2011	Caribou	SRB&A 2010b, 2011, 2012, 2013	
	2010- 2011	Caribou	SRB&A 2012, 2013				

Subsistence Use Areas

Figure 3.4-1 depicts Nuiqsut contemporary subsistence use areas for several time periods, as documented by Pedersen (1986), SRB&A (2003), and SRB&A (2010a). All three study periods cover a similar area ranging from between Barrow in the west and Kaktovik in the east, and as far south as Anaktuvuk Pass. SRB&A's (2010a) most recent use areas document Nuiqsut residents traveling beyond Atqasuk to Barrow in the west, offshore more than 50 miles northeast of Cross Island, to Camden Bay in the east, and beyond the Colville River in the south. The majority of Nuiqsut 1995-2006 use areas are concentrated around the Colville River, overland areas to the south and southwest of the community, offshore areas north of the Colville River delta, and northeast of Cross Island. Pedersen (1986) and SRB&A (2003) use areas for Nuiqsut are all within the extent of SRB&A (2010a) use areas described above with the exception of the 1973-1986 data extending as far as Kaktovik in the east and Anaktuvuk Pass in the south. All three study periods overlap with the project study area. New subsistence use area data from CPAI's Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2010b, 2011, 2012, and 2013) are presented in Figure 3.4-2. These four year data show high use of the Colville River and areas west of the community for caribou hunting during the 2008-2011 study years. Appendix G, Figures G-1 through G-9 display individual, resource-specific, subsistence use areas for available study years in Nuiqsut.

Pedersen's (1979) lifetime (pre-1979) use areas (Figure 3.4-3) show Nuiqsut residents utilizing a smaller area than the contemporary subsistence use areas shown on Figure 3.4-1 but still an extensive area centered around the community to harvest subsistence resources; reported use areas extended offshore approximately 15 miles offshore, as far east as Camden Bay, south along the Itkillik River, and west as far as Teshekpuk Lake. As part of *Nuiqsut Paisaŋich - Nuiqsut Heritage: a Cultural Plan*, Brown (1979) recorded all resources use areas (Figure 3.4-3). For all subsistence resources, the study documented early 1970s use areas that extended south around the Colville and Itkillik river drainages, offshore between Cross Island and Cape Halkett, and in overland areas east and west of the community. Both studies documented a similar extent of use areas as they were conducted during the same study year for the relatively same time period.

Harvest Data

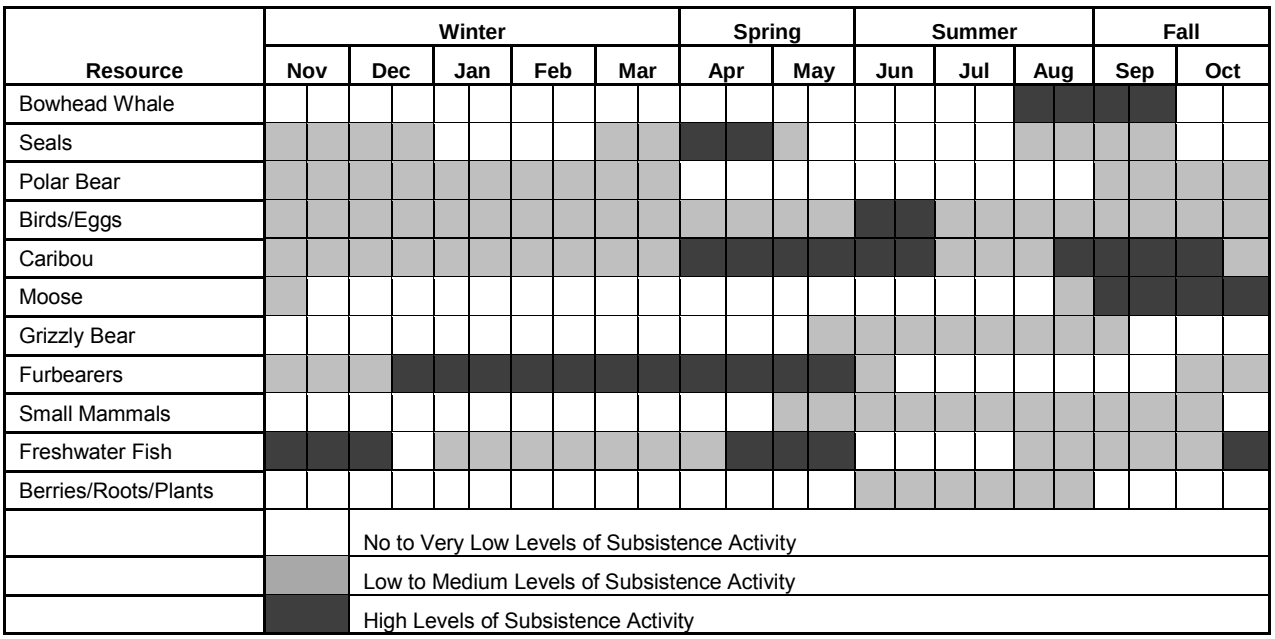
According to the available data, in 1985 and 1993, 100 percent of Nuiqsut households reported using subsistence resources (i.e., harvesting, processing, storing, distributing, preparing, and consuming) and over 90 percent of households participated in subsistence activities (i.e., attempted harvests of subsistence resources). During both years, households most commonly participated in harvests of non-salmon fish, large land mammals, and migratory birds (Appendix G, Table G-1). Data on per capita pounds are available for two study years and range from 399 pounds in 1985 to 742 pounds in 1993. Resources providing the highest percentage of the total harvest vary over the study years; marine mammals (primarily bowhead whale) contributed the highest amount to the total subsistence harvest during 1992, 1995-1996, and 2000-2001; non-salmon fish were the top harvested resource during the remaining three study years (1985, 1993, and 1994-1995). Large land mammals (primarily caribou but also moose) were generally the second or third most harvested resource during all study years. In terms of species, bowhead whales (*aġviq*), caribou (*tuttu*), Arctic cisco (*qaaqtaq*), broad whitefish (*aanaaqliq*), and moose (*tuttuvak*) were generally the top harvested species during most study years (Appendix G, Tables G-1 and G-2). Other subsistence species that have contributed highly to Nuiqsut subsistence harvests over the study years include seals, geese, Arctic grayling (*sulukpaugaq*), and burbot (*tittaaliq*). Salmon harvests are relatively minor in Nuiqsut; however, according to a recent study sponsored by the Bureau of Ocean Energy Management

there is evidence that suggests salmon catches in Nuiqsut are increasing (Carothers, Cotton, and Moerlein 2013).

Seasonal Round

Table 3.4-6 provides seasonal round data based on reports from the 1980s and 1990s; in several cases, the data in Table 3.4-6 conflict with more recent data regarding the timing of subsistence activities. Where applicable, this discussion supplements the data in the table with more recent available data. During the spring (April and May), Nuiqsut residents shift their focus from hunting furbearers to harvesting waterfowl. Beginning in May, residents travel along local rivers to hunt for caribou and offshore from the Colville River delta looking for seals (Table 3.4-6). Caribou harvests occur throughout the year, but with the most intensity during the summer months of June, July, August, and September (Braem et al. 2011; SRB&A 2013). In addition to traveling inland along the Colville River during the summer for fishing and caribou hunting, residents continue to travel to the ocean to hunt for ringed seals (*qaiġulik*), bearded seals (*ugruk*), and king and common eiders (*qiŋalik, amauligruaq*) during the months of June, July, and August (SRB&A 2010a). Berry and plant gathering also occur during the summer months (Table 3.4-6). Moose hunting takes place, alongside caribou hunting, in August and September along river hunting areas south of Nuiqsut (Fuller and George 1999). Bowhead whaling usually occurs in September when whaling crews are stationed at Cross Island with preparations for the whaling season beginning in August. The fall month of October is spent fishing and harvesting caribou close to the community. Gill netting, primarily for Arctic cisco, is most productive between October and mid-November. During the winter months, furbearer hunters pursue wolves (*amaġuq*) and wolverines (*qavvik*), target caribou and ptarmigan (*aqargiq*) as needed and available, and fish for burbot through the ice (Table 3.4-6).

Table 3.4-6. Nuiqsut Annual Cycle of Subsistence Activities



Source: Impact Assessment Inc. 1990, and Research Foundation of the State University of New York 1984.

3.4.3.4 Subsistence Uses in the Project Study Area

This section describes Nuiqsut's subsistence uses that have been documented within and near the project study area. Examples of subsistence baseline indicators that are useful in characterizing subsistence uses include:

- Subsistence use areas
- Travel method
- Travel routes
- Timing of harvest activity
- Duration and frequency of trips
- Observed change in resources
- Harvest diversity
- Harvest amount
- Harvest participation
- Harvest success
- Harvest sharing
- Harvest effort

The following discussion describes how these indicators can be used in characterizing subsistence uses under three primary categories: (1) Subsistence Use Areas and User Access, (2) Resource Availability, and (3) Community Participation. The data for these indicators are all drawn from information that has been presented in the previous section (Section 3.4.3.3) and in Appendix G. Data specific to the project area (e.g., travel method by use area, timing by use area) are not available for all study years.

Subsistence use areas refer to the locations in which subsistence users search for and harvest subsistence resources. Use of an area for subsistence purposes is dependent on being able to access the area and have subsistence resources that are available in the area. Subsistence use areas can range from small fishing locations to expansive overland caribou hunting areas and vary greatly in size depending on the targeted resource. Besides mapped data of these use areas, other key subsistence baseline indicators that are useful in characterizing subsistence use areas include months of use and frequency and duration of trips. User access refers to the method of transportation and travel routes that are used to access subsistence use areas. Methods of transportation and travel routes are factors in determining the size and location of areas that subsistence users harvest from. Communities with residents who can afford airplanes, for example, may access a larger area than communities without while residents with more limited means of transportation (e.g., four-wheelers) or small funds often subsist within a small use area near the community.

Resource availability describes the subsistence resources that are available within the study area or that move through the study area and are later harvested in other areas. Successful subsistence harvests depend on continued resource availability in adequate numbers and health in traditional use areas. Key subsistence indicators that characterize resource availability include per capita and household harvest amounts, harvest numbers, percent of households attempting to harvest and harvesting, and harvest diversity. Habitat areas for subsistence resources are also important in characterizing resource availability. In some cases, habitat

areas may be located outside the range of a community's subsistence use areas, yet these areas are still important to resource availability because resources may move or migrate through these habitat areas and later be harvested within a community's subsistence use area. Traditional knowledge is an important source of information that is useful in characterizing existing resource availability, resource changes, and habitat areas.

Community participation refers to the levels of existing community involvement in subsistence activities. Participation in subsistence activities promotes the transmission of skills from generation to generation, and sharing strengthens community cohesion within and among communities in the region and provides for an extensive distribution network of subsistence foods. Because Alaska Native culture is integrally tied to subsistence activities, higher levels of participation provide more opportunities for community members to pass on their traditional knowledge and cultural values to younger generations. These levels of involvement or participation are most often described using baseline indicators of percent of households or harvesters using, attempting to harvest, and sharing subsistence resources.

Sources of data that inform the above-described indicators for Nuiqsut include harvest data from the NSB, ADF&G, and SRB&A, and subsistence mapping studies such as Pedersen (1979), SRB&A (2003), SRB&A (2010a), and SRB&A (2010b, 2011, 2012, and 2013). Data from these harvest and subsistence mapping studies have been provided and/or discussed in the previous sections and selected indicators, based on data availability, are included in the following section as relevant to the project study area.

Subsistence Use Areas and Access

The project study area overlaps with the Nuiqsut subsistence use areas. Table 3.4-7 indicates which types of subsistence use areas for Nuiqsut overlap with the project study area by resource. According to these data, residents of Nuiqsut use the project study area for subsistence harvest activities for nearly all types of subsistence resources including large land mammals, furbearers and small land mammals, fish, migratory birds, ptarmigan, and vegetation. Marine mammals use areas also intersect the project study area; however, these use areas begin in the Colville River and extend to offshore areas. See Appendix G, Figures G-2 through G-9 for maps depicting resource category use areas overlapped by the project study area.

Table 3.4-7. Use Areas Overlapping Project Study Area by Resource Category

Resource Categories	Nuiqsut Use Areas Overlapping Project Study Area
Moose	X
Caribou	X
Other Large Land Mammals	X
Furbearers & Small Land Mammals	X
Marine Mammals[1]	X
Fish	X
Migratory Birds	X
Ptarmigan	X
Vegetation	X

Sources: Brown 1979, Pedersen 1979, Pedersen 1986, SRB&A 2003, SRB&A 2010a,

Notes: Not all studies addressed each of the resource categories listed in this table.

[1]Marine mammal subsistence use areas begin in Colville River and extend to offshore areas.

Several sources also provide specific data on the timing and method of transportation of Nuiqsut subsistence activities in the project study area. A subsistence mapping project conducted in Barrow, Kaktovik, and Nuiqsut provided data on all resources[2] subsistence use areas by month and travel method (SRB&A 2010a); in addition, an ongoing Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2010b, 2011, 2012, and 2013) provides similar data specific to caribou uses by month and travel method. The reader should keep in mind that the information presented in this *Subsistence Use Areas and Access* section is specific to activities that occur within the project study area (Figure 3.4-1 and Figure 3.4-2). Thus, any activities that occur outside of the specific project study area polygon are not included in the discussion.

The project study area is a 2.5 mile buffer of the four project alternative footprints, including infrastructure that is east of the already–approved CD5 development and in areas of existing infrastructure between CD1 and CD2. Except for a new pipeline between CD1 and CD4 that is parallel to an existing pipeline, the only areas of new infrastructure proposed for GMT1 occur west of CD5, in an area that is not directly accessible by boat. The project study area includes a portion of the Colville River that is commonly accessed by boat and used for subsistence, but will not be directly affected by new infrastructure associated with GMT1. While boating activities may be affected indirectly through changes in resource availability (see the discussion of Resource Availability below), direct impacts (occurring at the same time and place) on subsistence use areas will be limited to inland areas that are not accessed during boating activities. Therefore, in order to focus on current subsistence uses within areas of new infrastructure associated with the proposed project and to most accurately represent the directly affected use areas by excluding boat based subsistence activities, the analysis of uses within the project study area for *Months of Use* and *Method of Transportation* excludes subsistence use areas that are accessed by boat. Instead, these sections provide data on subsistence use areas within the project study area that are accessed by other modes of transportation such as snowmachines and four-wheelers.

During their subsistence mapping project, SRB&A (2010a) documented a total of 758 use areas that characterized the 1995-2006 subsistence use areas of 33 active and knowledgeable Nuiqsut subsistence harvesters. In total, 335 of the 758 individual use areas (approximately 44 percent) documented for the 1995-2006 time period (SRB&A 2010a) overlapped with the project study area (Table 3.4-8). Excluding use areas accessed by boat, a total of 234 overland use areas (31 percent) overlapped with the project study area. Each use area represents the area in which an individual Nuiqsut respondent searched for a particular resource; areas vary in size depending on the resource being targeted and can range from a small net site for Arctic cisco to large overland areas covering many square miles in search of resources such as caribou or wolf and wolverine. Data from the Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2010b, 2011, 2012, 2013) recorded 733 caribou use areas over the four study years. Of these 733 use areas, 627 (86 percent) are overlapped by the project study area; 164 (22 percent) caribou use areas overlapped overland use areas (i.e., non-boat use areas) within the project study area.

[2] SRB&A 2010a interviews reported information for the following resources: caribou, moose, bowhead whale, Arctic cisco, Arctic char/Dolly Varden, broad whitefish, burbot, geese, eider, ringed seal, bearded seal, walrus, wolf, and wolverine. Other resources such as ptarmigan, polar bear, vegetation, or other types of non-salmon fish and salmon were not documented and thus project area specific data are not available for these resources.

Table 3.4-8. Sources of Project Specific Subsistence Use Area Information

Source	Resource Type	Time Period	Total Number of Use Areas	Total Number (%) of Use Areas in Project Study Area	Total Number (%) of Overland Use Areas in Project Study Area
SRB&A 2010a	All Resources	1995-2006	758	335 (44%)	234 (31%)
SRB&A 2010b, 2011, 2012, and 2013	Caribou	2008-2011	733	627 (86%)	164 (22%)

Table 3.4-9 shows the percentage of Nuiqsut respondents reporting overland use areas within the project study area for the 1995-2006 time period (SRB&A 2010a). Overall, 100 percent of Nuiqsut active harvesters interviewed for the 1995-2006 time period reported overland use areas crossed by the project study area. Of these respondents, 85 percent reported caribou hunting in the project study area, the highest of any single resource. Both Arctic cisco and geese use areas within the project study area were reported by 76 percent of respondents followed closely by wolf and wolverine (approximately 70 percent). Nearly half of respondents reported burbot use areas in the project study area. Both Arctic cisco and burbot use areas in the project study area are accessed by snowmachine along the Colville River or overland via the frozen tundra. No other resources documented during the study had greater than 10 percent of respondents reporting use areas within overland areas crossed by the proposed project.

Table 3.4-9. Percent of Nuiqsut Harvesters Using Project Study Area – Overland Use Areas Only

Resource Category	% of Nuiqsut Respondents
Caribou	85
Arctic Cisco	76
Geese	76
Wolverine	70
Wolf	67
Burbot	45
Broad Whitefish	9
Eider	6
Moose	3
Arctic Char/ Dolly Varden	3
Percent of Total Harvesters Using Study Area	100
Total Number of Respondents Interviewed in Study	33

Source: SRB&A 2010a

Notes: SRB&A 2010a did not collect data on other resources except for marine mammals. Marine mammal subsistence use areas begin in Colville River and extend to offshore areas.

Months of Use

Figure 3.4-4 shows the percentage of overland use areas in the project study area, by month, as documented in SRB&A (2010a) for Nuiqsut. According to these data, overland uses of the project study area by Nuiqsut residents occur year-round, with the greatest peak of activity occurring in the winter from October to through May with lower levels of activity in June, July, August, and September.

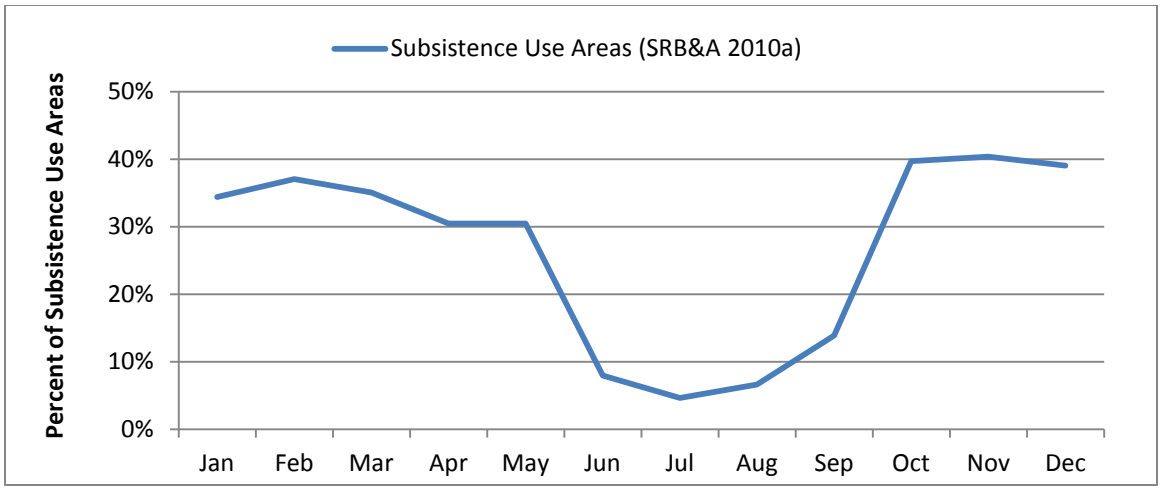


Figure 3.4-4. Overland All Resources Subsistence Use Areas by Month in Project Study Area – 1995-2006

Figure 3.4-5 and Figure 3.4-6 provides a specific depiction of the timing of caribou subsistence activities within the project study area (SRB&A 2010a, 2010b, 2011, 2012, and 2013). According to these data, Nuiqsut harvesters (similar to their all resources use areas) access the project study area for caribou hunting primarily during the winter months. Months of caribou hunting activities collected during the Nuiqsut Caribou Subsistence Monitoring Project (Figure 3.4-6) display a slight shift in the timing of caribou hunting activities in the project study area with a smaller percent of caribou use areas in the project study area accessed during the winter months, and a slightly higher percentage (from 25 percent to 30 percent) accessed in September. August caribou hunting activity also increased slightly during the study years for the caribou monitoring project (Figure 3.4-6) compared to the SRB&A 2010a study years (Figure 3.4-5). Possible explanations for this shift include documentation of the use of four-wheelers by younger Nuiqsut hunters, an activity that occurs primarily during August and September. Another possible explanation could be more caribou being available in the project study area during August and September. In either case, the available data do not provide a definitive answer as to the reason for the shift.

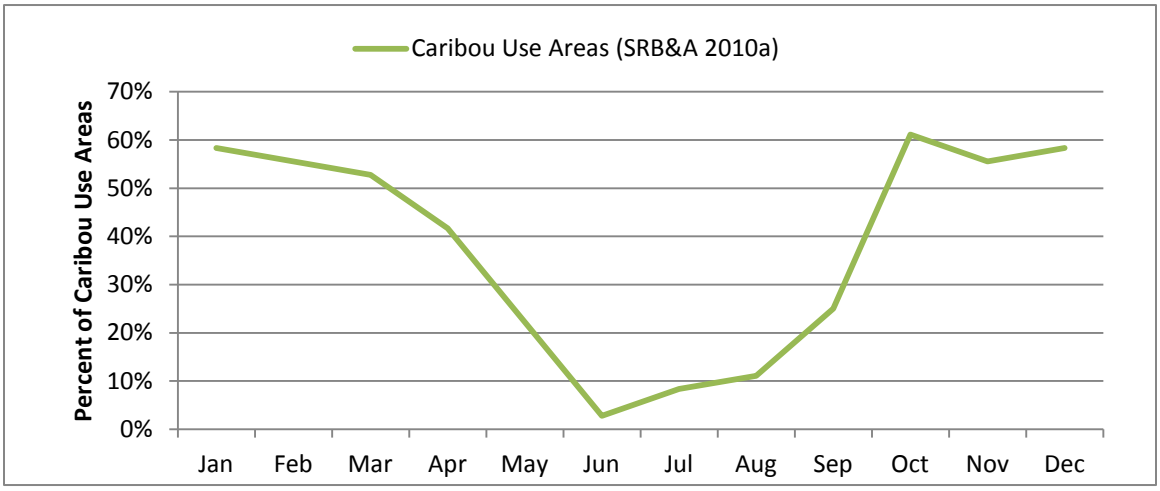


Figure 3.4-5. Overland Caribou Subsistence Use Areas by Month in Project Study Area – 1995-2006

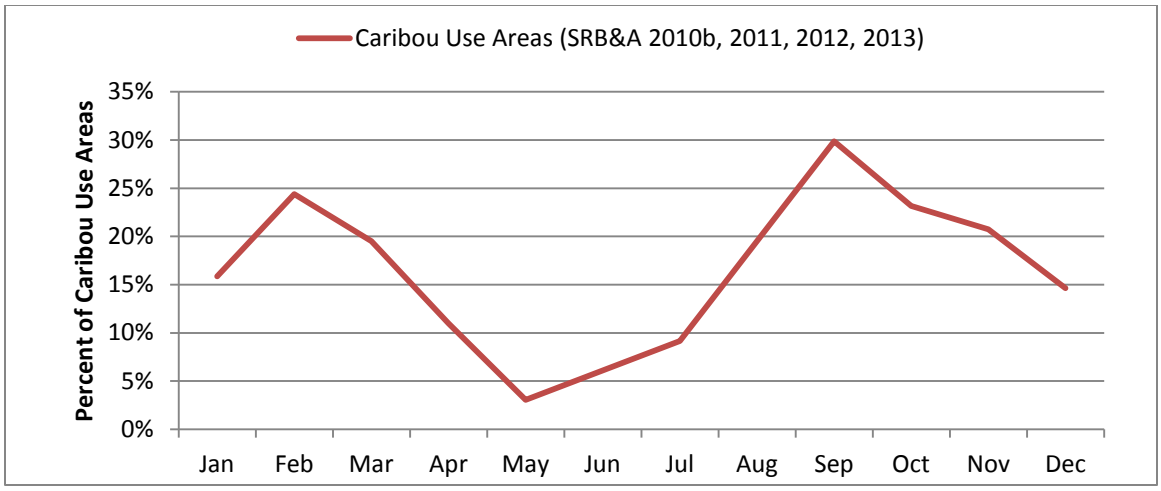


Figure 3.4-6. Overland Caribou Subsistence Use Areas by Month in Project Study Area – 2008-2011

As shown in Table 3.4-10, use of the project study area occurs for various resources at differing times of the year. As defined by total number of use areas, geese hunting, caribou hunting, Arctic cisco and burbot fishing, and wolf and wolverine hunting are the primary activities that occur in the project study area. As discussed above, overland caribou hunting occurs year-round in the project study area with the greatest number of use areas accessed during late fall and throughout the winter (September to April), when travel by snowmachine and four-wheeler is most common. Wolf and wolverine hunting also peaks during the winter particularly from January through March. Geese hunting within the project study area primarily occurs during May. Fishing primarily occurs for Arctic cisco and burbot with the peak of Arctic cisco harvesting occurring in October and November in the Colville River and burbot fishing occurring throughout the winter particularly from November through February. Other documented hunting activities are more limited within the project study area and include Arctic char and broad whitefish fishing (five use areas), eider hunting (two use areas), and moose hunting (one use area).

Table 3.4-10. Nuiqsut Months of Use in Project Study Area[3] - Overland Use Areas Only

Resource Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Use Areas
Arctic Char/ Dolly Varden													1
Arctic Cisco													36
Broad Whitefish													4
Burbot													19
Caribou													36
Eider													2
Geese													42
Moose													1
Wolf													27
Wolverine													29
	50-100% of Use Areas												
	25-49% of Use Areas												
	1-24% of Use Areas												

Source: SRB&A 2010a

Method of Transportation

Residents of Nuiqsut access the project study area using various modes of travel. Figure 3.4-7 shows the percentage of all resources use areas overlapping the project study area by reported method of transportation based on SRB&A 2010a. As shown in this figure, snowmachines are the most common mode of travel to the project study area. Less than seven percent of use areas in the project study area were accessed by four-wheelers, planes, or foot. As mentioned above this analysis excludes use areas accessed by boat, as the area where new infrastructure is proposed is primarily accessed using overland methods of travel such as snowmachine and four-wheeler.

When viewing use area data specific to caribou for the same 1995-2006 study period, Nuiqsut residents reported using similar methods of transportation in the project study area, with snowmachine the primary mode of transportation and limited use of all other travel methods (Figure 3.4-8). During the Nuiqsut Subsistence Caribou Monitoring Project for the 2008 through 2011 study years, Nuiqsut residents reported the greatest percent of overland caribou use areas were accessed using snowmachine (approximately 60 percent); however, the study reported a much higher percent of use areas in the project study area were accessed using four-wheeler (36 percent) compared to the 1995-2006 study period (6 percent) (Figure 3.4-8). This is consistent with the higher percentage of caribou use areas accessed in September than in previous studies (Figure 3.4-6); overland travel in September is generally limited to four-wheeler.

[3] Does not include use areas accessed by boat in order to capture the timing of overland travel in the project area.

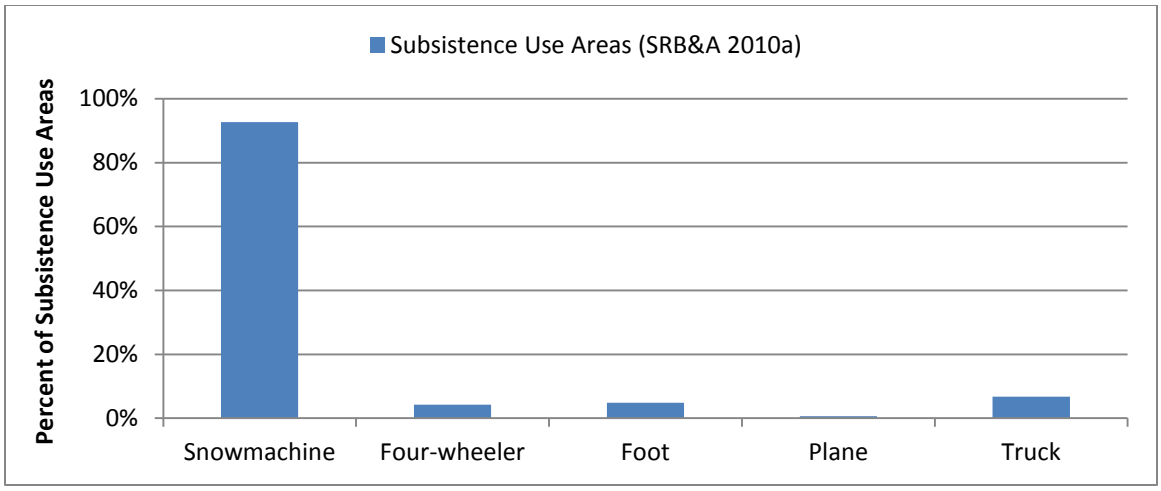


Figure 3.4-7. All Resources Subsistence Use Areas by Method of Transportation in Project Study Area

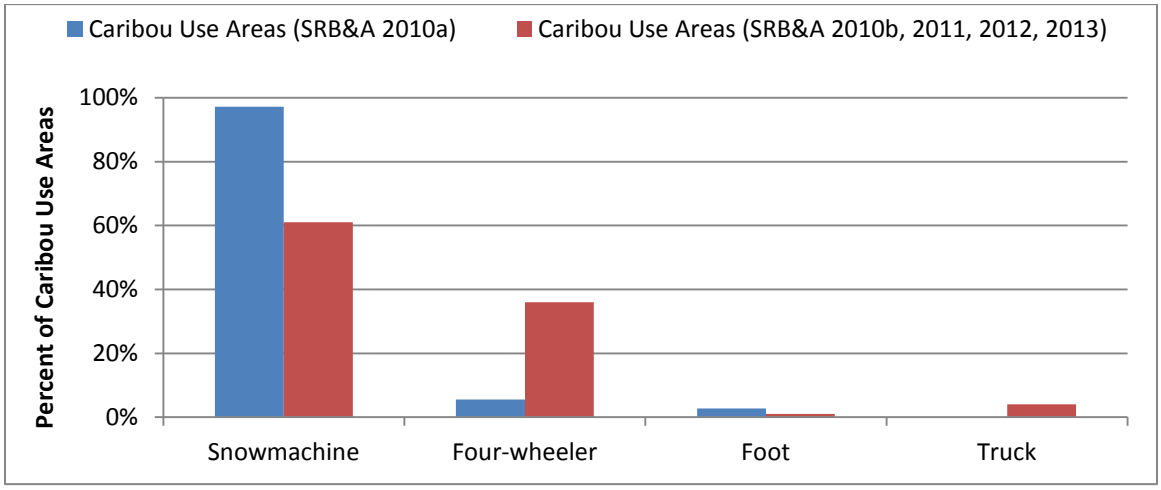


Figure 3.4-8. Caribou Subsistence Use Areas by Method of Transportation in Project Study Area

Figure 3.4-9 shows the types of travel method used to access caribou subsistence use areas within the project study area, by month. All resource travel method by month data are not available from the SRB&A 2010a study; however, as Figure 3.4-7 shows the majority of travel method to the project study area is by snowmachine, which typically occurs from October to May. Specifically for caribou, Nuiqsut respondents reported using snowmachine during the winter (October to April) and four-wheeler during the summer and fall (June to October) to access the project study area during the 2008 through 2011 study years (Figure 3.4-9).

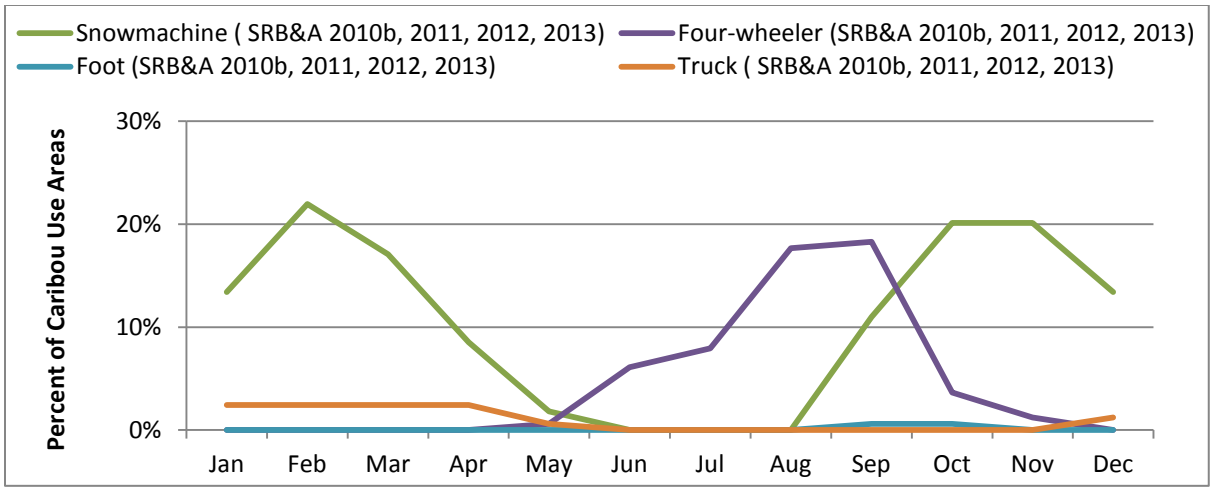


Figure 3.4-9. Travel Method by Month in Project Study Area – Caribou Only

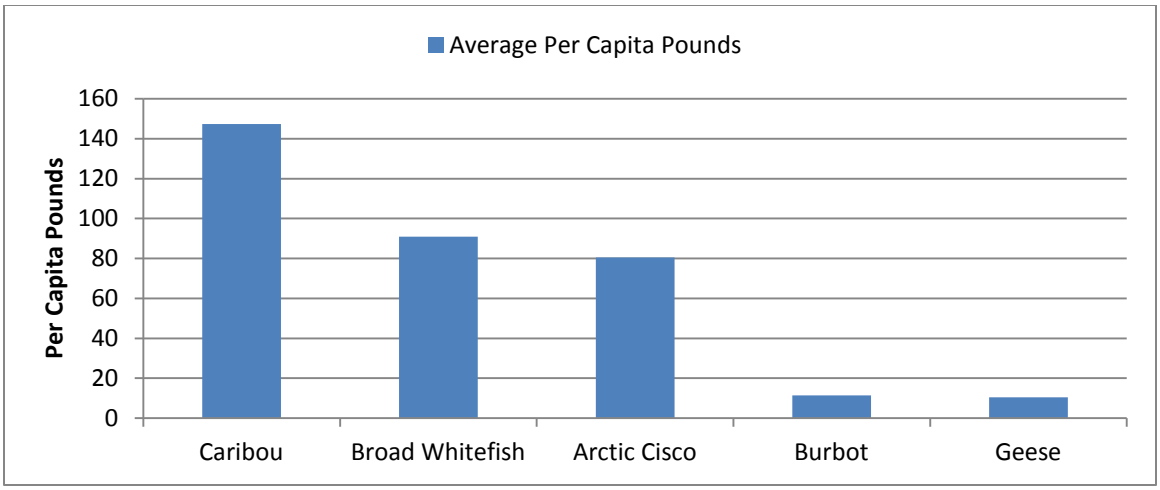
Figure 3.4-10 depicts travel routes that have been documented for Nuiqsut based on SRB&A 2010a interviews. Multiple travel routes within the project study area have been reported by residents of Nuiqsut. The majority of these travel routes head northwest of the community towards the coast and Barrow. The Nigliq channel of the Colville River is also a heavily utilized travel corridor to access use areas in the Colville Delta, Beaufort Sea, and Fish and Judy creeks.

Resource Availability

As noted above, a key indicator of resource availability is per capita harvests within a community. Increases or decreases in these numbers may indicate an increase or decrease in the availability of subsistence resources to local harvesters. This discussion focuses on providing baseline indicator data for seven primary subsistence resources harvested within the entire project study area including the Colville River area. These resources are as follows: caribou, geese, Arctic cisco, burbot, broad whitefish, wolf, and wolverine.

Figure 3.4-11 shows the average pounds per capita for five of the key resources (caribou, geese, Arctic cisco, broad whitefish, and burbot). These data represent total harvest from all subsistence areas based on data presented in Appendix G; per capita data are not available specifically to the project study area. Because pounds per capita are generally not applied to furbearers and small land mammals, wolf and wolverine were excluded from the figure. Despite the limitations, these data are still useful for describing the relative importance of these key subsistence resources for Nuiqsut in terms of edible pounds.

According to Figure 3.4-11, the average per capita harvest of caribou was 147 pounds, the highest of the five key resources harvested in the project study area. Harvests of broad whitefish and Arctic cisco were similar with an average of 91 and 81 per capita pounds for each resource respectively. The Colville River is a particularly productive spawning and overwintering area for both broad whitefish and Arctic cisco. During years when the Arctic cisco run is strong, this resource may provide a substantial portion of the yearly harvest for Nuiqsut. Burbot and geese contributed a lower amount at just over 10 pounds per capita.



Sources: See Appendix G, Table G-2 for individual data and references

Figure 3.4-11. Per Capita Pounds Harvested for Key Resources – All Study Years

Data from the Nuiqsut Caribou Subsistence Monitoring Project provide project study area specific harvest data that show the percent of the caribou harvest that came from the project study area by study year (Table 3.4-11). These data only represent the harvests reported by the interviewed respondents and are not based on the total community harvest. For the four study years (2008-2011), 17 to 37 percent of the respondents' caribou harvest came from harvest sites located within the project study area. In general, the four years of data show an increasing percentage of the caribou harvest coming from locations within the project study area. One possible reason for this increase includes increased documentation of younger hunters over the study years (SRB&A 2012: Table 4). These younger hunters are more likely to access overland areas by four-wheeler, such as those areas located within the project study area. Another reason for this increase could be due to the effect of increased development activity in the Colville delta and a shift of residents hunting patterns to areas west of the community where the proposed project is located. Over the four study years (2008-2011), the Nuiqsut Caribou Subsistence Monitoring Project has documented an increase in the percentage of harvests occurring in the area west of Nuiqsut, and a decrease in the percentage of harvests occurring along Nigliq Channel (SRB&A 2013). In 2011, nine percent of households in Nuiqsut said they avoided the Alpine area altogether because they believe they may experience impacts in the area (SRB&A 2012: 79, Table 41).

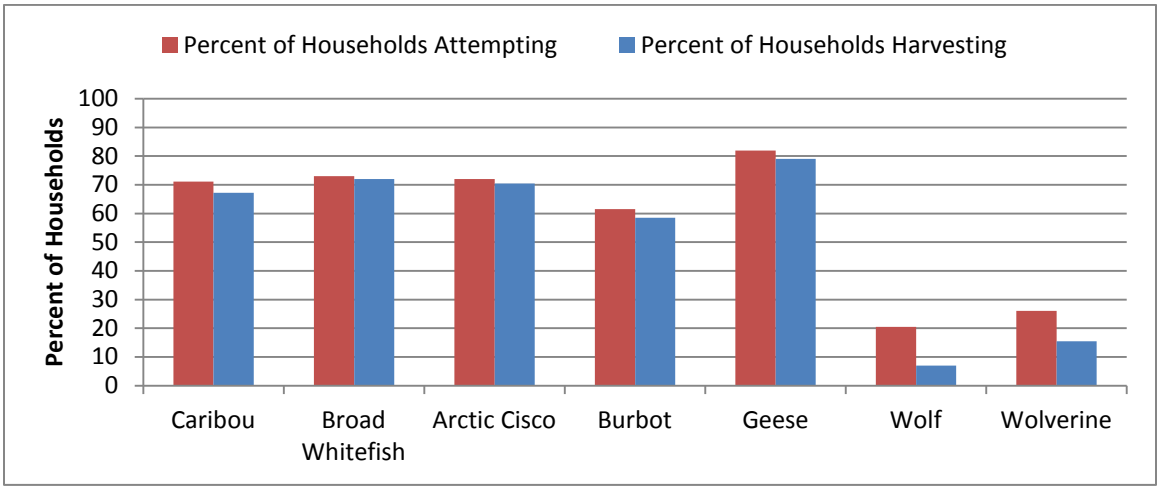
Table 3.4-11. Percent of Caribou Harvested in the Project Study Area

Caribou Study Year	Percent of Harvest in Total
2008	17%
2009	26%
2010	24%
2011	37%

Source: SRB&A 2010b, 2011, 2012, and 2013

Other indicators of resource availability include the percent of households attempting to harvest a particular resource and the percent of households that are successful. In general, the percentage of Nuiqsut households that successfully harvested a resource is comparable to the

percentage of households attempting to harvest resources including caribou, broad whitefish, Arctic cisco, burbot, and geese (Figure 3.4-12). SRB&A (2013:59) reported that data from the four year (2008-2011) monitoring study indicate an increase in the percentage of respondents who believed they had harvested enough caribou during the previous 12 months. Certain resources such as burbot and geese, although not yielding a high number of per capita pounds (12 and 11 pounds per capita, Figure 3.4-11), have a high percent of households (62 and 82 percent respectively) that participate in the activities. Wolf and wolverine show a greater disparity between the percentage of households attempting harvests and the percentage of households reporting successful harvests, indicating that overall success rates for these resources is lower than for other key resources harvested in the project study area (Figure 3.4-12), which is generally the case for wolf and wolverine in all harvest areas. However, the two indicators presented in Figure 3.4-12 do not provide information on whether the households harvested enough to meet their needs and/or how much effort (e.g., number of trips, duration of trip, costs) was expended in order to harvest the target resource. The table shows, in general, Nuiqsut households that attempt to harvest key resources are successful in doing so.



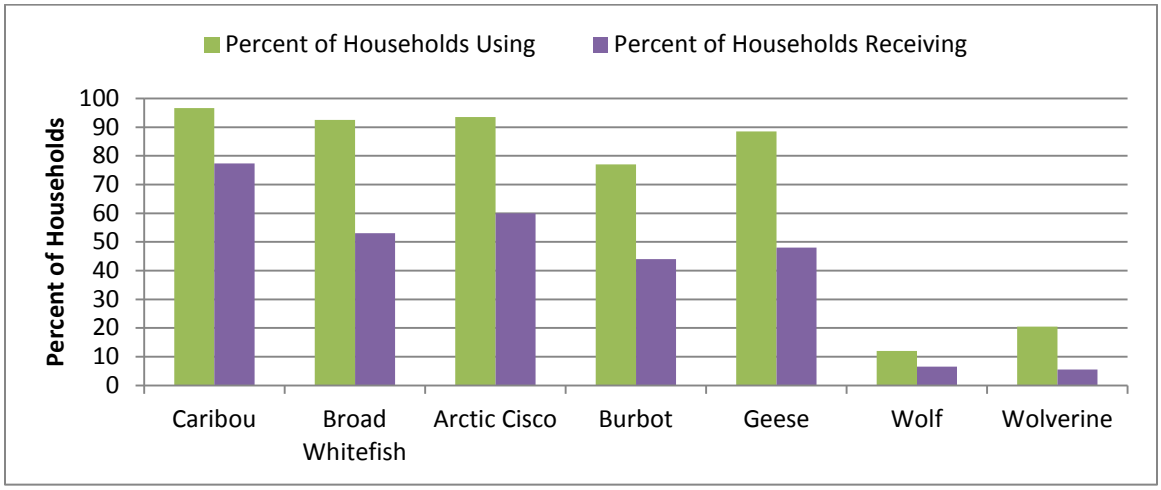
Sources: See Appendix G, Table G-2 for individual data and references

Figure 3.4-12. Harvesting and Attempting to Harvest for Key Resources – All Study Years

Community Participation

As noted above, key indicators of community participation include percent of households using, attempting to harvest, and sharing subsistence resources. This discussion focuses on providing community participation baseline indicator data for the seven key resources harvested within the project study area: caribou, geese, Arctic cisco, burbot, broad whitefish, wolf, and wolverine. Figure 3.4-13 shows the average percentage of households reporting using and receiving resources. Similar to per capita pound data, the data represent all community harvests; data for percent of households using and receiving resources are not available specifically to the project study area. According to the figure, the greatest percentage of households reported using caribou, broad whitefish, and Arctic cisco (greater than 90 percent). A high number of households also reported using geese (89 percent) and burbot (77 percent). Furthermore, caribou hunting, broad whitefish and Arctic cisco fishing, and geese hunting are subsistence activities that are conducted by a large percent of Nuiqsut households (between 70 and 80 percent, Figure 3.4-12). Among the key resources harvested in the project study area, wolf and wolverine use was reported among the fewest households.

Sharing of these key resources is high among all households, particularly for caribou which had an average of nearly 80 percent of households receiving the resource. Fish and geese are also shared among an average of 40 to 60 percent of households. Wolf and wolverine, which are not harvested primarily for consumption, are shared less often.



Sources: See Appendix G, Table G-2 for individual data and references

Figure 3.4-13. Percent of Households Harvesting Key Resources – All Study Years

3.4.4 Environmental Justice

Environmental Justice is defined in EO 12898 *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which requires that proposed projects be evaluated for "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." From the EPA website, http://www.epa.gov/environmentaljustice/, (April 30, 2013).

EPA policy guidelines for evaluating the potential environmental effects of projects require specific identification of minority populations when either: 1) the minority population of the affected area exceeds 50 percent or; 2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

The community of Nuiqsut is identified as being the closest community to be potentially affected by the project study area. The State of Alaska socioeconomic characteristics were selected as the reasonable reference population (BLM 2004, p. 327).

According to 2010 Census data about 87 percent of the population of Nuiqsut is Alaska Native or American Indian (specifically Iñupiat), an identified minority group. The ethnic composition of Nuiqsut compared with the State of Alaska is shown in Table 3.4-12. Based on the census data, the minority population in Nuiqsut is well above the 50 percent threshold specified in the EPA guidelines, so it is appropriate to consider potential environmental justice issues in

evaluating the effects of the proposed plan. Nuiqsut has an American Indian/Alaska Native membership of 87.1 percent. The statewide population is 14.8 percent American Indian or Alaska Native. Based on the census data, the minority population in Nuiqsut is well above the 50 percent threshold specified in the EPA guidelines, so it is appropriate to consider potential environmental justice issues in evaluating the effects of the proposed plan.

Table 3.4-12. Ethnic Composition of Nuiqsut Compared with State of Alaska

Category	State of Alaska		Nuiqsut	
	Population	Percent	Population	Percent
Total	**710,231**	**100.0**	**402**	**100.0**
Hispanic or Latino	39,249	5.5	0	0.0
Not Hispanic or Latino	670,982	94.5	402	100
Population of one race	658,356	92.7	391	97.3
White	473,576	66.7	40	10.0
Black or African-American	23,263	3.3	1	0.2
American Indian or Alaska Native	104,871	14.8	350	87.1
Asian	38,135	5.4	0	0.0
Native Hawaiian and Pacific Islander	7,409	1.0	0	0.0
Some other race	11,102	1.6%	0	0.0
Two or more races	51,875	7.3%	11	2.7

Source: The 2010 population numbers are actual counts from decennial censuses. Alaska Department of Labor and Workforce Development, Research and Analysis Section, 2010 Census, Demographic Profiles for Alaska and Nuiqsut, http://live.laborstats.alaska.gov/cen/dp.cfm (April 30, 2013).

3.4.5 Cultural Resources

3.4.5.1 Introduction

This section describes cultural resources of the ACP with a focus on cultural resources near the proposed GMT1 project area. As defined in BLM (2004, § 3.4.5.1, p. 329), cultural resources include:

> *sites and materials of prehistoric Native American, historic European and Euro-American, and historic Inupiat origin (for example, traditional cabin sites, camp sites, and burial grounds). The Cultural Resources section also includes a discussion of cultural resources of the Arctic Coast including traditional subsistence harvest sites and other traditional land uses areas, landscapes, symbols, and place names.*

Based on the above definition, this analysis focuses on traditional cultural sites, trails, travel/trade routes, and other cultural features near the GMT1 project. Because the ASDP and NPR-A IAP EISs (BLM 2004; BLM 2012) have already evaluated the proposed GMT1 project (formerly referred to as CD6), this section is tiered off of those documents and focuses on information that is new, updated, or not included in the previous EISs. Information for this section relies on the ADNR Office of History and Archaeology (OHA) Alaska Heritage Resources Survey (AHRS) database (ADNR OHA 2013), the NSB Traditional Land Use Inventory (TLUI) (NSB, Iñupiat History, Language, and Culture Division [IHLC] 2013a), and relevant cultural resources literature (e.g., oral histories, gray literature, academic journals).

3.4.5.2 Study Area

The study area for cultural resources includes all areas where the project may directly or indirectly impact cultural resources (Figure 3.4-14). The direct impact analysis area (e.g., ground-disturbing activities) is limited to the footprint of GMT1 project components. The indirect impacts analysis area (e.g., increased access, erosion) consists of the project study area (i.e., 2.5-mile buffer surrounding the proposed GMT1 project footprint). The visual and noise impacts analysis area is a 5-mile buffer encompassing the proposed GMT1 project footprint. The buffer for visual and noise impacts are based on BLM (2012, §§ 3.4.7 and 4.3.19) and (BLM 2004, § 3.2.3.3 and 4A.2.3.3). BLM (2012, p. 3-161) visual analysis identifies 5 miles as the distance in which management activities might be viewed in detail, and BLM (2004, pp 505-506) noise analysis states that minor noise impacts would occur to Nuiqsut residents at a distance of 5 miles from project construction and drilling. Activities that can be heard or viewed in detail (i.e., those less than 5 miles) may affect the setting, feeling, and/or association of cultural resources within the surrounding environment.

3.4.5.3 Ancestral Cultures

This section summarizes the history of ancestral cultures of the region and project study area. For a detailed discussion of the regional and project study area culture history, refer to BLM (2004, § 3.4.5.2) and BLM (2012, § 3.4.2). The earliest evidence for human occupation of the North Slope dates to the late Pleistocene and early Holocene around 14,000 years ago and belongs to the Paleoindian or Paleo-Arctic traditions[4] (Table 3.4-13). These populations were among the earliest migrants into North America from Siberia. As the Holocene era progressed, cultural changes that occurred in the region included the initial appearance of the Northern Archaic tradition at around 7,500 years ago. Archaeological evidence for the Northern Archaic tradition exists throughout the Arctic Foothills, Arctic Mountains, and ACP. The Arctic Small Tool tradition (ASTt) developed on the central Seward Peninsula and spread eastward across the Alaskan Arctic and beyond. ASTt includes the cultures of Denbigh Flint Complex, Choris, Norton, and Ipiutak (Kunz et al 2003). Approximately 1,600 years ago, evidence of whaling using boats appeared with the Birnirk culture. The Thule culture emerged about 1,000 years ago and is evident in archaeological sites across the North Slope region, as well as most Arctic areas. The Thule people are the direct ancestors of the North Slope Iñupiat who continue to live throughout the region.

[4] Tradition is defined as “a (primarily) temporal continuity represented by persistent configurations in single technologies or other systems of related forms” (Willey and Phillips 1958: 37).

Table 3.4-13. Ancestral Cultures of the NPR-A

Cultural Tradition/Age	Environment/Subsistence	Artifacts/Tools
Paleoindian Mesa and Sluiceway Complexes, Raven Bluff Assemblage 13,700–11,800 years ago	Land bridge connects Siberia and Alaska; drier and cooler than now; grassland, steppe prairie—mammoth, bison, muskox, caribou, moose, lion, short-faced bear	Bifacial, edge-ground fluted and unfluted lanceolate projectile points; bifacial knives; multi-spurred gravers; microblades w/Raven Bluff?
American Paleoarctic 10,300–7,500 years ago	Climate becomes warmer and wetter; tundra replaces grass; land bridge subsides; mammoth and bison gone	Microblade technology; burins; bifacial projectile points and knives
Northern Archaic 7,500–3,000 years ago	Annual temperatures similar or a bit warmer than 20th century average; dependence on big game primarily caribou, no evidence of marine exploitation	Microblade technology; notched and stemmed bifacial projectile points and knives; large scrapers
Denbigh Flint Complex 5,000–2,400 years ago (beginning of Eskimo cultural tradition)	Climate cooled slightly, drier than preceding period; caribou is primary subsistence animal; first evidence of sea mammal hunting; orientation more toward terrestrial than marine resources	Microblade technology; burins; diminutive side and end blades; flake knives; discoids; composite tools; semi-subterranean houses
Choris 3,800–2,200 years ago	Climate same as during the Denbigh Flint Complex period; caribou is primary subsistence animal, but there is increased emphasis on the hunting of sea mammals, primarily seals; most known sites are coastal; orientation slightly more toward terrestrial than marine resources	Burins; large bifacial projectile points; pottery; ground stone; bone, antler and ivory implements; semi-subterranean houses
Norton 2,600–1,800 years ago	Climate same as during the Denbigh Flint Complex period; caribou is primary subsistence animal, although seal hunting is an important aspect of the economy; generally more oriented toward terrestrial than marine resources	Pentagonal projectile points; end and side blades; flake knives; discoids; ground stone; pottery; composite tools; antler, bone and ivory implements; semi-subterranean houses
Ipiutak 1,800–1,200 years ago	Climate slightly warmer and wetter than preceding 3,000 years; marine and terrestrial resources equally exploited; more emphasis on sea mammal hunting than previously	End and side blades; flake knives; discoids; no pottery or ground stone; composite tools; intricate ornamental ivory carvings; burials; semi-subterranean houses
Birnirk 1,600–1,000 years ago	Climate same as during Ipiutak period; coastal resources exploited more than terrestrial; more emphasis on sea mammal hunting than previously; watercraft based open water whaling begins	End and side blades; ground slate tools; ivory and antler harpoon heads; composite tools; pottery; semi-subterranean houses
Thule 1,000–400 years ago	The climate cools about the middle of this period; almost exclusively a marine orientation; whaling technology at its prehistoric peak; caribou remains an important part of subsistence economy	End and side blades; ground slate tools; ivory and antler harpoon heads; composite tools; dragfloat; pottery, semi-subterranean houses
Late Prehistoric Eskimo 700–400 years ago	During most of this period the average annual temperature is cooler than previous 1,000 years; primarily a terrestrial subsistence economy centered around caribou; some exploitation of coastal ecosystem	End and side blades; long-stemmed projectile points; pottery, bone, antler, ivory implements; ground stone, semi-subterranean houses
Nunamiut 400 years ago–Historic	Warming begins about 150 years ago; exploitation of inland ecosystem centered on caribou; dramatic shift in aspects of subsistence economy after Euro-American contact about 125 years ago	Bifacial stone projectile points; bone and antler projectile points; metal projectile points; firearms; sod houses; Euro-American items after 1875

Reproduced from BLM 2012, § 3.4.2, Table 3-24

3.4.5.4 Overview of Regional History

This section summarizes the history of the region and project study area. For a detailed discussion of the regional and project study area culture history, refer to BLM (2004, § 3.4.5.3). Table 3.4-14 provides a synopsis of the regional history. Initial contact between North Slope Iñupiat and Europeans occurred early in the nineteenth century with exploration of the Arctic. Contact between the Iñupiat and non-Iñupiaq people dramatically increased with commercial whaling beginning in 1848. The importance of commercial whaling decreased in the early twentieth century and the influence of other Western activities on Iñupiaq culture increased. Trapping and trading, reindeer herding, missionary work, geological and ethnographic research, and oil and gas development all began near the end of the nineteenth century and beginning of twentieth century, some of which continue today.

Table 3.4-14. Regional History Synopsis

Time Frame	Historic Theme	Synopsis
1820s-1880s	European/Euro-American Exploration	Begins when Captain F.W. Beechey and Sir John Franklin attempted a rendezvous at Point Barrow Ship crews during this period interact with coastal Iñupiat and document landscape, Iñupiaq people and culture, and name geographic features Ends with the failed second Franklin Expedition rescue missions
1840s-1900s	Commercial Whaling	Begins when the first commercial whaling vessel passes through the Bering Strait to the Arctic Commercial whalers slaughter Arctic whale and walrus populations, introduce venereal disease and epidemics that decimate Iñupiaq population, disrupt indigenous trade networks, establish on-shore whaling stations, and provide an influx of trade goods Ends when commodities traditionally made from whale oil and baleen lose economic viability to similar products made from petroleum products and other materials (e.g., oil, corsets)
1880s-Present	Ethnographic and Anthropological Research	Begins with U.S. Army Signal Corps establishing a camp in Barrow to document Iñupiaq culture and other scientific pursuits as part of the first International Polar Expedition Researchers examine Iñupiaq life and cultural objects, Iñupiaq physical and cultural adaptations for Arctic survival, effects of resource development and cash economy on Iñupiaq culture Continues today as part of Iñupiaq cultural revival, academic research, and state and federal permitting process
1880s-Present	Military	Begins when the U.S. Army Signal Corps sets up a scientific station at Pt. Barrow U.S. Army and Navy personnel explore major North Slope rivers documenting ethnographic, geographic, and travel route information; the military conducts oil and gas exploration of the NPR-A; the Cold War spurs the U.S. military to establish the Distant Early Warning (DEW) line in the 1950s to detect Soviet long-range bombers; end of the Cold War leads to the demobilization and removal of DEW line sites across Alaska Continues today with increased presence of the U.S. Coast Guard patrolling the Beaufort and Chukchi seas
1890s-Present	Christian Missionaries	Begins with Sheldon Jackson's arrival and becoming head of education Missionaries convert Iñupiat to Christianity, build schools and hospitals, help manage reindeer herds, pressure Iñupiat to abandon traditional cultural practices; missionaries eventually singularize efforts to spreading Christianity Continues today as missionaries seek new converts and multiple denominations continue to establish in North Slope communities

Table 3.4-14. Regional History Synopsis (Continued)

Time Frame	Historic Theme	Synopsis
1890s-Present	Reindeer Herding	Begins when Sheldon Jackson introduces reindeer herding to the Arctic to provide a stable food source Incompatibility of reindeer herding with Iñupiaq subsistence practices, competition between Iñupiat and non-Natives, problem-plagued governmental regulations, the checker-boarding of landownership, and lack of communication between government and academic research and herders contribute to steady decline of reindeer herding on the North Slope (Stern et al. 1980) Continues today in some areas of Alaska, but in a greatly reduced form than in the first half of the twentieth century
1890s-1970s	Centralization of Communities	Begins with schools, post offices, trading posts, and reindeer stations altering Iñupiat settlement patterns through centralization into permanent communities Kaktovik permanently settled following establishment of trading post by Tom Gordon in 1923 Anaktuvuk Pass established in 1949 following formation of regular air service, postal office, and a school Ends with Nuiqsut, Point Lay, and Atqasuk reestablished as permanent communities in the 1970s following passage of ANCSA.
1900s-1930s	Trapping and Trading Posts	Begins with decline in whaling and rising importance of furs as an economic driver Former whalers such as Charles Brower and Tom Gordon establish trading posts at Barter Island and Demarcation Point Trading posts, combined with dramatic decreases in the caribou and Iñupiat populations, lure the remaining inland Iñupiat to settle in coastal settlements Ends when the Great Depression lessens the demand for furs
1900s-Present	Geologic Exploration and Oil and Gas Development	Begins with Schrader and Peters (1904) and Leffingwell (1919) geologic surveys of the Brooks Range and Canning and Colville Rivers Early geological exploration leads the way to the creation of the NPR-A; governmental oil and gas exploration NPR-A eventually leads to private industry investigating areas of the ACP, which leads to the discovery of Prudhoe Bay and construction of the Trans-Alaska Pipeline and Dalton Highway Exploration continues today with the GMT1 project and other projects across the North Slope
1930s-Present	Tourism	Begins with the advent of airplanes and several well-known aviators traveling to Barrow including Charles Lindbergh and Wiley Post in the early 1930s Continues today in Barrow and other North Slope communities as well as remote areas of the North Slope for hiking, sightseeing, boating, polar bear viewing, and other tourist activities

3.4.5.5 Community History

The village of Nuiqsut is an Iñupiaq community located approximately 13 miles southeast of the proposed GMT1 drill pad. As of 2010, Nuiqsut had 402 residents (U.S. Census Bureau 2011). An early location associated with Nuiqsut, although not a year-round settlement is *Niġliq*. *Niġliq* was a traditional ancestral gathering place near the mouth of the *Niġliq* Channel of the *Kuukpik* (Colville River). Here, inland and coastal Iñupiaq societies came together to celebrate, trade, and intermarry amongst themselves and with Athabascans who formally inhabited areas of the ACP and Brooks Range (Burch 1979). *Nuiqsutpiat*, the first year-round settlement location of the Nuiqsut community, is on *Nuekshat* Island in the main channel of the *Kuukpik* and was abandoned in the 1930s (Hoffman et al. 1978). *Niglinaat*, the second year-round settlement was established in the 1930s and is on an unnamed island just north of *Nuekshat* Island with residents leaving in the 1940s due to compulsory education in addition to job opportunities in larger settlements such as Barrow (Hoffman et al. 1978). In 1973, 27 Iñupiaq families resettled the community to its fourth and current location on the *Niġliq* Channel of the *Kuukpik*.

3.4.5.6 Cultural Resources in the Project Study Area

This section provides details on the types and numbers of cultural resources in the proposed GMT1 Project study area using existing, new, and updated data, as well as previously available information not included in BLM (2004; 2012). In addition to the AHRS and TLUI databases, the cultural resources described in this section include cultural resources documented in other sources, including traditional camps, cabins, trails, travel routes, and subsistence use areas. These cultural resources are included in the Nuiqsut Cultural Landscape that was documented by Brown (1979) and recently updated with new information as part of the research for the Foothills West Transportation Access Project (SRB&A 2013a). Each of the individual cultural resources described in this section are also contributing characteristics to the Nuiqsut Cultural Landscape.

The AHRS and TLUI databases are the primary repositories for cultural resource site information on the North Slope. The OHA maintains the AHRS database, an inventory of reported historic and prehistoric sites within the State of Alaska (ADNR, OHA 2013). The AHRS database includes objects, structures, buildings, sites, districts, and travel ways, with the general, but not absolute, provision that they are over 50 years old. The AHRS is primarily a geographic information system (GIS) database. The AHRS provides a broad overview of documented resources. In regards to adequacy, most of the data in the AHRS were compiled before precise mapping methods, involving global positioning system (GPS) locations, were available so locations and extents of cultural resources are often imprecise. Additionally, archaeological reports rarely address cultural resources that are non-artifactual, such as traditional cultural properties and cultural landscapes. Despite the limitations, the AHRS files, including the GIS and map-based data, archived documents, and reports, represent the best available information for archaeological and historic site locations and extents for the project study area.

The IHLC created the TLUI database to document place names, landmarks, traditional land use sites, travel routes, and important locations remembered by the Iñupiat. The inventory is designed to perpetuate this knowledge and protect these sites from disturbance or destruction due to development activities on the North Slope. The IHLC continues to update the TLUI database and documents continued use of Iñupiaq cultural properties, which reflects the continuity of use of historic and prehistoric sites by contemporary people. The TLUI database represents the best effort at integrating history, oral history and archaeology to understand the

late prehistoric and historic period use of lands by the Iñupiat. In total, 13 AHRS and 13 TLUI sites are located within the impact analysis areas. Six of the 13 AHRS sites match the descriptions of corresponding TLUI sites. These sites include several grave sites; multiple historic settlements or camps that include sod houses, caches, ice cellars, and historic artifacts; and a site consisting of caribou bones with evidence of butchering.

In addition to the AHRS and TLUI databases, a number of sources have documented cultural resource sites through various research methods including field surveys, oral histories, and subsistence mapping interviews. Limitations of these data are that they may include duplicate features documented within or by other similar studies. Due to time constraints, differences in data collection methods, and location discrepancies, efforts were not made to reconcile duplicate features within and between data sources, and counts of these features are not included in the environmental consequences analysis. However, these sources provide additional details and context regarding cultural resource sites in the project study area that are not available in the AHRS and TLUI databases, and the cultural landscape as a whole is addressed in the environmental consequences analysis. Place names were not included unless they were associated with a site. The following is a list of these sources and brief description of the types of information they documented:

- ASRC and AEIDC (1975) – the Native Land Use and Place Name Map of Arctic Alaska provides Iñupiat land use locations, trails, and routes;
- Amsden (1977) – dissertation on inland Iñupiaq historic settlement patterns, recorded camps, and other localities;
- SRB&A (2011b) – data collected during interviews with Anaktuvuk Pass residents related to the Foothills West Transportation Access Project. Data include areas of cultural importance, historic camps, and cabins;
- SRB&A (2010a) – data collected during subsistence mapping interviews in Nuiqsut for the 1995-2006 time period. Data include historic camps, cabins, travel routes, and trails;
- Selkregg (1975) – profile of Alaska's Arctic region. Data includes historic trade routes in the region; and
- Aboriginal Trade Routes documented in the *Nuiqsut Paisanich* (Brown 1979).

Table 3.4-15 presents a list and description of the various types of cultural resources documented from the above sources. These sites include historic camping locations, cabins, and travel routes, in addition to, historic sod house remains, grave sites, drying rack locations, and storage cellars.

Table 3.4-15. Additional Cultural Resources Documented within the Project Study Area

Site # (Source)	Time Period	Site Type/ Description	Direct (Project Footprint)	Indirect (2.5 mile buffer)	Visual/ Noise (5 mile buffer)
114 (Amsden 1977)	Historic	Site Name: *Tuigaurak.* Amsden (1977) documented two occupations of this camping location by Anaktuvuk Pass residents prior to 1969. The site is few miles upriver form the Colville Delta.			X
116 (Amsden 1977)	Historic	Site Name: *Neglik.* Amsden (1977) documented nine occupations of this camping location by Anaktuvuk Pass residents prior to 1969.			X
AKP CBN 10-01 (SRB&A 2011b)	Historic	"[I was born] a long time ago. 1934 on Colville River, outside of Nuiqsut. July 4. ...Sod house…1934 until 1939, we come down here [to Anaktuvuk Pass area]. I was this tall. It was a long time ago. "			X
NUI CMP 04-01 (SRB&A 2010a)	Historic and contemporary Iñupiat	*Remnagak*, the place name for the camp location was described as a seasonal fish camp from the old days. Possibly from the 1920s-1950s.			X
NUI TRV 05-29 (SRB&A 2010a)	Historic and contemporary Iñupiat	"In wintertime we've got a trail, the old cat train trail. [The trail goes] between Itkillik [River] and Anaktuvuk [River].... An old trail from back in the 1930s and 1940s. "		X	X
Brown 1979	Historic	The aboriginal trade route parallels the Colville River from the confluence of the Colville and Killik Rivers to the coast. Along the coast the trail runs from Tangent Point to Nechelik Channel.		X	X
Brown 1979	Historic	This aboriginal trade route follows the easternmost channel of the Colville River from the coast to just south of the confluence with the Nechelik Channel. On the coast the trail extends from the easternmost Channel of the Colville River to Tigvariak Island.		X	X
ASRC and AEIDC 1975	Historic	Drying Rack Places			X
ASRC and AEIDC 1975	Historic	Storage Cellars		X	X
ASRC and AEIDC 1975	Historic	Storage Cellars		X	X
ASRC and AEIDC 1975	Historic	Boat Launching or Carrying Places			X
ASRC and AEIDC 1975	Historic	Boat Launching or Carrying Places		X	X
ASRC and AEIDC 1975	Historic	Boat Launching or Carrying Places		X	X
ASRC and AEIDC 1975	Historic	Dump Sites		X	X
ASRC and AEIDC 1975	Historic	Winter and Summer Water		X	X
ASRC and AEIDC 1975	Historic	Ruined Cabins - Driftwood and Sod Still Remain			X
ASRC and AEIDC 1975	Historic	Ruined Cabins - Driftwood and Sod Still Remain		X	X
ASRC and AEIDC 1975	Historic	Old Graves			X
ASRC and AEIDC 1975	Historic	Drying Rack Places		X	X
ASRC and AEIDC 1975	Historic	Drying Rack Places			X
ASRC and AEIDC 1975	Historic	Drying Rack Places			X
ASRC and AEIDC 1975	Historic	Ruined Cabins - Driftwood and Sod Still Remain			X

Table 3.4-16. Additional Cultural Resources Documented within the Project Study Area (Continued)

Site # (Source)	Time Period	Site Type/ Description	Direct (Project Footprint)	Indirect (2.5 mile buffer)	Visual/ Noise (5 mile buffer)
ASRC and AEIDC 1975	Historic	Ruined Cabins - Driftwood and Sod Still Remain		X	X
ASRC and AEIDC 1975	Historic	Ruined Cabins - Driftwood and Sod Still Remain		X	X
ASRC and AEIDC 1975	Historic	Ruined Cabins - Driftwood and Sod Still Remain			X
ASRC and AEIDC 1975	Historic	[Winter travel route from Kaktovik to Point Hope accessed by snowmachine or dog team]		X	X
ASRC and AEIDC 1975	Historic	[Winter travel route following the Colville River from the Brooks Range to coastal winter trail from Point Hope to Kaktovik]		X	X
Selkregg 1975	Historic	The trail follows the Colville River from the confluence of the Colville and Killik Rivers to the coast where the trail turns east and follows the coast just beyond Oliktok Pt.		X	X

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Nuiqsut Cultural Landscape

According to the *Guide to Cultural Landscape Reports*, cultural landscapes are "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or that exhibit other cultural or aesthetic values" (Page, Gilbert, Dolan 1998:12). The Nuiqsut Cultural Landscape, reported by the Iñupiaq village of Nuiqsut and documented by Brown (1979), is a cultural resource that encompasses the proposed GMT1 project study area and was not included in the 2004 ASDP or 2012 NPR-A IAP/ EIS. During the late 1970s, Brown (1979, 2001) worked with the village of Nuiqsut to document this landscape described as an "approximation of their core ideas" and representing their "geographic and spiritual homeland." According to Brown (1979), the Nuiqsut cultural landscape has multiple defining characteristics. These characteristics include (Brown 1979:9):

- an area of historical extended use;
- aboriginal trade routes;
- TLUI sites; and
- an area of current (e.g., 1970s) intensive subsistence use.

Regarding the importance of this cultural landscape, Brown (1979:12) stated:

> *The Nuiqsut cultural landscape is the territory established by ancestors and passed-on by today's families to those of tomorrow. It is a complicated geography that can be shown on a map only if the boundary is a shifting horizon. It is a composite of places and events that people have directly experienced or heard about in songs and stories passed down through generations. Here, in this landscape - recalled in memory culture - is the history, the knowledge, the spirit of thousands of years of Inupiat experience.*

SRB&A (2013a)[5] reviewed the Nuiqsut Paisanich Cultural Landscape to incorporate new information that contributes to the cultural landscape since Brown's 1979 work. SRB&A (2013a) assessed these characteristics using current documentation standards for cultural landscapes reported in Page, Gilbert, and Dolan (1998). SRB&A chose the following document standards terminology as the equivalent of Brown's landscape characteristics:

- Land Use;
- Circulation;
- Archaeological Sites and Places Associated with Cultural Beliefs or Practices (i.e., Cultural Sites); and
- Cultural Traditions.

[5] SRB&A's (2013a) analysis included data (i.e., trails, travel/trade routes, traditional use areas) from the community of Anaktuvuk Pass because of the cultural relationship between the two communities and overlap of the two communities' traditional use areas in the interior Arctic Coastal Plain and Foothills. However, the cultural resources analysis for the proposed GMT1 project does not include the Anaktuvuk Pass data because they are not a study community for this project.

SRB&A (2013a) also added "Natural Systems and Features" as they are integral in defining the other landscape characteristics.

Land use includes both historic territories and historic use areas. Circulation features show the historical continuity of movement throughout the landscape by the Iñupiat. Cultural sites consist of locations defined by one or more of the following descriptors: archaeological, ancestral, historic, traditional, sacred, camp, cabin, birthplace, harvest, and subsistence. In addition to artifacts, oral histories, subsistence interviews, and ethnographic narratives, Iñupiaq place names demonstrate cultural ties to these specific locations. Cultural traditions such as subsistence, passing of traditional knowledge, trade, and oral histories/storytelling that occur across the landscape are just as integral to community identity as are the locations in which they take place. Natural systems and features (e.g., rivers, bluffs, pingos, wildlife) provide the setting in which cultural activities take place and heavily influence the characteristics of a cultural landscape.

The geographic extent of the cultural landscape is based on the "Historical Extended Use" area documented by Brown (1979) (Figure 3.4-16). Cultural sites are identified in Table 3.4-15 and Table 3.4-16 in addition to historic and traditional trails, travel/trade routes, and subsistence use areas.

The cultural resources that comprise the Nuiqsut Cultural Landscape are primarily located along river corridors, particularly Colville River, Itkillik River, and Fish Creek; in an overland area extending west of the community to Fish Creek and beyond to Teshekpuk Lake, and in coastal locations both west and east of the community.

Figure 3.4-17 focuses on the proposed GMT1 Project study area and the Nuiqsut Cultural Landscape characteristics. As shown in the figure, several important components of the Nuiqsut Cultural Landscape are located within the project study area. These include trails or travel routes extending north and east from the community along Nigliq Channel and Colville River and various sites located along those overland trails and surrounding the Nigliq Channel and Fish Creek. Many of the Iñupiaq cultural sites, trails, travel/trade routes, and other cultural features within the landscape are associated with ongoing multi-generational customary practices that generally occur in similar locations as past historic or traditional practices. The continuation of these customary practices into current times and at modern sites within the landscape help maintains the Iñupiaq cultural identity and ties to the cultural landscape.

3.4.6 Land Use

Land Use is governed by a series of laws, regulations, and authorizations that apply to the NPR-A and the proposed GMT1 project. The numerous NPR-A IAPs with their associated management tools, alternatives evaluation and mitigating measures, seek a balance between energy development and environmental protection. The key elements controlling land use are:

- Naval Petroleum Reserve Production Act of 1976;
- 43 CFR 2361;
- Surface and subsurface ownerships;
- Stipulations in federal oil and gas leases;
- IAPs established by BLM for the NPR-A;
- Land Use Plans established by the North Slope Borough;

- Critical Habitats and Threatened and Endangered Species designated under the Endangered Species Act;
- Wetlands; and
- Section 106 of the National Historic Preservation Act.

Land ownership in the project study area is both complex and evolving. As explained in the BLM (2004), BLM continues to manage with selections and land ownership options made under the provisions of the ANCSA and ANILCA. The result is a transfer of ownership and management by BLM as part of the NPR-A to private ownerships by the Village and Regional Corporations established by ANCSA.

What has changed since BLM (2004) is the amount of federal land selected and conveyed to the respective village and regional Native corporations. In February 2010, 17,288 acres of land in the vicinity of the proposed GMT1 and CD5 drill pads were conveyed under ANCSA to Kuukpik Corporation (surface) and ASRC (subsurface). Due to that conveyance, land ownership in the GMT1 and CD5 project areas is now mixed, with BLM and Kuukpik owning and managing different portions of the surface of the lands involved, and BLM and ARSC owning and managing different portions of the subsurface mineral estate. Land ownership in the project area is presented in Map 1.1-1.

Federal oil and gas leases, permits or rights of way on selected lands remain under BLM management until the land is transferred. Administration of federal oil and gas leases (subsurface) is waived when the effected subsurface is transferred. Lease stipulations continue to apply to the lessee on conveyed lands; however, only ASRC (as the new lessor) may enforce the lease stipulations on the conveyed lands; BLM no longer has jurisdiction to do so. The mix of land ownership and administration make land use in the project area more complex. See Section 1.1 Project Location and Land Status above for more discussion regarding land ownership.

3.4.7 Recreation

The recreation resources of the project study area are described in BLM (2004, § 3.4.7). BLM noted little specific recreation trends in the area. Public access to the project area in 2004 was limited to those who used aircraft to the Nuiqsut Airport or by local residents using snowmachine or all-terrain vehicle (ATV) for cross country travel. There are no federal, state, or NSB recreational developments or facilities. BLM considers the remote project study area to be well suited for non-winter outdoor recreation such as backpacking float boating, fishing, hunting, wildlife viewing, and birding. BLM managed lands outside of the boundaries of the NPR-A use a "Recreation Opportunity Spectrum" (ROS) to identify recreation resources. However, as a petroleum reserve this is not applicable to the project area and a class has not been designated. If a class were assigned, it was noted in 2004 that it would be "semi-primitive, motorized" (SPM), e.g. the recreation opportunities are characterized as located in a predominately natural or natural-appearing landscape, that has a feeling of remoteness, few user facilities, low road density, and where visitors have infrequent interaction with other visitors. Most recreation uses at that time were directly associated with the Colville River. BLM estimated there were 150 recreation users annually to the project study area with little during the winter (BLM 2004, § 3.4.7, pp.352 and 353).

BLM (2008, § 3.4.6) addresses the reaction and wilderness characteristics of the entire 4.6 million acre Northeast NRP-A Planning Area. That discussion confirmed the 2004 observations that there is little recreation use of the area other than that associated with the upper Colville

River and to a lesser extent the Colville River between Umiat and Nuiqsut. No data specifically relevant to the study area considered in the SEIS were provided.

BLM (2012, § 3.4.6) notes the outdoor recreation resources of the roughly 22.8 million acre NPR-A remain underused as result of the small resident population, costly access, and lack of facilities. No new data were provided that are specifically relevant to the study area considered in the SEIS.

3.4.7.1 Wild and Scenic Rivers

There are no designated or proposed Wild and Scenic Rivers located within the project study area (BLM 2012, Map 3.4.7-1).

3.4.7.2 Wilderness

Only federal ownerships are eligible for Federal Wilderness designation. The BLM (2012, § 3.4.8) describes the wilderness characteristics/values associated federal lands within the entire 22.8 million acre NPR-A. BLM is required to manage all lands recommended for wilderness designation "in accordance with the applicable land use plans and applicable provisions of law" (BLM 2012, § 1.5.1, p. 6).

The project study area is:

- Not located within or near any federally designated Wilderness area; and
- Not located within or near any federal lands previously recommended for Wilderness designation.

BLM concluded that most federal lands further than 5 miles from local communities offer the wilderness characteristics of solitude, opportunities for primitive and unconfined recreation, and that are for the most part natural (BLM 2012, § 3.4.8, p. 451). Wilderness Evaluation Area NPR-A H (Map 3.4.8-1) includes federal lands located in the drainages flowing into the Colville River from the vicinity of Umiat to the vicinity of Nuiqsut. The western parts of the Alpine Field with its associated production facilities are located in the northeastern most of this Wilderness Evaluation Unit.

BLM established a series of planning criteria that includes a determination that the planning effort will not "consider recommendations for legislation to allow...wilderness designation in NPR-A" (BLM 2012, § 1.5.2, p. 7). However, the BLM (2013, p. 22) noted that for the benefit of caribou it would not issue oil and gas leases in the southwestern NPR-A and even though wilderness characteristics was not the justification, it would also provide protection for important wilderness character of that area. The project study area is in an area with existing valid federal oil and gas leases. The ROD did not make any recommendations that existing oil and gas leases be cancelled or other wised modified because of wilderness values/character in the project study area.

BLM (2012, § 2.4.1, p.35) notes the planning effort may identify and/or make recommendations regarding possible areas appropriate for Wilderness designation independent of the planning effort. There are no new data on the wilderness values associated with study project study area since completion of the ROD (BLM 2013).

3.4.8 Visual Resources

The visual resources inventory of the project study area was described in BLM (2004, § 3.4.8) BLM (2012, § 3.4.9) describes the visual resources of the entirety of the NPR-A in terms of scenic quality, visual sensitivity, and distance zones. The current VRM Classes of the NPR-A were assigned in BLM (2013). There has been no new data since the ROD was signed in 2013. The Visual Resource Management (VRM) system provides a way used by the BLM to analyze potential visual impacts and an opportunity to apply visual design techniques to ensure that any surface-disturbing activities are compatible with the surroundings. The VRM classification system applies only to federal land managed by the BLM and to lands selected but not yet transferred from federal ownership. Although the BLM cannot apply stipulations to non-BLM ownerships, all ownerships outside of villages were included in the VRM Classes and are considered in this SEIS. The project area falls within VRM Class IV with the exception of about 10 acres at the southern most point, which was classified as VRM Class III. Management of visual resources on BLM ownerships are guided by the following objectives:

Class III Objectives

- Partially retain the existing character of the landscape
- Level of change to the landscape can be moderate
- Management activities may attract attention, but should not dominate the view of the casual observer
- Change should repeat the basic elements found in the natural landscape (form, line, color and texture)

Class IV Objectives

- Provide for activities that require major modification of the landscape
- Level of change to the landscape can be high
- Management activities may dominate the view and be the major focus of attention
- Minimize impacts through location and design by repeating form, line, color and texture

Visual modifications in the project study area include the existing oil and gas infrastructure associated with the Alpine Field with buildings, pipelines, a private airfield supporting oil and gas development, and roads. The community of Nuiqsut also has substantial modifications to the visual resources from the homes, businesses, internal community roads, and roads to the dump and the water supply lake, and a public airport. In addition a proposal to construct a spur road connecting Nuiqsut to the existing roads in the Alpine Field and a road to a proposed boat launch on the Colville River are in the permitting process that if approved will further expand modifications to the existing visual resources. It should be noted that the existing or pending modifications to the visual resources associated with Nuiqsut (including a new spur road or road and boat launch on the Colville River) are all on land owned by Kuukpik and not subject to the BLM VRM management objectives described above.

Oil and gas activities considered in the GMTU include winter exploratory drilling from ice pads with primary access supported by ice roads and ice air strips, production facilities on gravel

pads, and elevated pipeline systems; all of which would change the existing undeveloped visual character of Federal land in the project study area but still be consistent with a VRM Class III and IV. The BLM (2004a) authorized the approval of the proposed GMT1 Project, and BLM (2013) assumes that GMTU and specifically the GMT 1 would be developed under the Stipulations, ROPs, and BMPs described in Section 4.7, *Mitigation Measures*. There has been little change in the existing or prospective use of the project study area for oil and gas or other uses that could impact visual resources of Federal land in the project study area that were not considered in BLM (2004; 2004a) and the subsequent authorizations for construction and operation of production facilities in the Alpine Field that were contemplated in 2004. The BLM (2012; 2013) considered the visual resources associated with: the development facilities constructed since 2004, and assumed the GMTU would be developed by both the GMT 1 Project and the conceptual GMT 2 Project. The proposed GMT 1 Project has only been slightly modified since 2004 (see Section 2.2, *Summary of Changes for 2004*).

3.4.9 Local Transportation

Transportation facilities were described in Section 3.4.9 of the 2004 ASDP EIS, with information updated in BLM (2012, § 3.4.10). In the local area surface transportation includes local roads in Alpine and Nuiqsut and seasonal ice and snow roads from the existing oil field gravel road system to Alpine, which typically includes a spur to Nuiqsut. BLM has authorized numerous ice roads and snow trails from Alpine and Kuparuk to exploration drilling sites in the NPR-A. BLM also issues ROWs for NPR-A area wide winter use for transport of items across the tundra with tundra-approved vehicles.

Residents of Nuiqsut use snowmachines and ORV for off-road travel. Air travel is supported by an airport at Nuiqsut and airstrip at Alpine. Helicopter use in the area is an area of concern for the people of Nuiqsut. All permitttees are required to report to BLM the number and location of take offs and landings at the end of the summer. A summary of projected aircraft traffic, including helicopter use, for all alternatives is presented in Table 2.4-3.

Nuiqsut has additional transportation systems for its village. Bulk supplies are occasionally delivered to the mouth of the Colville River by barge and larger cargo ships, and then moved upriver to Nuiqsut by smaller vessels. Local residents use small boats to access subsistence resources. An existing system of pipelines is associated with the Alpine oil field, including a pipeline spur to deliver natural gas to Nuiqsut.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential effects that could result from the selection of any of the GMT1 project alternatives presented in this SEIS, including the No Action Alternative. This chapter is organized by specific resources. Each resource section starts with a brief discussion of methodology and includes definitions for the impact assessment criteria. The potential direct and indirect impacts on the resources are discussed separately for the two primary phases of the project: 1) construction and 2) drilling and operation. The potential impacts are characterized and compared among the alternatives, followed by a summary of mitigation measures in place, including BLM Lease Stipulations and BMPs, and project design features. A conclusion discussion for each resource summarizes the nature of the potential impacts and comparison of the alternatives, followed by a brief statement of how climate change may affect the resource within context of the predicted impacts.

The analysis of cumulative effects of the alternatives follows the resource-specific discussions in Section 4.6, which considers other reasonably foreseeable activities in the region. Section 4.7 summarizes the mitigation measures applicable to the project, and the chapter concludes with discussion of unavoidable adverse impacts (Section 4.8), the relationship between local short term uses and long term productivity (Section 4.9), and irreversible and irretrievable commitment of resources associated with proposed development (Section 4.10).

4.1 Introduction

Comprehensive analyses of environmental consequences of development of the entire Alpine Field, including GMT1 as it was designed in 2004, were performed in the program-specific BLM (2004). Environmental consequences of anticipated oil and gas development in the NPR-A, also including GMT1, were analyzed in BLM (2012). The analyses of potential environmental consequences of the proposed GMT1 Project provided in this section are tiered to, and incorporate by reference these previous analyses, with specific references cited in the discussions in the following sections.

The alternatives carried forward through the following analysis are:

- Alternative A – Proposed Project
- Alternative B – Avoid Fish Creek Setback
- Alternative C – Alternate Access (via Nuiqsut)
- Alternative D – Limited Access
- Alternative E – No Action

Two gravel supply options were considered for each action alternative:

- Clover site
- ASRC Mine site

Some features (e.g., drill pad, road, pipeline, and valve pads) of Alternative A remain the same in the other action alternatives; some project components are different. Major project components of each alternative are summarized below in Table 4.1-1.

Table 4.1-1. Major Project Components of the Action Alternatives

Component	Alternative A Proposed Project	Alternative B Avoid Fish Creek Setback	Alternative C Alternative Access (via Nuiqsut)	Alternative D Limited Access
Drill pad	11.8 acre	11.8 acre	11.8 acre	15.7 acre
Road (GMT1 to CD5)	7.8 miles; 60 acre	8.6 miles; 62 acre	7.8 miles; 60 acre	0
Additional road access to Nuiqsut	0	0	5.8 miles (Nuiqsut Spur Rd upgrade); 16.6 acre	0
Bridge(s)	2 (Ublutuoch R. and Crea Creek)	1 (Ublutuoch R.)	2 (Tiŋmiaqsiġvik [Ublutuoch] River and Crea Creek)	0
Pipeline System GMT1 to CD5[a]	8.1 miles	8.9 miles	8.1 miles	8.1 miles
Water Injection Pipeline CD1 to CD5	3.3 miles; new VSMs 6.1 miles; CD5 VSMs	3.3 miles; new VSMs 6.1 miles; CD5 VSMs	3.3 miles; new VSMs 6.1 miles; CD5 VSMs	3.3 miles; new VSMs 6.1 miles; CD5 VSMs
Ancillary Pads (2), east and west	East and west valve pads = 0.7 acre	East and west valve pads = 0.7 acre + 0.7 acre (CD5 tie in pad) = 1.4 acre	East and west valve pads = 0.7 acre	East and west valve pads = 0.7 acre
Air Access Facilities [b]	0	0	Airstrip access road, staging pad; airstrip upgrade = 14.0 acre	46.4 acre (airstrip and apron) + 9.6 acre (airstrip access road) + 14.9 acre (occupied pad) = 70.9 acre
Ice roads	22 miles - Year 1 26 miles -Year 2	25.5 miles - Year 1 18 miles - Year 2	30.5 miles - Year 1 11 miles - Year 2	20 miles - Year 1 27 miles - Year 2 12 miles– Years 3-30
Total Fill	625,500 cubic yards	682,000 cubic yards	859,700 cubic yards	845,600 cubic yards
Total gravel Footprint	72.5 acres	75.2 acres	103.6 acres	87.3 acres
Total mine area [c]	18.7 acres	19.8 acres	25.0 acres	24.5 acres
TOTAL FOOTPRINT	91.2 acres	95.0 acres	128.6 acres	111.8 acres

[a] Produced fluids pipeline, miscible injectant (MI) pipeline, injection water pipeline, lean gas pipeline, and messenger cable, and space for 24-inch future pipeline. In all alternatives, the 14" injection water pipeline extends 3.3 miles from CD1 to CD4N on new VSMs and 6.1 miles from CD4N to CD5 on existing VSMs .

[b] This includes additional facilities required for access by air (e.g. airstrip; airstrip improvements; ancillary pads) in Alternatives C and D.

[c] Mine site use may vary with alternative gravel demand, as required (i.e., Clover, ASRC, or both). Proposed yield from an 18.7 acre Clover site is 626,000 cubic yards of gravel. Estimated yield from ASRC Mine Site, based on estimates of gravel within the permitted footprint, indicate that approximately 34, 500 cubic yards of gravel will impact 1 acre of surface area.

[d] Same pipelines footnoted in "a" above, with an additional 2-in diesel line and 2-in waterline from CD1 to GMT1 drillsite.

4.1.1 Impact Criteria

For this DSEIS, criteria were developed to guide the evaluation of impacts from the proposed GMT1 development. These criteria were based on recent NEPA analyses of oil and gas development on the North Slope and adjacent marine waters. The analyses considered in developing impact criteria were: Draft SEIS on the Effects of Oil and Gas Activities in the Arctic Ocean (NOAA 2013c), BLM (2012), Alaska Stand Alone Gas Pipeline (Corps 2012c), Point Thomson EIS (Corps 2012), as well as BLM (2004). The criteria used in this DSEIS are modeled after NOAA (2013c), but considered features of the other analyses.

Using the impact criteria as a guide, analysis of the impacts of GMT1 development are based on previous related NEPA analyses, best available new information, and best professional

judgment. The DSEIS considers both the nature and degree of expected impact as described below.

In this DSEIS, the nature of an impact is generally defined by the intensity or magnitude of the impact, the duration, the geographic extent, and the context of the resource as defined by the following:

Intensity

Low: A change in a resource condition is perceptible, but it does not noticeably alter the resource's function in the ecosystem or cultural context.

Medium: A change in a resource condition is measurable or observable, and an alteration to the resource's function in the ecosystem or cultural context is detectable.

High: A change in a resource condition is measurable or observable, and an alteration to the resource's function in the ecosystem or cultural context is clearly and consistently observable.

Duration

Temporary: Impacts would be intermittent, infrequent, and typically last less than a month.

Interim: Impacts would be frequent or extend for longer time periods (an entire project season).

Long-term: Impacts would cause a permanent change in the resource that would perpetuate even if the actions that caused the impacts were to cease.

Extent

Local: Impacts would be limited geographically (e.g., within the indirect impact zone, or within the SEIS project study area), depending upon the resource; impacts would not extend to a broad region or a broad sector of the population, such as the entire ACP.

Regional: Impacts would extend beyond a local area, potentially affecting resources or populations beyond the SEIS project study area (e.g., the entire ACP) depending upon the resource.

State-wide: Impacts would potentially extend beyond the SEIS project study area and region (e.g., ACP) to include the entire State of Alaska or other relevant, resource-specific geographic regions, depending upon the resource.

Context

Common: The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality and is not protected by legislation. The portion of the resource affected does not fill a distinctive ecosystem role within the locality or the region.

Important: The affected resource is protected by legislation (other than the ESA). The portion of the resource affected fills a distinctive ecosystem role (such as an important subsistence resource) within the locality or the region.

Unique: The affected resource is listed as threatened or endangered (or proposed for listing) under the ESA or is depleted either within the locality or the region. The portion of the resource affected fills a distinctive ecosystem role within the locality or the region.

Separate impact criteria tables were developed and used to guide the analysis of impacts for each of the resources discussed under the physical, biological, and social environments. The impact criteria tables use terms and relative thresholds that are quantified for some components and qualitative for other components. Summary impact levels were then determined using the following guidance:

- Negligible: Impacts are generally extremely low in intensity (often they cannot be measured or observed), are temporary, localized, and do not affect unique resources.
- Minor: Impacts tend to be low in intensity, of short duration, and limited extent, although common resources may experience more intense, longer-term impacts.
- Moderate: Impacts can be of any intensity or duration, although common resources may be affected by higher intensity, longer-term, or broader extent impacts while important and/or unique resources may be affected by medium or low intensity, shorter duration, local or regional impacts.
- Major: Impacts are generally medium or high intensity, long-term or permanent in duration, a regional or state-wide extent, or affect important or unique resources.

The potential impacts were analyzed by reviewing the Applicant's project description and mitigation measures, data collected by the Applicant, and other information provided by the Applicant. Previous publications and data collected within and near the project study area by state, federal and local agencies were also reviewed. The Applicant's information was verified by independently reviewing reference sources and previous publications on these resources. The information regarding existing conditions as presented in Section 3, Affected Environment, was assessed relative to the Applicant's proposed action and the other alternatives described in Chapter 2, Project Alternatives, to assess impacts.

4.1.2 BLM Protective Measures

BLM (2013) includes a number of protective measures that would be imposed on activities permitted by the BLM in the NPR-A. These protective measures are in the form of Lease Stipulations and BMPs, provided in Appendix H. As explained further in Section 4.7, Mitigation, stipulations are specific to oil and gas leases, and describes objectives for protection of certain resources and management of certain activities. BMPs apply to all activities in the NPR-A. Stipulations and BMPs also provide a basis for analyzing potential impacts of an activity (BLM 2012, § 2.3.5). Other agencies with permitting authority for the proposed project have protective measures and regulatory requirements as part of their permit processes, as described in Table 1.4-1.

4.1.3 Summary of Impacts for Alternatives

A summary of the potential impacts for all the alternatives is presented in Table 4.1-2, with the exception of potential spills impacts, which is a not considered a resource but instead a topic relevant to the impact analysis, and is presented without impact ratings. It is also noted that for a few of the resources, the individual resource impact analysis criteria were not available and the author used best professional judgment to determine the overall impact ratings.

Table 4.1-2. Summary of Impacts for the Alternatives

Element of the Environment	Intensity Low (L), Medium (M), High (H)[1]					Duration Temporary (T), Interim (I), Long-Term (L)					Extent Local (L), Regional (R), Statewide (S)					Context Common (C), Important (I), Unique (U)					Summary Negligible (N), Minor (M), Moderate (D), Major (J)				
Alternative:	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**	**A**	**B**	**C**	**D**	**E**
Geology and Physiography	H	H	H	H	--	L	L	L	L	--	**L**	L	L	L	--	C	C	C	C	--	M	M	M	M	N
Petroleum Geology	H	H	H	H	--	L	L	L	L	--	**R**	R	R	R	--	C	C	C	C	--	J	J	J	J	N
Soils and Permafrost	H	H	H	H	--	L	L	L	L	--	**L**	L	L	L	--	C	C	C	C	--	M	M	M	M	N
Sand and Gravel Resources	H	H	H	H	--	L	L	L	L	--	**L**	L	L	L	--	C	C	C	C	--	M	M	M	M	N
Paleontological Resources	H	H	H	H	--	L	L	L	L	--	**L**	L	L	L	--	C	C	C	C	--	M	M	M	M	N
Water Resources	L	L	L	L	--	L	L	L	L	--	**L**	L	L	L	--	I	I	I	I	--	M	M	M	M	N
Climate and Meteorology [2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N	N	N	N
Air Quality	M	M	M	H	--	I	I	I	I	--	**L**	L	L	L	--	I	I	I	I	--	D	D	D	J	N
Noise	M	M	M	H	--	T	T	T	T	--	**L**	L	L	R	--	I	I	I	U	--	M	M	M	D	N
Climate Change[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	N	N	N	N	N
Vegetation and Wetlands	M	L	M	L	--	I	I	I	I	--	**L**	L	L	L	--	I	I	I	I	--	D	M	D	M	N
Fish	M	M	M	M	--	L	L	L	I	--	**L**	L	L	L	--	I	I	I	I	--	M	M	M	M	N
Birds	L	L	L	L	--	L	L	L	L	--	**L**	L	L	R	--	I	I	I	I	--	M	M	M	M	N
Terrestrial Mammals	L	L	L	M	--	L	L	L	L	--	**L**	L	L	R	--	I	I	I	I	--	M	M	M	D	N
Threatened and Endangered	L	L	L	L	--	L	L	L	L	--	**L**	L	L	L	--	U	U	U	U	--	N	N	N	N	N
Socio-Cultural Resources	H	H	H	H	--	L	L	L	L	--	**R**	R	R	R	--	I	I	I	I	--	J	J	J	J	N
Economy[2]	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	M	M	M	M	N
Subsistence	H	H	H	H	--	L	L	L	L	--	**R**	R	R	R	--	I	I	I	I	--	J	J	J	J	N
Environmental Justice	H	H	H	H	--	L	L	L	L	--	**R**	R	R	R	--	U	U	U	U	--	J	J	J	J	N
Cultural Resources	M	M	M	M	--	I	I	I	I	--	**R**	R	R	R	--	I	I	I	I	--	D	D	D	D	N
Land Use and Ownership	M	M	M	M	--	L	L	L	L	--	**L**	L	L	L	--	C	C	C	C	--	D	D	D	D	N
Recreation	L	L	L	L	--	T	T	T	T	--	**L**	L	L	L	--	C	C	C	C	--	N	N	N	N	N
Visual Resources	M	M	M	M	--	L	L	L	L	--	**R**	R	R	R	--	C	C	C	C	--	M	M	M	M	N
Transportation Systems	M	M	M	M	--	L	L	L	L	--	**R**	R	R	R	--	C	C	C	C	--	M	M	M	D	N

"--" = Not applicable or not ranked. See Section 4.1.3.

[2] Only summary impact ratings are provided for these resources.

4.2 Physical Environment

The following discussion on environmental consequences on or by the physical environment is generally categorized and organized as it is in BLM (2004).

4.2.1 Terrestrial Resources

The action alternatives would result in impacts to the terrestrial environment during the construction and operation. These impacts are described in detail by BLM (2004, § 4F.2.1) and generally for the Northeast NPR-A (BLM 2008b, §§ 4.3.2 - 4.3.3) and the entire NPR-A (BLM 2012, § 4.3.2 - 4.3.3). The following discussion summarizes the impacts and is supplemented with information from the Point Thomson FEIS related to potential impacts to the terrestrial environment (Corps 2012, §§ 5.1 – 5.2).

The physiography (geomorphology), geology, paleontology, soils, and permafrost of the project study area are closely related and likely to be impacted by similar activities. The impact criteria for these resources are defined in Table 4.2-1, and each alternative has been evaluated to determine the impacts of project activity on each resource.

Table 4.2-1. Impact Criteria— Terrestrial Resources

Impact Category	Magnitude	Definition
Intensity	High	Adverse effects to physiographic, geological, or paleontological resources for which no mitigation is available. Adverse effects to soils or permafrost such that the resulting ground surface is below tundra grade and backfilling with overburden is required to prevent ponding and/or flow of water for restoration to be successful.
	Medium	Adverse effects to physiographic, geological, or paleontological resources that could be mitigated. Disturbance to soils or permafrost is such that revegetation by seeding or sodding with native tundra is required to prevent degradation of the thermal regime, erosion, or ponding or water flow for restoration to be successful.
	Low	Changes to physiographic, geological, or paleontological resource conditions with no adverse effect. The thermal regime is maintained and disturbance of vegetative cover such that successful site rehabilitation can be accomplished through natural recolonization.
Duration	Long-term	Impacts exceed the life of the project.
	Interim	Impacts last the life of the project.
	Temporary	Impacts last during a phase of the project.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality and is not protected by legislation.
Geographic Extent	Statewide	Extends beyond the project study area.
	Regional	Extends beyond project components but within project study area.
	Local	Within footprint of project components and extending up to 165 ft beyond the footprint of project components.

4.2.1.1 Construction

Impacts to terrestrial resources (physiography, geology, paleontology, soils, and permafrost) include direct effects of construction, including the installation of gravel pads, gravel roads, gravel airstrips, and pipeline supports (VSMs); excavation of material sites; and construction of ice roads and ice pads. The footprint of gravel fill for each action alternative is summarized in

Table 4.2-7. A summary of ice road construction and associated water use for the project alternatives is presented in Section 2.4.7.3 and Table 2.4-2. Impacts could also occur from spills and from removal of gravel pads and gravel roads during reclamation. These activities would impact soil productivity and could alter the moisture regime of tundra near the structure by changing natural drainage patterns and areas where snow accumulates (BLM 2012, § 4.3.3.2, p. 104).

Impacts to surface terrain would result from construction of roads, production pads, airstrips, and gravel mining. Impacts would be localized to the footprint of the facilities and gravel mine(s) and their immediate surroundings. Placement of gravel on the tundra for roads, production pads, and airstrips would directly affect physical characteristics such as thermal regime and hydrology.

The thermal regime of permafrost is the dominant control on soil formation and soil properties on the ACP. Problems associated with oil field development in the continuous permafrost zone stem from alteration of ground temperatures by construction and operation of oil production infrastructure. Destructive thermokarst often results where permafrost thawing occurs in ice-rich, fine-grained sediments (BLM 2004, § 4A.2.1.3, p. 416).

Gravel pads and roads would completely cover the natural soils within the project footprint and can cause their compaction. Landscape modification resulting from gravel mining, pipeline construction, digging, excavation, and placement of fill is particularly damaging in the Arctic because of the slow rate of soil formation. Soils in the project study area are subjected to cold and anoxic conditions that retard soil formation, allowing exposed mineral soil layers to persist for decades. In addition, any disturbance that removes the insulating surface organic layer or decreases the solar reflectance of the surface may result in differential thawing of the permafrost and cause thermokarst, subsidence, and increased potential for soil erosion and sedimentation (BLM 2012, § 4.3.3.2, p. 105).

Construction of ice roads and pads would have localized impacts on soils, which would usually be limited to compression of the tundra. A recent BLM study of ice road impacts found that the wetter the area (evaluated during summer), the less damage to insulating vegetation and soils from large-tired vehicles. Recovery from most minor impacts to vegetation would be expected within a few years. Long-term disturbance from ice pads, ice roads, ice airstrips, and snow trails would be negligible to the health of the soils and proper functioning of the landscape. Although some evidence of crushed tussocks may still be apparent, new growth would preclude any exposed soils or extensive changes in the active layer (BLM 2012, § 4.3.3.2, p. 107).

The material used for gravel fill could also impact soil near gravel structures. Saline material used as fill increases the salinity of water draining off of or leaching through the structure. Increased salinity at a site could alter the soil properties in the immediate vicinity of the gravel structure. Construction of gravel pads, roads, and airstrips could also result in indirect effects to soils by altering the moisture regime of tundra near the structure due to changing natural drainage patterns and areas where snow accumulates. Snowdrifts caused by gravel structures would increase the soil surface temperature in winter and increase thaw depth in the soil near the structures. Blockage of natural drainage patterns can lead to the formation of impoundments. The use of adequate cross-drainage structures in gravel roads and attention to the natural drainage patterns during design of developments could help reduce impacts to soils from impoundments.

Development of new gravel mine sites, including the proposed Clover site, would affect the existing tundra surface by requiring the complete removal of surface vegetation, and overburden and extraction of the underlying gravels. Depending on site-specific conditions, a large disturbance such as this could cause thawing of the permafrost around the mine site perimeter, which would create additional landform changes. Gravel mining could result in the creation of shallow or deep water habitats. If ponds are created, they would likely be much deeper than a typical North Slope lake, and as is normal under a water body that does not freeze completely during winter, thaw bulb formation likely would follow (BLM 2004, § 4A.2.1.1, p. 414).

Gravel mining outside of floodplains is preferable since it would not affect fish habitat. However, with the scarcity of gravel deposits in the NPR-A, the most likely sources are within streams and floodplains (BLM 2012, § 4.3.7.2, p. 152). Sand and gravel mining within stream channels and active floodplains can impact channel structure (e.g., upstream headcutting, downstream channel incision), increase turbidity and sedimentation, and cause shifts in invertebrate communities, which can degrade local fish habitat conditions and modify fish species suitability. Channel incision (i.e., bed lowering) can lead to subsequent channel widening (reducing pool habitat), contribute to further increases in sediment loads through streambed and streambank erosion, and cause landscape-level impacts by lowering base flow in tributaries. In one case study, channel incision from instream gravel mining exposed buried gas pipelines and bridge piers downstream (BLM 2012, § 4.3.7.2, p. 152).

The availability of gravel sediments used as fish spawning areas is limited within the ACP of the NPR-A and there may be an association between these sites and optimal gravel-extraction sites, increasing the probability that spawning grounds could be impacted. For example, the Clover site is within a small tributary of the Tiŋmiaqsiġvik (Ublutuoch) River. The narrow Tiŋmiaqsiġvik (Ublutuoch) River contains the only extensive reaches of gravel in the entire Fish Creek watershed, and is likely used for spawning by arctic grayling and other fish species. The Clover site is partially within the Tiŋmiaqsiġvik (Ublutuoch) River setback, located approximately 0.5 mile from the Tiŋmiaqsiġvik (Ublutuoch) River.

Upon abandonment, the Clover site would become a small lake (Appendix I Clover Mining and Rehab Plan). The Clover site is a likely location for the disposal of gravel if land management agencies require the removal of roads or production pads at other sites on the west side of the Nigliq Channel upon abandonment. Rehabilitation of floodplain gravel mines to create deep pools suitable for fish overwintering and spawning is well-documented around current North Slope oil developments (BLM 2012, § 4.3.7.2, p. 152). Site reclamation could potentially include constructing or enhancing connecting channels from surrounding streams and rivers.

Excavation of the gravel source would require removal of overlying soils and create long-term impacts to soil productivity in the footprint of gravel-extraction sites. Stockpiling of overburden mixes organic and mineral horizons with the parent material from below, which destroys all soil development and will likely not redevelop.

Pipeline construction would displace soil during installation of VSMs and would disturb a zone around the VSM that is approximately 20 inches wide. VSMs are installed in winter and spoils material is collected from the surface for proper disposal. Approximately 0.05 acre of soil would be disturbed per pipeline mile for gathering lines. Pipelines could also impact soils indirectly by altering snow accumulation patterns and by shading vegetation, which may decrease soil temperatures and could potentially affect plant growth. Soil under a pipeline receives less direct sunlight during the growing season than does the soil that is not under a pipeline. Therefore,

there could potentially be a reduction in heat absorption by the ground cover, leading to a shallower active layer.

Low-ground-pressure vehicles may be allowed to travel on the tundra during periods other than when the ground is frozen and covered with snow as authorized by BLM. Because of restrictions that would be placed on this activity, impacts to soil should be limited to the compression (reduction) of the insulating mat, similar to what happens during winter following traffic by low-ground-pressure vehicles.

Ground-impacting activities of the action alternatives could alter permafrost as described in BLM (2004, § 4F.2.1.3) and BLM (2012, § 4.5.3.2). Structures must be designed to avoid thawing their own foundations. Roadways and buildings must be elevated on thick gravel berms or pads, or on pilings. Gravel berms for roads are elevated above the tundra surface to ensure that the subgrade remains frozen. Oil pipelines generally must be built on VSMs to ensure that the heat from the transmission of warm fluids does not thaw the surrounding permafrost, causing differential settlement. Heated buildings can also thaw the permafrost, leading to thaw settlement, if they are not elevated on pilings or their foundations insulated and refrigerated. On pads with closely spaced wells, extensive refrigeration with passive heat pipes and insulation (thermosyphons) is required to ensure that the heat from fluids does not melt the permafrost. In order to protect facilities, appropriate designs are necessary to minimize or prevent thawing of the permafrost.

Abandonment and reclamation of project facilities could impact soils by dust fallout along roads, by ice roads and other off-road tundra travel associated with dismantling of pipelines and by disturbance to soils adjacent to VSMs during their removal. The level of impact from these activities would be roughly the same as that during construction if gravel fill was removed; impacts to the landscape may be less if the gravel were to be left in place. BLM will determine whether or not to remove the roads upon abandonment and reclamation. If roads and pads were left in place, and especially if cross drainage across roads was not maintained, water impoundment would occur, and could alter soil hydrology as described for the construction period. Thaw subsidence is difficult to predict, and complete restoration to prior conditions is not likely if it occurs (BLM 2012, § 4.3.3.2, p. 112). Alternatively, roads and production pads left in place upon abandonment could remain in place for many decades, particularly in drier areas. Costly methods are required for rehabilitating the gravel roads, pads, and mine sites that dominate disturbed land. Construction of berms and basins, application of topsoil, and use of various plant cultivation techniques are required on these sites. However, only a very limited amount of topsoil has been stockpiled for future use in the oilfields (BLM 2012, § 4.8.7.6). Sewage sludge is being considered as an alternative source of organic material. Native legumes with nitrogen-fixing ability could be essential for sustaining the long-term productivity of those sites. In areas that have soils with high ice content, the production pads may gradually subside into thermokarst troughs and removal of roads and production pads in ice-rich areas could result in subsidence and pond formation.

Spills could adversely affect soils and permafrost as described in Section 4.5.

4.2.1.2 Drilling and Operation

The drilling and operation phase of the project would have negligible effect on landforms. Maintenance grading of the surfaces of production pads and roads would modify the surface, but the general shape of the road and production pads would be the same throughout the life of the facilities.

Under all action alternatives, the primary geologic resource impacted by the project during construction would be gravel resources. Drilling oil production wells at the GMT1 production pad would directly impact the physical integrity of reservoir and overlying bedrock by pulverization and fracture. Impacts to petroleum geology would occur primarily from extraction of petroleum hydrocarbon resources; however that is the purpose of the proposed project. In context, this would constitute a loss of the committed resources, but result in beneficial economic impacts described in Section 4.4.2. A minor amount of bedrock would be disturbed and relocated to the surface during drilling. Annular disposal and injection of fluids could have impacts on subsurface geology; however regulations and permits control both types of activities, minimizing potential adverse effects. In addition to the BLM, the Alaska Oil and Gas Conservation Commission (AOGCC) has regulatory oversight of all oil and gas drilling, production, and well abandonment for the protection of oil and gas resources (20 AAC 25.005 – 25.990).

The passage of vehicle traffic over gravel pads, roads, and airstrips would result in a dust shadow with measurable effects on soil, vegetation, and permafrost extending out to 300 feet from the edge of the gravel (Auerbach et al. 1997). Within dust and gravel deposition areas soil properties such as moisture, temperature, chemical reactions, and nutrient regimes could be altered. In extreme instances, this deposition may bury the existing organic horizon of the soil with a new layer of higher bulk density that would restart the soil-forming processes. The area of potential indirect impact from gravel spray was evaluated by calculating the acreage within 300 feet of the gravel roads and pads.

4.2.1.3 Comparison of Alternatives

A summary of the direct and indirect impacts to soil and permafrost resulting from gravel fill for the four project alternatives is provided below in Table 4.2-2. The geomorphic units impacted by gravel footprint for the alternatives are summarized in Table 4.2-3.

Table 4.2-2. Direct and Indirect Impacts of Construction

Impact Type	Acres of Impact per Alternative			
	A	B	C	D
Direct	72.5	79.3	97.5	87.3
Indirect [1]	595.3	613.7	1,368.7	275.9

[1] Indirect impacts evaluated by GIS as a 300- foot buffer surrounding gravel infrastructure.

Table 4.2-3. Geomorphic Units Impacted by Gravel Footprint

Geomorphology	Direct Impact per Alternative[2] (acre)				Portion of Project Study Area[3] (percent)			
Alternative:	A	B	C	D	A	B	C	D
Alluvial-Marine Deposit	50.5	25.9	41.5	44.1	0.4	0.2	0.3	0.4
Fill and Embankments	0.0	0.0	1.4	0.0	<0.1	<0.1	0.8	<0.1
Lower Perennial River, non-glacial	0.1	0.1	0.1	0.0	0.1	0.1	0.1	<0.1
Lowland Headwater Floodplain	0.3	0.0	0.4	0.0	0.2	<0.1	0.3	<0.1
Meander Active Overbank Deposit	0.3	0.3	0.3	0.0	0.2	0.2	0.2	<0.1
Meander Inactive Overbank Deposit	0.5	0.5	0.5	0.0	0.5	0.56	0.6	<0.1
Old Alluvial Terrace	0.2	2.3	24.5	0.0	<0.1	<0.1	0.1	<0.1
Shallow Isolated Thaw Lake		3.1		0.8		0.02	<0.1	0.1
Thaw Basin, Ice-rich Center	6.9	13.7	9.4	18.4	0.1	0.11	0.1	0.1
Thaw Basin, Ice-rich Margin	13.6	33.4	19.4	24.0	18.9	46.14	26.8	33.2
Total	72.5	79.3	97.5	87.3	0.1	0.1	0.1	0.1

[1] Geomorphic classification and mapping from Jorgenson et al. 2003.

[2] Percentages for each geomorphic unit based on the 90,059 acres with the geomorphology mapped within the Project Study Area.

[3] Percent of total footprint based on 102,487 acre Project Study Area.

Alternative A has the smallest footprint of direct gravel impact (72.5 acre) of the four alternatives evaluated, whereas Alternative C has the largest (97.5 acre). Alternatives B (79.3 acre) and D (87.3 acre) fall intermediate between these with respect to direct impact of gravel fill. The potential indirect impacts of gravel spray and dust deposition are based upon the same areal coverage of gravel fill but without a road, Alternative D has the smallest area of gravel spray (275.9 acre) among the four alternatives, whereas Alternative C has the largest area (1,368.7ac).

Alluvial-marine deposits would be impacted most by construction of gravel infrastructure under Alternatives A, C, and D, whereas Ice-rich Margin Thaw Basin would be impacted the largest amount under Alternative B (Table 4.2-3). Ice-rich Thaw Basin terrain is considered an unfavorable substrate for maintaining thermal stability and reliability of project infrastructure where alternative geomorphology is available.

Development of the Clover site would impact soil and underlying permafrost by excavation and removal of the overburden material in order to access the underlying gravel. Table 4.2-4 summarizes the geomorphic units impacted by development of the gravel source. The largest area of impact would be to Old Alluvial Terrace geomorphic type (18.8 acre; Alternative D).

Table 4.2-4. Geomorphic Units Impacted at the Clover Site

Geomorphology	Direct Impact (acres)[1]				Portion of Project Study Area (percent)[2]			
Alternative:	A	B	C	D	A	B	C	D
Delta Abandoned Overbank Deposit	2.1	2.2	2.8	2.8	0.2	0.2	0.18	0.2
Old Alluvial Terrace	14.1	14.9	18.8	18.4	0.2	0.2	0.25	0.2
Thaw Basin, Ice-rich Center	2.5	2.7	3.4	3.3	0.1	0.1	0.03	0.1
Total	18.7	19.8	25.0	24.5	0.1	0.2	0.15	0.2

[1] Acreage proposed by Applicant for Alternative A. Values for Alternatives B, C, and D were estimated based on proportional increases in gravel footprint; the final may be more or less than this acreage at Clover depending upon use of the ASRC Mine Site as discussed in Section 2.

[2] Percentages for each geomorphic unit based on the 90,059 acres with the geomorphology mapped within the project study area.

[3] Percent of total footprint based on 102,487 acre project study area.

Impacts to gravel resources under all the action alternatives are expected to be of high intensity (e.g., gravel extraction) and long-term in duration, but of local extent since development of the Clover site under each of the Alternatives would represent less than 0.5 percent of the project study area, which is approximately 100,000 acres in size. Considering that the resources are common as defined in the impact criteria, the overall impacts are characterized as minor for all action alternatives. Alternative E, No Action, would incur no impacts to gravel or other geologic resources and overall impacts are rated as negligible.

The volume of rock impacted by drilling is inconsequential compared to the total volume of bedrock in the project study area. Direct impacts to bedrock during construction would produce no measurable effect and are considered negligible under the action alternatives.

Impacts to petroleum geology under all the action alternatives are expected to be major because GMT1 will result in the irreversible and irretrievable commitment of petroleum hydrocarbon resources of the GMTU; however, this is the Applicant's stated purpose for the project. Impacts to petroleum geology would be the same across all action alternatives because the location of the gravel pad does not vary by alternative. Under the no action alternative (Alternative E) there would be no impacts to petroleum geology.

Gravel infrastructure for the project would have direct impacts to the tundra that vary slightly among the four action alternatives, with the least amount of impact estimated for Alternative A (72.5 acres) and the greatest amount under Alternative C (97.5 acres), followed by Alternative B (79.3) acres and Alternative D (87.3 acres).

Overall, the impacts to land shape, the geology other than petroleum and gravel resources, paleontological resources, soils, and permafrost are predicted to be of medium intensity (e.g. burial by gravel) and long-term in duration, but of local extent since the total footprint of each action alternative represents less than 0.1 percent of the project study area, which is approximately 100,000 acres in size (see Figure 1.1-1). Because the resources are common as defined in the impact criteria, the overall impacts are characterized as minor for all action alternatives. Alternative E, No Action, would incur no impacts to gravel or other geologic resources and overall impacts are rated as negligible.

4.2.1.4 Mitigation

Avoidance or reduction of impacts is provided through design features, mitigation described in Section 4.7, and by following protective measures of BLM (2013: A-7, A-10, C-2, E-4, E-5, E-6, E-8, E-12, and L-1. Impacts are expected to be minor and within the range described in BLM (2004, § 4F.2.1.1).

Facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities, are expected to effectively minimize the amount of habitat that would be altered by gravel pads and other surface disturbances.

Avoidance or reduction of potential impacts to permafrost is provided through geotechnical studies, design and operation features, and mitigation described in Section 4.6. Insulated conductors will be used to minimize subsidence issues and provide near well bore protection. Thermosyphons would be installed adjacent to certain infrastructure components to protect the permafrost conditions and the infrastructure. Additional design measures required by state and federal permit conditions would contribute toward the avoidance and minimization of impacts on soils and permafrost include the following:

- Placing a minimum of 5 feet of gravel fill, to insulate the underlying permafrost.
- Elevating heated buildings or structures on pilings, to prevent or reduce heat transfer to underlying soils and preserve the thermal integrity of the permafrost.
- Elevating all on and off-pad pipelines above grade on VSMs.
- Minimizing or avoiding impoundments (which can act as thermal sinks and create thermokarst) by maintaining natural drainage.
- Designing bridges and culverts to maintain existing surface drainage patterns, prevent erosion, and ensure adequate water flow to maintain soil ice features.
- Installing thermosyphons around wells to remove unavoidable heat transfer from wellbore fluids. Additionally, well conductor piles will be insulated.
- Requiring workers to stay on gravel surfaces unless their job duties require them to be on the tundra, to minimize compaction and disturbance to surface insulating vegetation or snow.
- Applying dust control measures to roads, pads, and summer mining activities to protect insulating vegetation, and minimizing dust settlement on vegetation or snow which could increase thermal conductivity and promote earlier spring thaw in affected areas.
- Reducing surface discharge of wastewaters through use of a disposal well, including zero discharge of produced water and drilling wastes. Surface discharges could erode surface soil, create drainage patterns, and initiate thermokarst erosion.
- Implementing operating procedures and maintenance programs to ensure the design measures remain in effect throughout the life of the project. These include maintaining gravel depth according to design measurements, maintaining culverts and bridges to provide unimpeded water flow, and maintaining the well thermosyphons.
- Implementing spill prevention and response programs.
- Overburden for gravel mining is either placed on previously disturbed area within the pit or on an ice pad.

Erosion control measures would be included in the project SWPPP. Several of the mitigating measures designed to protect vegetation and wetlands would reduce impacts to soils and permafrost.

4.2.1.5 Conclusion

The direct effects of the action alternatives on soil include compaction, alteration of soil or water flow patterns, and damage to soil during construction of gravel pads, roads, and airstrips, from excavation of gravel mine sites, and installation of VSMs. Impacts to permafrost are similar to those described for soils, but can be more pronounced in ice-rich permafrost. Direct or indirect exposure of permafrost to the air and sunlight can result in permafrost degradation and thaw settlement (thermokarst). Soil and the underlying permafrost could also be altered by indirect impacts of gravel spray, dust deposition, salinity effects on vegetation from gravel, snowdrifts, and blockage of or change to natural drainage patterns.

Overall, the impacts to physiography (land shape), geological resources (other than petroleum and gravel resources), paleontological resources, soils, and permafrost are predicted to be minor for all the action alternatives. There would be no impacts to these resources under Alternative E.

Impacts to petroleum geology under all the action alternatives are expected to be major because GMT1 will result in the irreversible and irretrievable commitment of petroleum hydrocarbon resources of the GMTU as this is the Applicant's stated purpose for the project; Alternative E would have no impacts to petroleum geology. The impacts to gravel resources are characterized as minor for all action alternatives as the effects are high intensity, local in extent, and long-term in duration. Alternative E, No Action would incur no impacts.

Climate change may have several effects on the soil profile over time, exacerbating the loss of permafrost and soil insulation from activities associated with any of action alternatives. The depth of the active layer is expected to increase as permafrost is degraded over time, resulting in water accumulations or excessive drainage from organic soils, depending on the topography and drainage patterns. Warming temperatures may also accelerate the rates of decomposition of organic matter, accelerating the loss of soil insulation. Bacteria and microbial cavities in soils would be expected to increase substantially with rising soil temperatures, which may accelerate the rate of biological soil development and aid in recovery of soils after damage. Increased rates of erosion and soil subsidence from warming temperatures, as permafrost melts could also occur.

4.2.2 Water Resources

The water resources evaluated in this section include groundwater, lakes, streams, estuaries, and near shore environments (Figure 4.2-1). The project-related effects on water resources were evaluated in BLM (2004, § 4F2.2) for the proposed activities in the project study area. In addition, BLM (2012, § 4.3.4) provides a recent and thorough update of the potential effects of oil and gas development on water resources, as does the Point Thompson Final EIS (Corps 2012, § 5.6). The water resources impacts evaluation in these documents is adopted into the analysis presented in this SEIS.

Potential impacts to surface water quality are described in BLM (2012, § 4.5.4.2) and BLM (2004, § 4F.2.2.2). As hydrology and surface water quality are closely linked, the evaluation of potential impacts to water resources, with respect to both hydrology and surface water quality, is covered in this combined section.

Potential impacts to hydrology and surface water quality from project alternatives were evaluated based on the criteria summarized in Table 4.2-5.

Project activities that have the potential to impact water resources during construction, drilling, and operations include, but are not limited to:

- Gravel mining
- Placement of gravel fill for infrastructure (e.g., roads, pads, airstrips)
- Bridge and culvert installation
- Pipeline construction
- Construction of ice roads
- Water supply extraction (for ice roads, construction, drilling, and operations)

The potential hydrology impacts are generally categorized as follows (BLM 2004, § 4F.2.2):

- Shoreline disturbances and thermokarst
- Blockage or convergence of natural drainage

- Increased stages and velocities of floodwater
- Increased channel scour
- Increased bank erosion
- Increased sedimentation
- Increased potential for overbank flooding
- Removal or compaction of surface soils and gravel, and changes in recharge potential
- Produced water spills
- Petroleum hydrocarbon spills
- Demand for water supply

Major areas of concern for surface water impact are described in BLM (2004, § 4F.2.2.2) and BLM (2012, § 4F.5.4.2).

Avoidance or reduction of potential impacts to water resources is provided through siting and design and mitigation. In addition to the stipulations and BMPs, project activities that could impact water resources will be subject to federal, state and local permit requirements. As a result, impacts to hydrology and water quality are expected to be minor and within the range described in BLM (2004).

Table 4.2-5. Impact Criteria—Water Resources

Impact Category	Magnitude	Definition
Intensity	High	Changes to the hydrologic regime that require rehabilitation or cannot be rehabilitated to maintain pre-project hydrologic function. Changes in water quality such that protected water use classes are violated to the extent that mitigation measures would not be effective and remediation measures would be necessary, or changes in water quality that result in a new environment in which new water classes are achieved.
	Medium	Changes to the hydrologic regime are measurable, yet do not require rehabilitation to maintain pre-project hydrologic function. Examples per type of impact: • Drainage patterns change, yet impoundment and draining are similar to annual flooding and seasonal inundation extents. • Streamflow or stage changes, yet seasonal and annual base flow and peak events are preserved, and flood inundation limits are similar. • Stream velocity changes, but erosional and depositional characteristics are preserved and increases are not compounded. • Lake levels change seasonally but recharge annually. Changes in water quality based on protected water use classes predicted but can be mitigated.
	Low	Slight changes to the hydrologic regime that are not measurable. Slight changes in water quality that do not violate protected water use classes.
Duration	Long term	Impact to hydrologic regime would exceed 4 years. Impact to water quality would exceed the life of the project.
	Interim	Impact to hydrologic regime would last beyond a season but less than 4 years. Impact to water quality would last the life of the project.
	Temporary	Impact to hydrologic regime would be seasonal and associated with only the construction or drilling phases. Impact to water quality would last a short period during a phase of the project.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality and is not protected by legislation.
Geographic Extent	Statewide	Changes to hydrologic regime extend beyond the immediate water body affected, or affect a large portion of an individual water body of great size or critical value. Impacts beyond the immediate water body are due to hydrologic connections such as downstream, upstream, lakes feeding stream, stream feeding lakes, and shallow groundwater connections between lakes and other lakes or streams. Water quality changes occur in the water bodies adjacent to project component footprint and associated waters that are hydraulically connected to those resources across a large portion of the project study area.
	Regional	Changes to hydrologic regime are limited to areas without stream connections or water bodies of great size or critical value that are discernible from either aerial photographic interpretation or a GIS hydrography dataset. Water quality changes are confined to the area within and around a project component footprint and the water bodies directly surrounding the project component.
	Local	Changes to hydrologic regime are limited to areas without lakes or stream connections that are discernible from either aerial photographic interpretation or a GIS hydrography dataset. The area of water quality changes is small and could be easily contained from moving downstream or throughout a water body for mitigation purposes.

4.2.2.1 Construction

Several activities during the construction phase have the potential to impact hydrology and surface water quality. These activities are summarized below and include gravel mining, placement of gravel fill for infrastructure (e.g., roads, pads, airstrips), bridge and culvert installation, pipeline construction, water supply extraction, and groundwater well reinjection activities and spills. Oil spills could occur from pipelines; storage tanks; exploration and/or production facilities/infrastructure; drilling rigs; vehicles; and vessels during either the construction or operations phase. Spills occurring from pipelines or leaving pads and roadbeds could enter water sources reaching tundra ponds, lakes, creeks, or rivers. Spills can occur at any time during the year. The potential effects of oil spills are described in BLM (2012, § 4.3.4.2).

Groundwater impacts associated with gravel mining are likely to be moderate to major, but limited in area and temporary, only extending for the period of use and rehabilitation. It is anticipated that the majority of the gravel mining associated with the project will come from the proposed Clover site. Upon completion of gravel extraction activities from the proposed Clover site, the pit would be allowed to fill naturally over a multiple year period and the site will be rehabilitated.

During gravel mining, it is probable that shallow taliks and supra-permafrost water zones will be temporally eliminated in the immediate vicinity of the gravel mine. However, the effect of this loss on water resources would be negligible, because the area of impact would be localized and supra-permafrost zones would re-establish over time once the mine pit is filled with water. The subsurface water-bearing zone would be permanently eliminated in the immediate footprint of the mine, but would be replaced by surface water that is connected to the shallow groundwater. Additionally removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics, lake shoreline flow patterns, erosion, sedimentation, and ice damming (National Research Council 2003). Gravel extraction could produce sedimentation as discussed in BLM (2012, § 4F.5.4.2, pp 12 and 13).

In the event the Clover site is not available, gravel would likely be obtained from the existing ASRC Mine Site. Use of the ASRC Mine Site as the gravel source would eliminate impacts within the Tiŋmiaqsiġvik (Ublutuoch) River setback area, including the small drainage crossing through the mine site.

The construction of the action alternatives (e.g., the placement and construction of gravel pads, roadways, pipelines, bridges, airstrips, and culverts) could affect natural drainage patterns (creation of new channels and inundation of dry area), stream stage (water level) and streamflow (volume), stream velocity (which influences erosion and sedimentation rates), groundwater flow, and lake levels. Modification of the natural surface water drainage patterns may result from blockage or redirection of flow. Disruption of streambeds and stream banks can also remove protective shoreline vegetation and lead to channel erosion and sedimentation, formation of meltwater gullies, plunge pools from perched culverts, and formation of alluvial fans in streams and lakes (BLM 2012, 4.4.4.2, p. 377).

A few examples of construction activities that can impact hydrology include displacement of a lake or pond by fill, or placing fill (such as for an airstrip or road) transversely across grade, thereby blocking the natural drainage of sheet flow runoff, shallow groundwater, stream input, or rain catchment. Placing fill transversely across grade would also change snow accumulation patterns, which, in turn, would change drainage patterns once the snow melts. Placing fill transversely across grade or the predominant wind direction may also change snow accumulated patterns, which, in turn, may change drainage patterns once the snow melts.

Impacts to drainage patterns may result in increased inundation (flooding) or drying of affected areas. Increased inundation may in turn increase thermokarst action in the affected area.

Gravel fill on tundra could potentially change recharge potential, block natural drainage and existing hydrology; erosion of roads and pads could increase sedimentation into waterways. During construction, sediments and dust could be disturbed and deposited on snow and ice during the winter or on tundra and open water during the summer. The sediments and dust could be introduced into the water column, causing an increase in turbidity. Snow roads, ice roads, and ice pads are temporary structures and impacts, if any, are expected to be minor and short term. Details related to erosion and sedimentation during the construction phase is provided in BLM (2004, § 4F.2.2.2).

Where gravel fill is placed in wet areas to construct a road, pad, or airstrip, the receiving waters could temporarily have higher suspended solids concentrations and greater turbidity. Fugitive dust which enters surface water bodies can also increase turbidity. Further information regarding turbidity during the construction phase is provided in BLM (2004, § 4A.2.2.2).

Roads and airstrips that are aligned perpendicular to stream channels and the direction of sheet flow have a greater potential to impound sheet flow and shallow groundwater, than roads or airstrips aligned generally parallel to existing drainage patterns. The GMT1 access road in Alternatives A, B, and C generally transverses the hydraulic gradient and potentially could result in increased inundation (flooding) upgradient of the road, and decreased inundation down gradient of the road as discussed in BLM (2012, § 4.3.4). Prolonged inundation can impact vegetation and result in thermokarst.

A direct effect of winter road and pipeline construction is the potential disturbance of tundra vegetation and soils. Disturbed and exposed soils are more susceptible to erosion and subsequent sedimentation during spring breakup than non-impacted areas. Fugitive dust from construction can also be deposited on snow and ice during the winter. When melting occurs, this dust can enter surface water bodies, increasing turbidity.

The proposed production pads, airstrips, and roads have been designed to account for thermal criteria (minimum thickness to prevent permafrost degradation) and hydrologic criteria (50-year flood plus 3 feet) for minimal impact to the surrounding tundra. However, the construction of permanent gravel roads and pads will compact underlying soil, potentially impact thaw depths, and reduce infiltration. Locally, this may result in inundation of previously dry areas during breakup, changes in stream flow, and potential lake recharge. The duration of impacts will be long- term because the roads and pads will remain during the period of operation.

Increased or decreased stream velocities could result in increased erosion or sedimentation. Generally, increases in velocity result in increased erosion, and decreases in velocity result in increased sedimentation. Flow constrictions such as through culverts or bridges would most likely lead to increased stream velocity, which may increase erosion. Similarly, flow blockages or other obstructions can lead to decreased velocity, potentially resulting in inundation and potentially increased sedimentation. Diversions may also affect erosion and sedimentation. Decreasing the volume of water flowing in a stream typically decreases velocity and sediment transport capacity, while increasing streamflow typically increases velocity and erosive capacity.

Potential impacts to drainage that may be caused by the GMT1 road (common to Alternatives A and C) were evaluated using a preliminary inundation analysis with conservative assumptions.

The methods followed the general approach described in the Point Thomson Project EIS (Corps 2012, Appendix S). In the analysis (modeling), the maximum headwater depth at each road crossing is assumed to equal the height of the culvert. Culverts were assumed to be 4 feet in diameter and installed every 500 feet. on the ground surface. Thus, the maximum water depth immediately upstream of each road crossing (culvert) is 4 feet. This hypothetical water surface was used to estimate the inundated area, by projecting the upgradient of the road until a 4 foot elevation rise occurred. Areas with the flattest topography experience the greatest ponding, and steeper areas less ponding. The extent of downstream indirect impacts was calculated by assuming a typical hydraulic expansion angle of 2:1 from each culvert and spacing between culverts of 500 feet. The 2:1 ratio results in a downstream impact zone of 500 feet. In this 500 feet zone, the area directly downstream of the culvert would be inundated with flow while the area between culverts, downstream of the road embankment, would receive less flow and be somewhat drier. It is not possible to determine an amount or percentage of how much wetter or drier the areas would be without a detailed modeling exercise.

Based on these methods and assumptions, the potential upstream inundation area was calculated to be the area shown on Figure 4.2-2, which is approximately 2,800 acres (Table 4.2-6). This value is considered a preliminary worst-case scenario. Elevation data was derived from *Google Earth Pro 2013\Shuttle Radar Topography Mission Digital Elevation Model*[6], which has relatively low resolution and likely results in over-estimates of the inundation areas. In addition, a 4-foot diameter thin edge projecting culvert under inlet control conditions can convey 66 cfs. Based on the USGS regression equations for Region 7, a contributing drainage area of approximately 435 acres is required to generate a 50-year design flow of 66 cfs. Many of the projected culvert locations have contributing areas less than 435 acres. Despite these shortcomings, the crude model does provide a mechanism for estimating the maximum extent of increased inundation that potentially could occur under worst-case conditions. A similar analysis for Alternative B is presented in Figure 4.2-3.

Table 4.2-6. Potential Altered Inundation Area by New Roads

Alternative	Area of Increased Stage (ponding) Upstream of Gravel Roads (acre)1	Area of Decreased Stage (Drying) Downstream of Gravel Roads (acre)2
A	2,757	469
B	2,939	482
C	Similar to A	Similar to A
D	Negligible3	Negligible3

[1] Analysis follows methods established in Point Thompson EIS. Method assumes a maximum water depth of 4-feet at the base of the road, based on the assumption a 4-foot culvert would be installed every 500 feet along access roads. Method is considered a rough order of magnitude estimate of the maximum inundation area per alternative.

[2] Impacted area is a 500-foot zone on the downgradient side of the roadway based on a 500-foot culvert spacing.

[3] Gravel roads constructed under Alternative D are limited, and generally not located cross gradient to established drainage pattern, so inundation assumed to be negligible. There may be localized inundation adjacent to gravel embankments.

Pipeline construction within the project study area would have minor effects on water resources related to ice road construction and associated water withdrawals from local lakes. Narrow streams will be crossed using elevated pipelines on suspension spans. All pipelines would be routed to avoid lakes. Once installed, suspended pipelines would have no effect on stream and water flow characteristics, but would have potential effects related to oil spills (as discussed under Section 4.2.2.2). Buried pipelines are not included in the project designs, avoiding the potential impacts of thermokarst and subsidence associated with such installations.

[6] A component of Google Earth Pro®; Shuttle Radar Topography Mission, http://www2.jpl.nasa.gov/srtm/.

Water withdrawal to support components of each alternative (e.g., ice roads for winter construction and camp water use) could affect the water levels of lakes used as water sources, and any connected water body, such as streams or wetlands. Only permitted lakes, rivers, or reservoirs (under ADNR Temporary Water Use Permit (TWUP) and if required, ADF&G Fish Habitat Permit) would serve as water sources. Excessive water withdrawal could result in a reduction of available overwintering habitat, reduced space, reduced oxygen availability, and could potentially result in mortality of fish. The results from water withdrawals under permits, as a result, are anticipated to be minor, temporary impacts to groundwater levels (shallow or deep), surface water levels, or drainage patterns associated with groundwater withdrawals during the summer season. Lakes would be the principal supply for fresh water during construction. Water demand is described in Table 2.4-2.

Ice roads and ice pads are used extensively during the winter season for access. Ice bridges will be required to be breached at stream crossings, especially where fish passage is a concern or the quantity of expected flow is substantial during breakup. Under all of the alternatives, no long-term impacts are anticipated from ice roads, ice pads, or ice bridges as discussed in BLM (2012, § 4F.5.4.2, pp 12 - 13).

Ice road construction over lakes deep enough not to freeze to the bottom could affect dissolved oxygen (DO) concentrations. Many of these lakes are just a foot to a few feet deeper than the minimum 6 foot depth necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake could freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced below the 5 parts per million (ppm) DO standard needed to protect resident fish (ADEC 2003b). Details related to DO concentrations during the construction phase are provided in BLM (2004, § 4A.2.2.2).

Ice roads built over creek and river crossings have the potential to restrict fish passage, resulting in mortality or redirection of fish. Water withdrawal and ice roads would support construction activities, and will therefore be temporary for Alternatives A, B, and C.

Similar to the construction phase, removal of gravel from areas near streams and lakes can result in changes to stream or lake configurations, stream-flow hydraulics, lake shoreline flow patterns, erosion, sedimentation, and ice damming (National Research Council 2003). Locating gravel pits at an adequate distance from streams and lakes would minimize these impacts. The Clover site is located within an ephemeral drainage approximately 0.5 mile upgradient from the Tiŋmiaqsiġvik (Ublutuoch) River. Gravel extraction could produce sedimentation as discussed in BLM (2012, § 4F.5.4.2, pp 12 and 13).

Upon completion of gravel extraction activities from the proposed Clover site, the pit would be allowed to fill naturally over a multiple year period and the site will be rehabilitated. The mine pit would modify the existing drainage pattern because it would create a deep reservoir where a small drainage currently exists. However, the impact would primarily occur during the period when the reservoir is being filled and retains water that normally would flow into the Tiŋmiaqsiġvik (Ublutuoch) River. Once the reservoir is filled, water is expected to continue to flow down gradient to the Tiŋmiaqsiġvik (Ublutuoch) River through the reservoir.

Long-term effects of the Clover site development on the drainage pattern would be medium intensity and local extent. The water in the flooded pit would likely remain unfrozen near the bottom, altering the thermal regime, and creating a thaw bulb around and beneath it,

potentially resulting in localized thermokarst. The steep side slopes of the excavation will likely slough as they thaw, becoming more gradual over time, and causing slight infilling. Maintaining a stable water level within the excavated area will be critical to the success of the rehabilitation. As described in BLM (2004, § 4F.2.2.1), the long-term impact from mining the Clover site will be offset by the rehabilitation of the site into functional bird habitat, as described in Appendix I.

Treatment of surface water is required prior to use as a potable water source. A potable water treatment or domestic wastewater treatment system must undergo ADEC plan review and approval before use. Further information regarding potability during the construction phase is provided in BLM (2004, § 4F.2.2.2).

During the construction phase, temporary camps could be used. It is expected that sewage and all solid waste will be transported to CD1 for disposal in existing systems. Potential discharges of treated domestic wastewater to tundra will be in accordance with the APDES permit as discussed in BLM (2004, § 4F.2.2.2, pp 1086 and 1087). This applies for all action alternatives and will not be analyzed further for this SEIS.

No deep injections of waste material or water are proposed during the construction phase so impacts to the deep aquifer during construction will be minor to negligible.

The discussion in BLM (2004, § 3.2.2.2) and BLM (2012, § 3.2.10.2) regarding alkalinity and pH indicates that freshwater within the project study area is only weakly buffered with low alkalinities in ponds and lakes. Details related to how construction, and domestic needs could affect water quality, and specifically alkalinity and pH is discussed in BLM (2004, § 4A.2.2.2).

4.2.2.2 Drilling and Operations

The operation of the action alternatives could affect natural drainage patterns, stream stage and streamflow, stream velocity, groundwater flow, and lake levels as described for the construction phase. Locally, the gravel roads may result in inundation of previously dry areas during breakup, changes in stream flow, and potential lake recharge. In general, impacts are expected to be localized and somewhat proportional to the size of the pad or road. However, the configuration of gravel fill also affects impacts. For example, a linear road running perpendicular to the hydraulic gradient will result in a larger extent of hydrological impacts than a consolidated, square pad of similar acreage. The duration of impacts will be long- term because the roads and pads will remain during the period of operation.

Ice roads and ice pads are used extensively during the winter season for access and for drilling. Ice roads may require breaching at stream crossings if fish passage is a concern during breakup. Under all of the alternatives, no long-term impacts are anticipated from ice roads, ice pads, or ice bridges as discussed in BLM (2012, § 4F.5.4.2, pp 12 and 13).

The impacts of increased stream velocities beneath bridges and through culverts during flooding events were addressed in BLM (2004, § 4F.2.2.1). Constricting flows can result in increased stream velocities and a higher potential for ice jams, scour, and stream bank erosion. Impeding flows can result in a higher potential for bank overflows and floodplain inundation. These potential impacts need to be minimized by incorporating design features to protect the structural integrity of the road- and pipeline-crossing structures to accommodate all but the rarer flood events.

Once installed, suspended pipelines would have no effect on stream and water flow characteristics. Buried pipelines are not included in the project designs, avoiding the potential impacts of thermokarst and subsidence associated with such installations.

Water withdrawal to support components of each alternative (e.g., operations, dust control, and camp water use) could affect the water levels of lakes used as water sources, and any connected water body, such as streams or wetlands. Only permitted lakes, rivers, or reservoirs (under ADNR Temporary Water Use Permit (TWUP) and if required, ADF&G Fish Habitat Permit) would serve as water sources. Water withdrawal in the summer from lakes could also result in a temporary lowering of the shallow groundwater in adjacent wetlands as the groundwater recharges the lake. The impacted area would be localized around the lakes' perimeter. Lakes would be the principal supply for fresh water during operation. Lakes could supply fresh water for (1) the seasonal construction of ice roads and pads (2) drilling, (3) hydrostatic testing, (4) dust abatement on roads, pads, and airstrips during summer, (5) potable water and (6) fire suppression and maintenance activities. There are no plans to install water production wells in the project study area. Temporary, minor impacts to groundwater levels (shallow or deep), surface water levels, or drainage patterns associated with deep groundwater withdrawals during the summer season.

Water use for the operation period will be approximately 25 percent of that required during the construction period for Alternatives A, B, and C. Water withdrawals to support ice road construction would be necessary during drilling and operation of Alternative D. Details related to water withdrawal from lakes during the operation period is provided in BLM (2004, § 4A.2.2.2).

During drilling there will be deep injection of drilling fluids (as per approved permit). Drilling fluids are typically a preparation of water, clay, and chemicals circulated into a well during drilling, and must be disposed of when drilling operations cease.

As discussed in BLM (2004, § 4A.2.2.2), discharges of treated domestic wastewater in the operation period could occur to tundra in accordance with APDES permit requirements. This applies to all the action alternatives.

As stated in BLM (2004, § 4A.2.2.2), the following changes to water quality may occur during the drilling and operations phase of the project:

- Increased turbidity of water bodies in the project study area may result from dust fallout, flooding, erosion, or bank failure.
- Water withdrawals for drilling and/or operations may have short-term (lasting only one season) impacts on alkalinity, pH, or oxygen content in the project study area.
- No discharge of sewage directly to water bodies in the project study area would occur and therefore, it is not anticipated that there would be an increase in fecal coliform counts over the naturally occurring concentrations.

Pipelines suspended over streams should have no effect on stream habitat and flow characteristics provided these are elevated sufficiently to avoid flooding (BLM 2012, § 4.3.7.2, p. 154). Pipelines transporting petroleum hydrocarbons, especially where suspended over streams, could potentially result in a spill to water resources.

4.2.2.3 Bridges and Culverts

Three primary stream crossings have been identified and extensively monitored for the proposed GMT1 access road (Figure 4.2-4). These sub-drainage basins are well defined and have been delineated through the available aerial photography and topographic maps, as show in Figure 3.2-2 (Baker 2009, Fig. 1.3 and Fig. 2.7). The current design proposes bridges over the two anadromous streams at Tiŋmiaqsiġvik (Ublutuoch) River and Crea Creek with a cross-drainage culvert at Barely Creek. Presently, the bridges and culverts are in the conceptual phase of the design process.

Bridges are proposed in areas where channelized flow occurs with a 50-year reoccurrence interval of 500 cfs or greater (BLM 2004, § 2.3.9.1). Bridge abutments and on-tundra aprons will be armored to protect the road and tundra from scouring. During break up when high flows are expected, the road will be frozen, reducing material for scour potential. Appropriate slope protection of armor rock, articulated concrete matting, and re-vegetation or other protection will be utilized where necessary. Piles will be set deep enough so that the bridge structures will remain stable for the designed scour event (BLM 2004, § 4F.2.2.1). Scour analyses will be done for both the Ublutuoch and Crea Creek as part of the final bridge design[7].

Culverts are considered at all water crossings that do not require a bridge. The design criteria for all culverts is such that they will prevent raising the water level on the upstream side of the crossings by more than six inches compared to the down gradient side for more than one week after peak discharge. Culverts will be installed at regularly spaced intervals to mitigate the risk of sheet flow interruption and thermokarst. Final design of the culverts for the CD5 to CD7 access road will also depend upon breakup information for those drainages that could affect the roads (BLM 2004, § 4F.2.2.1). At this time, these crossings are not expected to present any technical challenges beyond what is currently practiced for the region.

For preliminary permit drawings, only the more evident culvert locations are identified from aerial photographs. During the preliminary road alignment, a field reconnaissance will be conducted to identify and mark as many obvious culvert locations as possible. With the combined ground survey of the road alignment, collected field data and aerial photography, cross drainage culverts will be identified and placed in the design drawings. After the road centerline has been staked, a final field visit will be conducted and additional cross-drainage culverts will be located as required. Thus far, detailed information regarding culvert placement and design has not yet been gathered, but will be done during final road alignment[8]. In conjunction to culverts placed in specific drainage locations, cross-drainage culverts will be placed under the road approximately every 500 feet. Cross-drainage culverts may be up to 60 inches in diameter (BLM 2004, § 2.3.9.1).

Tiŋmiaqsiġvik (Ublutuoch) River

The Tiŋmiaqsiġvik (Ublutuoch) River lies in the southeast portion of the FCB. The creek is sinuous with a low flow gradient, flowing north into Fish Creek approximately 10 river miles (RM) upstream from Harrison Bay. The channel is characterized by numerous meander bends, often with undercut banks and associated bank sloughing along the edges. At the location of the road crossing, the drainage area comprises approximately 228 square miles (MBJ 2009, § 2.1.1).

[7] Communication from Lynn DeGeorge, CPAI to Bridget Psarianos, BLM, 01/08/14.

[8] Communication from Bill Morris, ADF&G to Stacie McIntosh, BLM, 01/07/14.

Based on ten years of data collection, the average date for peak discharge is June 4 followed by several days of elevated flows (MBJ 2013, § 4.1). The average observed peak direct discharge in the vicinity of the proposed road alignment is 2,200 cfs (Baker 2013, Table 4.1). Historic peak flow observations ranged from 1,440-5,360 cfs (MBJ 2013, Table 4.1). Calculations from the 2009 flood frequency analysis estimated the 50-year and 100-year discharge events for the Ublutuoch to be 8,800 cfs and 9,800 cf, respectively (MBJ 2013, Table 4.2).

The presently considered design for the Ublutuoch Bridge is 350 feet long and constructed using five sets of 32-inch pilings positioned approximately 85 feet apart and a bridge deck elevated approximately 26 feet BP Mean Sea Level (BPMSL) above the ground level made of 31–foot-wide precast concrete slabs. The bridge deck will have a removable guardrail and will be rig-capable. The pipelines will be located on the structural steel supports attached to the bridge girders, below the bridge deck. Sheet pile abutments for erosion protection will be located at each end of the bridge. The proposed 350-foot bridge would extend from bank to bank and is designed to span a 50-year discharge event. As such, there will be a span over the main channel of 93 feet on the eastern side. The bridge will be designed to have no piers located in the channel which is approximately 1 foot BPMSL during normal flows.

Hydraulic modeling of permanent structures was described in BLM (2004, § 4F.2.2.1). Assuming open water conditions, the impact from the proposed 350-foot bridge was evaluated with a 100-year discharge event and showed no measurable increase in surface water elevation on the upgradient side of the bridge (URS 2003). Based on the rating curves from this model, the current deck elevation is designed to be well above the 100-year water-surface of 12.1 BPMSL (Baker 2011, Table 5.3). Though the upper portion of the west floodplain is inundated during high flows, the majority of the flow is conveyed along the lower west floodplain and main channel, neither of which will be constricted by the current design when ice jams are not present (see Figure 4.2-5). Thus, stream velocity and channel scour is not expected to vary much from baseline conditions. Should an ice jam occur during moderate to large floods, it is possible some back water could result. However, significant ice jamming is not anticipated since the lower west floodplain could provide an alternative route for stream flow if the main channel is blocked (BLM 2004, § 4F.2.2.1). In addition, roads leading up to the bridge will be required to provide for natural flow during high discharge events. The Tiŋmiaqsiġvik (Ublutuoch) River bridge design is shown in Appendix A, Sheets 29 through 31 of 36.

Though recommendations have been made for a 100-year flood event design, that design criterion is not considered an industry standard at this time). By increasing the overall length from the 120 foot minimum required by BLM (2004a) to 350 feet, some concerns regarding impacts to stream hydrology and habitat have been addressed by removing the abutments from the 1-year and 2-year flood levels (BLM 2004, § 2.4.6.5). It should also be noted the length of spans between piers in the current design have been extended (85 and 93 feet) from the approximately 50 foot spans in Alternative A, further reducing potential ice jamming (BLM 2004, Sheet 54 of 71). Though scour computations have yet to be conducted at crossings other than the Nigliq channel, given the low velocities and frozen substrate, significant scouring is not expected. The concerns regarding the impacts of increased stream velocities beneath bridges and through culverts during flooding events during flooding events have been addressed in BLM (2004, § 4F.2.2.1).

Crea Creek

The 3.6 square mile drainage basin of Crea Creek flows northeast into the Tiŋmiaqsiġvik (Ublutuoch) River through a series of connected pools, ponds, and lakes (MBJ 2009, § 2.1.2.5). The drainage is uniform in cross-section, having a firm channel bed with underlying sedges and

the banks dominated by willows. Channelized flow was observed in 2005, 2006, 2010, 2011 and 2013 (MBJ 2011, § 2.2.2.3; MBJ 2013, § 3.2.2). An aerial view of the Crea Creek is shown in Figure 4.2-6. Observations during the 2011 monitoring event reported direct discharge of 61 cfs and peak indirect discharge of 84 cfs (MBJ 2011, §§ 4.2.7.1-4.2.7.2). In the 2009 flood frequency analysis, the 50-year and 100-year discharge event were calculated to be 269 cfs and 303 cfs, respectively (MBJ 2013, Table 4.6).

The 40-foot-long Crea Creek Bridge will be constructed using two sets of pilings positioned approximately 40 feet apart with sheet pile abutments for erosion protection located at each end of the bridge. The bridge deck will have a removable guardrail and will be designed to support a drill rig. The opening for water flow will be 25 feet wide with no piers located in the stream channel. The pipeline will cross Crea Creek on VSMs spanning the creek. The Crea Creek bridge design is shown in Appendix A, Sheet 32 of 36.

Unlike the Nigliq crossing, the Ublutuoch and Crea crossings are designed to carry the load of a 1,400 ton drill rig module, requiring shorter spans than the other CD5 bridges. The Nigliq crossing is a smaller single-lane structure that can only support 175 ton coil tubing rigs. The Applicant has indicated they are unable to move a drill rig over the CD5 bridges and will rely on ice roads in addition to the gravel roads and bridges for movement in the field[9].

Barely Creek

Located between Crea Creek and the Tiŋmiaqsiġvik (Ublutuoch) River, Barely Creek bisects a channel of beaded streams that drain a small sub-basin comprising 0.7 square miles of ponds and marshes (MBJ 2009a, §2.1.2.4). The channel is defined by connected pools that drain northeast into the Tiŋmiaqsiġvik (Ublutuoch) River. Native grass dominates the area with tussocks in regions bordering the channel reach. Channelized flow was observed at the proposed stream crossing during the spring breakup monitoring events in 2005, 2006, 2009, 2011 and 2013. This location was not monitored in 2010 (MBJ 2011, § 2.2.2.1; MBJ 2013, § 3.2.2). Field observations in 2011 measured direct discharge of 4.4 cfs with a calculated indirect peak discharge of 16 cfs (MBJ 2011, §§ 4.2.5.1-4.2.5.2). The 50-year and 100-year discharge events were calculated at 68 cfs and 78 cfs, respectively (MBJ 2013, Table 4.5). An aerial view of Barely Creek is shown in Figure 4.2-6.

Because of the limited flow, this location has been selected for a cross drainage culvert that will allow for fish passage. The typical design for fish passage culverts are shown in Appendix A. The final design will be implemented during the survey of the road alignment and installed prior to spring breakup which will be observed for changes in the hydrology. Additional culverts or changes in the design may be put into action as site-specific needs are further assessed.

4.2.2.4 Comparison of Alternatives

The differences in the size, location, and construction of infrastructure among the different alternatives generally correlate with impacts among the alternatives. The stipulations and design requirements, described in Section 4.7, *Mitigation*, specify measures to protect natural flow characteristics and water quality.

All four action alternatives have the potential for spills to water resources including tundra ponds, lakes, creeks, and rivers resulting from pipelines; storage tanks; production

[9] Communication from Lynn DeGeorge, CPAI to Bridget Psarianos, BLM, 01/08/14.

facilities/infrastructure; drilling rigs; vehicles; and/or vessels. Because the location and length of oil transit pipelines under the action alternatives are similar, the potential risk to water resources from a pipeline spill is also expected to be similar. Each of the action alternatives would cross the Tiŋmiaqsiġvik (Ublutuoch) River at the same location with block valves at each side of the crossing.

One important distinction between the alternatives is that Alternative D would not have a road between GMT1 and CD5 that crosses the Tiŋmiaqsiġvik (Ublutuoch) River, Crea Creek, and Barely Creek as do the other action alternatives. However, Alternative D would require a diesel pipeline to provide fuel to the GMT1 drill site, which would pose incremental spill risk along the pipeline system. Spills are discussed further in Section 4.5.

As described in BLM (2004, § 4F.2.2.1), adequate monitoring and adherence to pumping regulations would limit impacts on lake water levels to short-term duration. Long-term (longer than one year) impacts on lake water levels are likely to be minor because natural annual recharge processes are sufficient to fully recharge the lakes each year BLM (2004, § 4F.2.2.1). Thus impacts on lake water levels will be short-term and low intensity.

The GMT1 access road under Alternatives A, B, and C will intersect with several small channels and drainages that have surface water connections to lakes downgradient. In addition, Alternatives A and C would cross the Tiŋmiaqsiġvik (Ublutuoch) River, Barely Creek, and Crea Creek.

Project activities under Alternative B that could impact the hydrologic regime and surface water quality are essentially the same as Alternative A. The primary change in project components of Alternative B versus A with potential to alter the impact to hydrology is difference in location of a portion of the GMT1 access road further south and outside of the Fish Creek Setback (Alternative B). As shown on Table 4.2-7 (Summary of Major Components Potentially Impacting Hydrology), this causes a slight increase in length of the road and eliminates the stream crossings of Crea Creek and Barely Creek. Alternative B would avoid pipeline crossings of two Tiŋmiaqsiġvik (Ublutuoch) River tributary streams, potentially reducing the likelihood of a large spill reaching the river compared to Alternatives A, C, and D. The Fish Creek Setback is avoided and therefore any erosion and sedimentation that could be caused in or around waterbodies within the setback, would not occur. The Tiŋmiaqsiġvik (Ublutuoch) River crossing would be in the same location as Alternative A. The impacts to groundwater would be the same type and intensity as discussed for Alternative A.

Table 4.2-7. Summary of Major Components Potentially Impacting Hydrology[1]

Alternative	Total Gravel Fill Footprint (acre)	Total Length of New Roads (mi)	Number Of Bridged Crossings	Potential Number of Culverts[2]
A	72.5	7.8	2	81
B	79.3	8.6	1	85[3]
C	97.5	7.8	2	81
D	87.3	1.2	0	13

[1] All values are estimates subject to change in final design.

[2] Culvert would be installed along gravel roads to drain sheetflow between streams. The number of potential culverts to be installed assumes one culvert per 500 linear feet of new road. More may be necessary for drainage depending upon local conditions, and placement would be determined during road layout to coincide with low areas to maximize drainage.

[3] Due to the greater amount of thaw basin geomorphology and associated wet ground crossed by the Alternative B road route, more culverts would be required to maintain adequate drainage, which would be determined prior to the road construction.

The impacts to rivers and drainage basins under Alternative B would be similar to Alternative A. The slightly longer road (approximately 0.8 mile) would incur incremental impacts associated with road construction. These impacts are principally changes in the drainage pattern, stream flow and erosion or sedimentation. Additional culverts will be required due to the traverse of the thaw basin. Inundation analysis of the GMT1 access road was performed as described for Alternative A. This analysis indicated a slight increase in the areas of inundation as shown on Figure 4.2-2 and Table 4.2-6. The more southern route of the access road causes it to cross an area with thaw basins and generally wetter conditions (tundra) than Alternative A. Therefore, the road may restrict the flow of water more than in Alternative A. In addition, there could be increased localized sedimentation and erosion along the road corridor due to poor soils and associated increase in road maintenance. But these impacts are estimated to be negligible for Alternative B overall. The elimination of the river crossing at Crea Creek would eliminate the associated impacts of bridge construction to stream flow, sedimentation, and erosion. However, this is a minor crossing so the reduction in impact is minor.

Water withdrawal from lakes and ice roads would support construction activities, and would therefore be temporary under Alternative B. Erosion of roads and pads could increase sedimentation into waterways. However, based on results of prior sampling and analyses, this is not expected to have a measurable effect on water quality, such as turbidity, as reported in MJM Research (2007), MBJ (2009b), and MBJ (2010).

Project activities under Alternative C that could impact the water resources are generally the same in the nature of impact as Alternative A, and include placement of gravel for pads and roads, construction of ice roads and ice pads; construction of pipelines; construction of a new gravel mine site; water withdrawal from area lakes and reservoirs for construction of ice roads, pads, and other temporary ice infrastructure, and drilling. The extent of the impact is greater with Alternative C, which would incur more direct gravel footprint and more indirect gravel spray, and more gravel dust impact as estimated by GIS analysis of the project components. The impact to the water quality would generally be the same types and intensity, but extended over a greater distance compared to Alternative A. With the increase of roads and airport infrastructure, there is a higher likelihood of erosion and sedimentation than with Alternatives A and B. Other water quality criteria would be similar as to that described in Alternatives A and B.

The impacts to rivers and drainage basins would be the same type as discussed for Alternative A. The degree of impact would also be similar except for the impacts associated with the construction of the partial airstrip extension in Nuiqsut. The 500-foot extension runs perpendicular to the hydraulic gradient in the area and crosses a pronounced low-lying area which serves as a drainage to the south. This extension would have localized, low impacts to the drainage pattern and any associated stream flow in the drainage. The gravel fill would intercept (block) movement of sheet flow runoff and possibly shallow groundwater. There may be ephemeral stream flow in this drainage, at least during breakup. Changing orientation to avoid these impacts would not be feasible because of existing orientation of the airstrip. Culvert placement beneath the airstrip to allow some cross drainage would be problematic because the airstrip would be 100 feet wide. Therefore, the flow of water would need to be diverted around the west end of the airstrip where it could be reconnected with the original drainage, or a bridge across the drainage would need to be constructed.

The additional roadway constructed on the west side of Nuiqsut to bypass the village and reach the airstrip would also have some impacts to the drainage pattern. However, it will run close to existing roads orientated in the same direction so the additional impacts are minor. The total

potential inundation area for the new road construction under Alternative C is considered approximately equivalent to Alternative A (Table 4.2-6). This is because the majority of the new roadway to be constructed is the GMT1 access road, which is the same for both alternatives.

The impacts to lakes and ponds would be the same type and intensity as discussed for Alternative A. Alternative C does require 37 percent increase in gravel than Alternative A. However, the additional gravel is needed for fill in the Nuiqsut area and would likely come from the existing ASRC Mine Site.

Project activities under Alternative D that could impact the hydrologic regime are similar to the other alternatives, and include placement of gravel infrastructure for pads and roads; construction of pipelines; construction of a new gravel mine site; water withdrawal from area lakes and reservoirs for construction of temporary ice infrastructure. Alternative D also requires significantly more water withdrawal from local lakes to support drilling during the non-winter months when ice road access to APF would not be possible.

The primary change in project components of Alternative D with potential to alter the degree of hydrological impacts is the reduction in the total length of new roadways, and the construction of an airstrip. Despite the elimination of the access road which parallels the pipeline, the new gravel foot print is larger than Alternative A due to the addition of the airstrip and increase in pad size to support a remote, self-sufficient camp and drilling operation. In addition, the degree of ice road construction and water usage for ice road construction, drilling and camp use is greater. Table 4.2-7 summarizes the major components of the project relevant to the alternatives comparison.

The impacts to rivers and drainage basins under Alternative D would be less than those for Alternative A. The gravel road to be constructed from GMT1 to the new airstrip is relatively short and for the most part is situated on topographically high ground and does not traverse any major drainages, so the road would have relatively minor impacts to the drainage patterns and associated ephemeral stream or sheet flow. There are no identified river or stream crossings along the route. To the extent there are impacts to drainage patterns, they will be localized. Potential inundation caused by the presence of the road is likely to be negligible.

The 5,000-foot airstrip and associated pads at GMT1 do not cross any major drainages or streams. However, because the gravel foot print is relatively large, it will have minor impacts to the localized drainage pattern. To minimize surface water ponding adjacent to the gravel embankments, the gravel surface may need to be contoured to direct surface water runoff (from precipitation and snow melt) to the down-gradient edges of the pad. The width of the pad and airstrip are too large to traverse with culvert. If ponds develop, runoff may need to be routed along the edges of the airstrip and pad. Over the compacted gravel surface there will be less infiltration of precipitation which may reduce the recharge of shallow groundwater in the immediate area. However, this impact will be localized and of low intensity.

Alternative D is estimated to require more ice road construction than Alternative A (Table 2.4-2). There are more ice road miles during the construction phase, and also a need for annual ice roads during the operating period, which are not needed under Alternative A. Therefore, the impacts of ice roads under Alternative D will be greater and of longer duration compared to Alternative A. The ice roads could alter the drainage pattern, stream stage, and streamflow during spring breakup because the ice would melt more slowly than the surrounding tundra and streams. Blockage of streamflow and increased stream stage could occur due to ice roads that are not adequately slotted or breached.

The impacts to lakes and ponds would be the same type as discussed for Alternative A. However, there would be considerably more water usage over the life of the project due to the reliance on ice roads on an annual basis during the operational phase. In addition, there is water usage in the summer months to support drilling. Water usage is over twice as much during the construction and drilling phase and 30 times greater during the operational phase. However, as described for Alternative A, adequate monitoring and adherence to pumping regulations would limit impacts on lake water levels to minor and of short-term duration. However, these impacts would occur on an annual basis for the life of the project unlike under Alternative A. In addition, Alternative D requires 35 percent more gravel mining than Alternative A, so the impacts associated with gravel mining at the Clover site may be slightly greater.

Potential water quality impacts under Alternative D could result from construction and operation of the project in a similar manner as the other action alternatives. The primary difference is the elimination of the GMT1 access road from CD5 to GMT1 drill site, which would reduce the opportunity for water quality impacts along the road. Although less gravel and its associated impacts would not be dispersed along the road corridor under Alternative D, there would be a comparable amount of gravel discharged onto the tundra surface for construction of an airstrip and additional pad space for living quarters and storage.

The additional facilities required for a limited access GMT1 pad will increase the required gravel pad space and the subsequent footprint of the proposed development. Moving gravel from its source to its final location creates a potential for gravel spillage in water bodies, and an increase in water turbidity.

In comparison to the other action alternatives during the operation period, Alternative D could result in higher spill risk due to increased activity with aircraft operations and year-round living accommodations.

4.2.2.5 Mitigation

All roads would be designed and constructed to provide adequate cross flow to prevent raising the water level on the upstream side of roads by more than 6 inches compared to that for the downstream side of the roads for more than 1 week after peak discharge (BLM 2004, § 2.4.6.1, p. 103).

Potential impacts and associated mitigation measures for the proposed project are summarized in Table 4.2-8 below. Culvert(s) will be placed at ephemeral streams, to maintain hydrologic flow. The Tiŋmiaqsiġvik (Ublutuoch) River bridge length would be increased in length to 350 feet from the 120 foot minimum in BLM (2004a), reducing the total road fill by more than 200 feet at the bridge approach, reducing potential flow restriction and associated erosion and sediment accumulation.

Specific measures to protect water resources are provided in BLM (2013: A-1 through A-7, B-1, B-2, C-2, C-3, C-4, E-2, E-3, E-4, E-6, E-8, K-1, and K-2). In particular, stipulation K-1 prohibits permanent facilities within 3 miles of Fish Creek and 0.5 mile of the Tiŋmiaqsiġvik (Ublutuoch) River, except for essential pipeline and road crossings to the main channel which must be approved on a case-by-case basis. In addition to BLM lease stipulations and BMPs, project activities that could impact water resources will be subject to federal, state, and local permit requirements.

Impacts to water resources will be mitigated by:

- Lease Stipulation E-2 – Prohibits permanent oil and gas facilities within specified distances from waterbodies,
- BMP E-6 – Requires that stream and marsh crossings be designed and constructed to ensure free passage of fish, reduce erosion, maintain natural drainage, and minimize adverse effects to natural stream flow
- Lease Stipulations K-1 (Rivers) and K-2 (Deep Water Lakes) – Require setbacks from rivers and lakes for permanent oil and gas facilities to minimize the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deep water lakes. Setbacks in the project study area include: Fish Creek (3 miles), Tiŋmiaqsiġvik (Ublutuoch) River (0.5 mile), and lakes with depths of >13 feet (0.25 mile).
- BMP A-6 – Requires all cuttings and drilling mud to be disposed of by injection, allowing on-pad temporary storage of muds and cuttings, as approved by ADEC. Freshwater aquifers are protected by surface casing that is installed and cemented in place at varying depths. EPA establishes aquifer exemption depths for certain disposal well classes. BLM and AOGCC both authorize casing setting depths for protection of fresh water aquifers on federal leases.

With adherence to BMPs, permit requirements, and lease stipulations, impacts to water resources are possible but likely to be localized in extent and temporary in duration.

Baseline flow data collected within the Fish Creek basin during spring breakup since 2009 (Baker, 2012) will be used to assess potential impacts to drainage resulting from road construction after the initial construction season.

Table 4.2-8. Summary of Potential Water Resources Impacts and Mitigation Measures

Resource	Activities	Potential Impact	Mitigation
Groundwater and Shallow Lakes	Construction of the GMT1 gravel pad and access road	Compaction of surface soils or removal of gravels and changes in recharge potential	The GMT1 pad and access roads are designed to limit acreage of fill and to prevent changes in recharge. The Applicant has rehabilitation plans available for review in Appendix I, *Clover Potential Material Source Draft Mining and Rehabilitation Plans*
Groundwater	Underground disposal of non-hazardous waste	Contamination of groundwater (Note: groundwater is not typically a potable water source on the North Slope). Change(s) of groundwater flow patterns.	Underground disposal will be performed in accordance with applicable permits to prevent impacts to groundwater resources.
Lakes and Ponds	Construction of gravel access road and ice roads	Increased bank erosion and sedimentation.	Gravel roads and pads will have erosion control mechanisms such as jute mats.
Lakes and Ponds	Construction and use of road and pads.	Dust fallout on ice and snow which melts in spring, or direct fallout on water bodies in summer, resulting in increasing turbidity	Dust control measures for roads and construction areas to avoid impacts of dust on nearby water bodies
Lakes	Ice road construction, camp use, and drilling activities	Dewatering of lakes; impacts to fish	Water will be withdrawn only from permitted lakes and only permitted amount of water will be withdrawn.
Streams	Construction of the gravel access road, pipeline, and bridges and culverts	Blockage of natural drainage (channels and sheet flow); increased stages and velocities of floodwater, channel scour, bank erosion, sedimentation, and potential for over-bank flooding	Road, pipeline, and water crossings will be designed to maintain existing hydrology, including during flood periods. Gravel roads, culverts, and bridges will be designed to have erosion control mechanisms and will follow the Alpine Facilities Erosion Control Plan (See Appendix C).
Streams	Construction of ice roads	Blockage of natural drainage and increased floodwaters	Ice roads will be designed to avoid blockage of drainage and will be scored prior to spring breakup

4.2.2.6 Conclusions

In general, all action alternatives have the potential for long-term impacts to local water resources resulting from the placement of new infrastructure. Most impacts are related to changes in the drainage pattern, and to a lesser degree stream flow. There also would be short-term, temporary impacts from ice infrastructure (e.g., roads and pads). These impacts tend to be proportional to the amount of area impacted by infrastructure, with modifications due to specific activities and locations. However, for all action alternatives the intensity of impacts is characterized as minor and of localized extent.

Potential surface water quality impacts may be categorized as follows, and discussed in BLM (2004, § 4F.2.2.2, pp 1092 and 1093):

- Accidental release of fuels and other substances
- Reductions in DO and changes in ion concentrations in lakes
- Increases in turbidity and suspended solids.

Impacts on hydrology from Alternative A would result primarily from construction of gravel infrastructure (e.g., roads and pads), which could modify drainage patterns and streamflow. These effects would be long-term, localized, and of low intensity. Ice roads and ice pads could seasonally affect natural drainage patterns and streamflow during spring breakup. However, this impact would be limited to the construction phase, and thus temporary. Water withdrawal for ice roads, drilling, and camp use has the potential to temporarily lower lake levels. The

overall hydrological impacts of ice roads and the associated water usage is negligible, while the impacts of roads and pads are characterized as minor due to the longer duration. Erosion and sedimentation associated with road and pad building could increase sedimentation into waterways. However, based on previous studies there will be no measurable effect on water quality (MJM Research, 2007, 2009b, and 2010).

Because gravel fill construction would take place over winter when most water bodies are frozen, it is expected that impacts on water quality would be limited. Discharges of treated wastewater could occur to tundra in accordance with APDES permit requirements. It is not anticipated that there would be an increase in fecal coliform counts over the naturally occurring concentrations. As stated in BLM (2004, § 4F.2.2.2, p. 1091), increased turbidity of water bodies in the project study area would result from dust fallout, flooding, erosion and sedimentation, or bank failure. It is not expected that alkalinity and pH of surface water bodies would be affected beyond the snowmelt period. Adherence to federal and state operational guidelines, safety practices, planning requirements, lease stipulations, and BMPs will all serve to reduce impacts from these activities. The overall degree of impact for Alternative A to the hydrology and water quality is considered minor.

Impacts on hydrology and water quality from Alternative B would be of similar type and intensity as described for Alternative A. Due to the slightly greater length of gravel roads, there may be slightly greater impacts to the drainage patterns, stream flow and the amount of sedimentation or erosion. However, the magnitude of the increase is negligible. The Fish Creek Setback is avoided and therefore potential erosion and sedimentation and associated turbidity that could be caused in or around waterbodies within the setback, will not occur. Overall, impacts to hydrology and water quality under Alternative B are expected to be minor.

Impacts on hydrology from Alternative C would be of similar type and intensity as described for Alternative A. However, the Nuiqsut airstrip extension causes additional impacts to drainage patterns and stream flow. The impact to the drainage pattern is major in the localized area of the airstrip extension because it causes gravel fill to be placed in a pronounced drainage. Flow thorough this drainage would need to be rerouted around the airstrip. Construction and use of the Nuiqsut airport road and pad infrastructure has the potential to result in greater erosion and sedimentation than Alternative A. Turbidity could be increased. Other water quality impacts would be similar as to that described in Alternatives A and B. Overall, hydrology and water quality impacts would be minor.

Impacts on hydrology from Alternative D would be of similar type as described for Alternative A, but the magnitude, duration and geographic extent varies. In general, the impacts to the drainage pattern would be of a greater magnitude but would occur in a more localized area. Impacts on water level in lakes will be of similar magnitude as Alternative A, but occur for a longer time due to the annual withdrawals to support operations. Alternative D has a greater gravel footprint and requires more gravel mining from possibly both the Clover site and the ASRC Mine Site. Moving gravel from a source to its final location creates a potential for gravel spillage in water bodies, and an increase in water quality turbidity. Greater use of lake water will increase the potential for DO depletion if not carefully monitored. Dust fallout, erosion and sedimentation could potentially affect the turbidity of smaller water bodies in the vicinity of the airstrip and new infrastructure. Overall, Alternative D would have minor impacts to hydrology and water quality.

Global climate change could have unpredictable impacts on winter temperatures, water balance, water availability, and timing and magnitude of spring floods (BLM 2012, § 4.2.4.4).

These changes could alter the impacts discussed for each alternative. A longer and warmer growing season could result in increased potential evapotranspiration reducing available water in lakes. Premature melting of ice roads could occur with sudden spring melts, requiring emergency demobilization in order to protect the tundra, and potentially leave less time for proper abandonment of ice bridges. Increased snowfall combined with late summer rainfall could increase the magnitude of spring peak flows above the normal range of flows, causing increased erosion and sedimentation. All alternatives under consideration would be affected, although impacts under Alternatives D may be greater due to a greater reliance on ice roads for annual operations.

4.2.3 Atmospheric Environment

4.2.3.1 Climate and Meteorology

Impacts to climate and meteorology are described in BLM (2004, § 4.2.3.1) and BLM (2012, § 4.5.1.2). GHGs have been identified as a possible contributor to the rise in global mean temperatures. Ongoing scientific research has identified the potential impacts of anthropogenic (from human activities) GHG emissions and changes in biologic carbon sequestration on the global climate. Through complex interactions on a regional and global scale, these changes are thought to cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat radiated by the earth back into space, much as glass traps heat over a greenhouse. Construction and operations activities would generate GHG emissions (See Section 4.6, *Cumulative Effects*). Due to the quantity and duration of these emissions, project impacts to climate and meteorology are expected to be negligible.

4.2.3.2 Air Quality

To address compliance with the National Ambient Air Quality Standards (NAAQS) and air quality related values (AQRVs; visibility and deposition), BLM convened a technical workgroup under the terms of the Memorandum Of Understanding Among The U.S. Department Of Agriculture, U.S. Department Of The Interior, And U.S. Environmental Protection Agency, Regarding Air Quality Analyses And Mitigation For Federal Oil And Gas Decisions Through The National Environmental Policy Act Process Understanding (Air Quality MOU), signed June 23, 2011. In conjunction with U.S. Fish and Wildlife Service, U.S. EPA, U.S. Bureau of Ocean Energy Management, National Parks Service, U.S. Forest Service, and the State of Alaska, air quality modeling was conducted to address potential near-field and far field air quality impacts.

The modeling was conducted by CPAI (via its contractor, AECOM) pursuant to the Air Quality MOU between these agencies regarding air quality analyses and mitigation in connection with oil and gas development on Federal lands. The modeling effort involved the completion of an emissions inventory for Alternatives A and D; near-field modeling for ambient air quality impacts; far field modeling for visibility and deposition; and an Air Quality Impacts Assessment. All of these documents were reviewed by members of the technical workgroup. Alternative A was initially selected for an emissions inventory because this alternative is the Applicant's proposed project. An emissions inventory was subsequently completed for Alternative D, to understand how emissions would differ from those emissions determined for Alternative A and to assess air quality impacts. Alternatives B and C have emission sources of the same types as proposed under Alternative A, from which emissions related to the construction and operation of the longer access road could be estimated. Alternative D, the roadless alternative, has different numbers of and schedules for operation of emission sources due to ice road use and the need to operate an airstrip and camp at the GMT1 pad. Alternative

A dispersion modeling analyses are considered to be representative of Alternative B and C air quality impacts due to the similarity in sources. It is assumed the same groupings of construction equipment would operate but the construction schedule would be extended for longer access road construction under Alternatives B and C.

In addition to completing AERMOD modeling for ambient air quality, CPAI undertook an additional long-range modeling effort, using the CALPUFF model. Use of the CALPUFF model was intended to assist BLM in preparation of the air quality analysis in the Supplemental EIS by providing modeled results for potential future visibility impairment and deposition in Gates of the Arctic National Park and Preserve and the Arctic National Wildlife Refuge, which are designated as Class II Areas under the Clean Air Act. These areas were identified by USFWS as Sensitive Class II areas, as defined in the Air Quality MOU, for the GMT1 SEIS air quality analysis because the areas are within 185 miles (300 kilometers) of the GMT1 well pad. The methodology and results of these modeling efforts are more fully described in Appendix H of BLM (2012).

Emissions sources for construction, drilling, and production phases of the GMT1 project consist of typical equipment that has been used at other recent drill sites on the Alaska North Slope. The following air pollutants would be produced during activities associated with this project under all alternatives: nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter (PM, including both $PM_{2.5}$ and PM_{10}), volatile organic compounds (VOC), total reduced sulfides (TRS), lead (Pb), hazardous air pollutants, and greenhouse gases such as carbon dioxide, methane, and nitrous oxide. Emissions of other regulated pollutants would be negligible. The types and amounts of air pollutants generated vary based on the phase of activity. Fugitive dust generated by driving on unpaved roads, particularly during summer months is assumed to be primarily PM_{10}. Combustion particulate matter emissions are assumed to be primarily $PM_{2.5}$. Use of dust control measures will be required to limit impacts to air quality, and use of ultra low sulfur diesel (ULSD) fuel will limit sulfur emissions.

Construction emissions, which are short-term and transient, would consist of fuel combustion emissions from on-road and non-road heavy equipment used in site preparation to excavate gravel, build the gravel pad and the access road, and construct the pipelines, VSMs, electrical lines, and communications lines from GMT1 to CD5. Additionally, small electric power generator engines, heaters, and other fuel-burning equipment as well as fugitive dust sources such as gravel excavation, storage, and placement would contribute to emissions during construction. Three construction seasons would be required. CPAI would be required to apply dust suppression measures to fugitive dust sources using a performance-based approach. Drilling emissions would also be released into the atmosphere concurrently with a portion of the construction phase of the project.

Operational emissions from GMT1 will be low because few permanent stationary source emission units are proposed for installation on the well pad after completion of construction. The ongoing and long-term emissions proposed at GMT1 include those from a heater, fugitive dust from vehicle travel to transport workers and materials to the site, and minor fugitive emissions of field gas (containing VOCs and HAPs) from equipment and pipeline components. Production activities would also include periodic well interventions and, potentially, well infill drilling. These activities will require the use of fuel-fired heaters, boilers, engines, temporary storage tanks for flowback fluids, and additional mobile sources.

Emissions from project-related equipment, including stationary sources, mobile sources (including aircraft), non-road engines, and fugitive sources, are quantified and included in

dispersion modeling for this SEIS air quality impacts assessment. Electric power from existing, off-site generation will be provided to the site after construction which will limit total project site emissions. Electricity will be provided by existing facilities which do not require any modifications as a result of the GMT1 project development under Alternative A.

Elimination or reduction of impacts to air quality from GMT1 project development is provided through design and operations features, mitigation described in Section 4.6, and the following protective measures of BLM (2013: A-9, A-10, E-1, and E-8).

Air pollutant emissions from the project will be subject to federal and state air quality regulations under the CAA and the Air Quality MOU. Air pollution impacts are limited by air quality regulations and standards, and state implementation plans, or SIPs, established under the federal CAA and the Clean Air Act Amendments (CAAA) of 1990. In Alaska, air pollution impacts are managed by ADEC under the Alaska Air Quality Control Regulations (18 AAC 50) and the EPA-approved SIP. The proposed project is unlikely to have emissions that exceed the minor source thresholds. In Alaska portable oil and gas operations must be authorized under an ADEC minor air quality permit. Based on total emissions and source types involved, the project will be required to obtain applicable state and federal air quality permits.

Alternative A

An emission inventory was prepared and an ambient air quality impact analysis was performed for Alternative A to compare model-predicted air quality impacts to applicable NAAQS and AAAQS in the near field and NAAQS/AAAQS and Air Quality Related Values (AQRVs) at locations within the Gates of the Arctic National Park and Preserve and the Alaska National Wildlife Refuge. Modeled concentrations were also compared to the Class II PSD increments for Infill Drilling, the operational activity with the highest potential emissions.

Emission Inventory

An emission inventory for Alternative A has been prepared for BLM as required under the Air Quality MOU regarding air quality analysis and mitigation required for agency decision-making (See Section 4.2.3.2). The emission inventory was developed using representative down hole produced fluids samples, manufacturer's emission data, AP-42 (USEPA 1995), the USEPA MOVES model (version 2010b), the USEPA National Mobile Inventory Model (NMIM, that uses current versions of MOVES and NONROAD models) for emissions from non-road engines, the FAA Emissions and Dispersion Modeling System (EDMS) for aircraft emissions, and Gas Research Institute emission factors/emission models and other accepted engineering models. The estimated emissions for Alternative A are shown in Table 4.2-9 for construction emissions and Table 4.2-10 for operational emissions. For each pollutant the highest rolling 12-month total emission in tons was selected for construction and for operations. These maximum 12-month emissions may not occur simultaneously but are presented to summarize the maximum possible emissions over the three-year construction period and future projected operations during any year.

Table 4.2-9. Maximum Potential 12-Month Construction Emissions for Alternative A

Pollutant	12 Month Time Period Ending	Tons Per Year
NO_X	Year 1, Month 10	125
CO	Year 1, Month 10	127
SO_2	Year 1, Month 10	1.9
PM_{10}	Year 2, Month 12	245
$PM_{2.5}$	Year 3, Month 2	33.2
VOC	Year 3, Month 5	25.6
HAPs	Year 3, Month 6	2.05
GHG (CO_2e)	Year 3, Month 7	30,980
TRS	Year 3, Month 5	12.9

Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Air Quality Impact Analysis," AECOM, 2013

Table 4.2-10. Maximum Potential 12-Month Operational Emissions for Alternative A

Pollutant	Production Year Type	Point Source and Mobile Equipment Emissions	Fugitive Emissions	Total Tons Per Year
NO_X	Typical Production Year	93.4	NA	93.4
CO	Typical Production Year	43.1	NA	43.1
SO_2	Infill Drilling Year	0.82	NA	0.82
PM_{10}	Infill Drilling Year	6	239	244
$PM_{2.5}$	Infill Drilling Year	5.5	47.1	52.6
VOC	Infill Drilling Year	10.5	27.4	37.9
HAPs	Infill Drilling Year	1.9	1.0	2.9
GHG (CO_2e)	Infill Drilling Year	33,550	521	34,071
TRS	Infill Drilling Year	0	0.1	0.1

Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Air Quality Impact Analysis," AECOM, 2013

Hazardous air pollutant (HAP) emissions will result from combustion of fuels and from venting or fugitive emissions of field gas during well completions and production operations. HAPs are not routinely monitored on the North Slope. EPA has identified a subset of HAPs which are priority mobile source HAPs, including acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. Combustion HAP emissions will result from the operation of mobile sources for Alternative A and from fuel combustion in stationary equipment. Mobile source HAP emissions are projected to decrease over time due to use of cleaner fuels and cleaner engines. Nationally, mobile source HAP emissions are projected to decrease by 72 percent from 1999 to 2050, even if vehicle activity increases by 145 percent. (FHWA 2012)

Emissions of HAPs are also a concern from well venting during drilling and well completion activities which will occur during the developmental drilling phase of the project. A maximum emissions case was developed for several air toxics from this activity to model the short-term and long-term impacts from developmental drilling. The HAPs analyzed include benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde.

Near-Field Analysis

The ambient air quality impact analysis covered various activities related to the construction, and routine operation of a wellsite, access road, pipelines and ancillary facilities to support the

development of GMT1. For the near-field analysis impacts from criteria pollutant emissions of PM_{10}, $PM_{2.5}$, NO_2, SO_2, and CO, and emissions of air toxics (benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde) were evaluated.

Several factors were considered in selecting the modeled emission scenarios including the Alternative A construction and operation schedule, the location of the project related emissions and their proximity to ambient air or sensitive receptors, and the relative magnitude and type of emissions for each activity. Five scenarios were selected for the near-field dispersion modeling analysis to cover the range of GMT1 project-related worst case emissions for the various pollutants:

1. Access Road and Pad Construction
2. Mining the Clover Material Source
3. Infill Drilling
4. Operation of the Nuiqsut Man Camps
5. Well Intervention

The modeling analysis conservatively included tailpipe emissions from mobile sources. The EPA Guideline Model (EPA 2005), AERMOD (Version 12345) was used. Alternative A impacts to ambient secondary $PM_{2.5}$ and ozone were not predicted using dispersion modeling. The AERMOD dispersion model does not have the capability to account for secondary particulate matter formation when predicting particulate matter impacts. Ozone was not modeled because the total VOC emissions of less than 50 tpy indicate that ozone formation will be minimized. Therefore, a qualitative assessment of the potential contribution to regional ozone and secondary $PM_{2.5}$ formation was conducted. Details of the analysis are provided in the Air Quality Impact Analysis report, which is included in Appendix K. The background concentrations presented in Section 3.2.3.2 were added to the model-predicted GMT1 project impacts to estimate total ambient air quality impacts.

The maximum ambient air quality impacts for all modeled scenarios under Alternative A are shown in Table 4.2-11.

Table 4.2-11. Alternative A Impacts Compared to Established Ambient Criteria

Pollutant	Averaging Period	Infill Drilling Max	Well Intervention	Road and Pad Construction	Clover Material Source	Nuiqsut Camps	Maximum Total Concentration (μg/m^3)	NAAQS/ AAAQS (μg/m^3)	Percent of NAAQS/ AAAQS	Scenario Resulting in Highest Concentration
CO	1-hour	2,403	1,983	3,011	3,427	1,933	3,427	40,000	9	Clover Material Source
	8-hour	1,680	1,587	2,268	2,380	1,462	2,380	10,000	24	Clover Material Source
SO_2	1-hour	11	11	11	24	8.2	24	196	12	Clover Material Source
	3-hour	21	21	21	48	18	48	1,300	4	Clover Material Source
	24-hour	10	10	8.5	13	7.1	13	365	4	Clover Material Source
	Annual	0.80	0.76	0.43	0.45	0.41	0.80	80	1	Infill Drilling
NO_2	1-hour	138	164	155	168	146	168	188	89	Clover Material Source
	Annual	42	10	34.2	40	18	42	100	42	Infill Drilling
PM_{10}	24-hour	115	107	113	75	59	115	150	77	Infill Drilling
$PM_{2.5}$	24-hour	29	21	34.7	33	18	35	35	99	Road and Pad Construction
	Annual	8	4	7.42	5.9	4.4	8.0	12	67	Infill Drilling

Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Air Quality Impact Analysis," AECOM, 2013

High 24-hour $PM_{2.5}$ impacts are predicted from the infill drilling scenario modeled. Predicted annual emissions for $PM_{2.5}$ and PM_{10} demonstrate compliance with the standards for Alternative A. The modeling initially assumed 75 percent control of fugitive dust based on watering. Typically, 25 percent to 50 percent control efficiency for fugitive dust is modeled in drier and warmer climates throughout the lower 48 contiguous United States. The EI calculations estimating fugitive dust emissions were refined to correct certain conservative assumptions and to more accurately reflect actual operations. By making these refinements to the calculations, project activities must only achieve an overall fugitive dust control efficiency of around 45 percent for emission levels to remain as previously estimated and modeled.

Given the geography and climate of the area, mitigation provided through a dust control plan, and the amount of water available on the North Slope, a higher control efficiency than that typically seen in drier and warmer climates can be expected. Watering at a frequency of about once per day can reasonably be expected to achieve around 50 percent or better fugitive dust control efficiency, given the conditions generally found on the Alaskan North Slope during the summer months. BLM will use a performance-based approach to watering (i.e., in response to visible dust), require watering a minimum of twice per day, as well as additional watering in the event that visible fugitive dust emissions are observed by project personnel.

High ambient NO_2 impacts in excess of the NAAQS/AAAQS were predicted during the access road and pad construction due to emissions from construction equipment.

Under federal and state PSD regulations, increases in ambient air concentrations in Class I and Class II areas are limited by PSD increments. Emissions associated with a project may increase ambient concentrations above baseline levels only within the specific increments developed for SO_2, PM_{10}, $PM_{2.5}$, and NO_2. Modeling results for the Infill Drilling scenario are presented in Table 4.2-12. For this SEIS, modeled concentrations are compared to the Class II PSD increments. These comparisons are made for informational purposes only, and the analyses described herein are not intended to be, nor should they be interpreted as a regulatory increment consumption analysis.

Table 4.2-12. Alternative A Impacts Compared to PSD Class II Increments for Infill Drilling Scenario

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)
SO_2	3-hour	3.4	512
	24-hour	2.84	91
	Annual	0.46	20
NO_2	Annual	39.3	25
PM_{10}	24-hour	71.2	30
	Annual	21.2	17
$PM_{2.5}$	24-hour	33.3	9
	Annual	5.83	4

Ambient air quality impacts were also modeled for receptors in Nuiqsut to determine the effect of the project on the closest residences. The highest modeled concentrations for each pollutant are presented in Table 4.2-13.

Table 4.2-13 Alternative A Impacts Compared to Established Ambient Criteria at the Community of Nuiqsut

Pollutant	Averaging Period	Total Concentration (μg/m^3)	NAAQS/AAAQS (μg/m^3)	Percent of NAAQS/AAAQS	Scenario Resulting in Highest Concentration
CO	1-hour	163.8	40,000	4	Clover Material Mining
	8-hour	24.5	10,000	13	Clover Material Mining
SO_2	1-hour	1.4	196	5	Clover Material Mining
	3-hour	1.1	1,300	1	Clover Material Mining
	24-hour	0.2	365	2	Clover Material Mining
	Annual	0.001	80	0	Clover Material Mining
NO_2	1-hour	39.3	188	41	Clover Material Mining
	Annual	0.1	100	3	Clover Material Mining
PM_{10}	24-hour	1.6	150	33	Pad and Access Road Construction
$PM_{2.5}$	24-hour	0.6	35	22	Clover Material Mining
	Annual	0.005	12	18	Clover Material Mining

Air Toxics Impact Analysis

Results of the air toxics ambient analysis in the vicinity of the project activities are presented in Table 4.2-14, and results of the air toxics ambient analysis in the community of Nuiqsut are presented in Tables 4.2-15 and 4.2-16.

Tables 4.2-14 and 4.2-15 show maximum modeled 1-hour concentrations are below the criteria levels for each of the air toxics evaluated and that annual modeled concentrations are below the RfCs for each of the air toxics evaluated. Table 4.2-16 shows that the total cancer risk for both the MLE and MEI scenarios are less than 1.0E-06 near the pad and in the community of Nuiqsut which represents a less than one-in-one million cancer risk.

Table 4.2-14. Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment

Pollutant	REL (1-hour) (μg/m^3)	Maximum Modeled 1-hour Concentration (μg/m^3)	Non-carcinogenic RfC[3] (Annual) (μg/m^3)	Maximum Modeled Annual Concentration (μg/m^3)
Benzene	1,300 [1]	3.3	30	0.060
Ethyl benzene	350,000 [2]	0.5	1,000	0.0017
Formaldehyde	55 [1]	1.8	9.8	0.050
n-Hexane	390,000 [2]	68.9	700	0.49
Toluene	37,000 [1]	2.6	5,000	0.031
Xylene	22,000 [1]	1.1	100	0.016

[1] USEPA Air Toxics Database, Table 2 (USEPA 2011).

[2] No REL available for these air toxics. Values shown are from (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA 2011).

[3] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

Table 4.2-15. Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment for Nuiqsut Community Receptor

Pollutant	REL (1-hour) (µg/m3)	Maximum Modeled 1-hour Concentration (µg/m3)	Non-carcinogenic RfC3 (Annual) (µg/m3)	Maximum Modeled Annual Concentration (µg/m3)
Benzene	1,300 1	0.19	30	3.80E-05
Ethyl benzene	37,000 1	0.029	5,000	1.05E-06
Formaldehyde	350,000 2	0.10	1,000	3.15E-05
n-Hexane	22,000 1	3.89	100	3.11E-04
Toluene	390,000 2	0.15	700	1.98E-05
Xylene	55 1	0.061	10	1.01E-05

[1] USEPA Air Toxics Database, Table 2 (USEPA 2011).

[2] No REL available for these air toxics. Values shown are from (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA 2011).

[3] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

Table 4.2-16. Air Toxics Long-term Cancer Risk Analysis for Nuiqsut Community Receptor

Exposure Scenario1	Pollutant	Maximum Modeled Annual Concentration (µg/m^3)	Carcinogenic Unit Risk Factor[2] (1/µg/m^3)	Exposure Adjustment Factor	Cancer Risk
MLE	Benzene	3.80E-05	7.8E-06	0.43	1.28E-10
MLE	Ethyl benzene	1.05E-06	2.5E-06	0.43	1.13E-12
MLE	Formaldehyde	3.15E-05	1.3E-05	0.43	1.76E-10
Total Inhalation Cancer Risk					**6.73E-11**
MEI	Benzene	3.80E-05	7.8E-06	0.43	1.28E-10
MEI	Ethyl benzene	1.05E-06	2.5E-06	0.43	1.13E-12
MEI	Formaldehyde	3.15E-05	1.3E-05	0.43	1.76E-10
Total Inhalation Cancer Risk					**3.**05E**-07**

[1] MLE = most likely exposure; MEI = maximally exposed individual. Duration = 30 years (life of project)

[2] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

Ambient Ozone and Secondary $PM_{2.5}$ Analysis

A qualitative analysis for ambient ozone cumulative impacts was performed for Alternative A. The analysis, which consisted of a review of recent emission trends of ozone precursors, a review of existing monitoring data, and a review of recent literature that details polar ozone trends and chemistry, clearly indicated that regional ozone concentrations are low (well below the NAAQS/AAAQS) and are not correlated to levels of anthropogenic precursor emissions. The conclusion is the small increase in regional precursor emissions that occur as a result of the project will have negligible effect on existing background ozone concentrations. Regional ozone levels will remain well below the NAAQS/AAAQS. Refer to Appendix K, Section 5.1.3, of the Air Quality Impact Analysis for the detailed analysis of ambient ozone cumulative impacts (AECOM 2013).

Evidence compiled by EPA Region 10 suggests that secondary $PM_{2.5}$ formed from precursor emissions on the Alaskan North Slope is low even in light of large precursor emissions. Therefore, precursor emissions from the relatively small GMT1 project will not result in significant secondarily formed $PM_{2.5}$. Refer to Appendix K, Section 5.1.4, of the Air Quality Impact Analysis for the detailed analysis of secondary $PM_{2.5}$ formation (AECOM 2013).

Near-Field Analysis Conclusions for Alternative A

The dispersion modeling analysis of near-field project impacts indicates compliance with all criteria pollutant NAAQS/AAAQS for all averaging periods. The near-field ambient air quality impacts analysis demonstrates that significant air quality impacts will not result from the construction or operation of Alternative A. If CPAI achieves approximately 45-50 percent control of fugitive dust, the project will meet all state and federal air quality standards. As described above, BLM will use a performance-based approach to road watering to achieve the needed control efficiency. The impacts were predicted using dispersion modeling of ambient air quality impacts as directed under the Air Quality MOU.

Far-Field Analysis

The purpose of the far-field analysis is to quantify potential far-field air quality impacts to both ambient air concentrations and AQRVs from air pollutant emissions of NO_X, SO_2, PM_{10}, and $PM_{2.5}$. Air quality-related values include atmospheric deposition and visibility.

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area in a given amount of time (kg/ha-yr, kilogram per hectare per year). Atmospheric deposition occurs as both wet and dry deposition. Wet deposition refers to air pollutants deposited by precipitation, such as rain and snow. One expression of wet deposition is precipitation pH, a measure of the acidity or alkalinity of the precipitation. Dry deposition refers to gravitational settling of particles and adherence of gaseous pollutants to soil, water, and vegetation.

Visibility can be defined as the ability to see color, texture, and contrast at a distance and can be reported as visual range, in units of distance such as miles. Visibility can be addressed by scene monitoring (producing images with a camera) or more fully by optical and chemical analyses (such as the Integrated Monitoring of Protected Visual Environments (IMPROVE) network).

The far-field analyses were performed using the EPA-approved version of the CALPUFF modeling system (Version 5.8) that was subsequently modified by the USFWS to account for Polar Stereographic coordinate system (BLM 2012). Impacts were analyzed for the community of Nuiqsut and the Sensitive Class II areas located within 185 miles (300 kilometers) of the GMT 1 Project shown in Table 4.2-17. The scenario modeled in CALPUFF was the Infill Drilling scenario, selected to represent the maximum emissions for fuel combustion sources with the most potential to cause far field air quality and AQRV impacts.

Table 4.2-17. Class II Areas of Concern

Area of Concern	Managing Agency	PSD Classification
Gates of the Arctic National Park	National Park Service	II
Alaska National Wildlife Refuge	Fish and Wildlife Service	II
Nuiqsut	Alaska Department of Environmental Conservation	II

The CALPUFF-predicted concentration impacts were compared with ambient air quality standards and post-processed to compute: 1) AQRV impacts due to light extinction change for comparison to visibility impact thresholds in Sensitive Class II areas; and 2) AQRV impacts due to deposition rates for comparison to sulfur (S) and nitrogen (N) deposition thresholds.

The analysis of air quality impacts from NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at the Alaska National Wildlife Refuge and Gates of the Arctic National Park indicated that total maximum ambient concentrations will be below the NAAQS/AAAQS for all pollutants examined for Alternative A.

Table 4.2-18. GMT1 Project-Only Air Quality Impacts at Alaska National Wildlife Refuge

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m³)	Ambient Background (µg/m³)	Total Impact (µg/m³)	NAAQS/AAAQS (µg/m³)	Percent of NAAQS/ AAAQS
NO_2	1-hour [1]	2.42E-02	38	38	188	20
	Period [1, 2]	2.04E-04	2.9	2.9	100	3
SO_2	1-hour [1]	3.72E-04	7.7	7.7	196	4
	3-hour [1]	2.46E-04	18	18	1,300	1
	24-hour [1]	1.09E-04	6.8	6.8	365	2
	Period [1, 2]	4.29E-06	0.34	0.34	80	0.4
PM_{10}	24-hour [1]	1.38E-02	48	48	150	32
$PM_{2.5}$	24-hour [1]	1.38E-02	7.1	7.1	35	20
	Period [1, 2]	6.84E-04	2.2	2.2	12	18

[1] The maximum impacts are reported for all averaging periods.

[2] Due to two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

Table 4.2-19. GMT1 Project-Only Air Quality Impacts at Gates of the Arctic National Park

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m³)	Ambient Background (µg/m³)	Total Impact (µg/m³)	NAAQS/AAAQS (µg/m³)	Percent of NAAQS/ AAAQS
NO_2	1-hour [1]	1.23E-02	38	38	188	20
	Period [1, 2]	2.54E-05	2.9	2.9	100	3
SO_2	1-hour [1]	2.54E-04	7.7	7.7	196	4
	3-hour [1]	2.34E-04	18	18	1,300	1
	24-hour [1]	9.04E-05	6.8	6.8	365	2
	Period [1, 2]	1.62E-06	0.34	0.34	80	0.4
PM_{10}	24-hour [1]	1.32E-02	48	48	150	32
$PM_{2.5}$	24-hour [1]	1.32E-02	7.1	7.1	35	20
	Period [1, 2]	3.39E-04	2.2	2.2	12	18

[1] The maximum impacts are reported for all averaging periods.

[2] Due to two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

Change in atmospheric light extinction relative to background conditions is used to measure regional haze. Analysis thresholds for atmospheric light extinction are set forth in FLAG (2010), with the results reported in percent change in light extinction and change in deciview (dv). A 5 percent change in light extinction (approximately equal to a 0.5 change in dv) is the threshold recommended in FLAG (2010) and is considered to contribute to regional haze visibility impairment. A 10 percent change in light extinction (approximately equal to 1.0 dv) is considered to represent a noticeable change in visibility when compared to background conditions. The BLM considers a 1.0 dv change as a potentially adverse impact. However, no applicable local, state, tribal, or Federal regulatory visibility standards exist. The jurisdictional Federal Land Manager or Tribal government responsible for that land is responsible for

determining if adverse impacts are or are not significant. These determinations may differ from BLM levels for significant adverse impacts.

Visibility conditions calculated for the direct Alternative A project impacts using the FLAG method were evaluated at each distant Class II area of concern to determine if the 98th percentile change in light extinction exceeds both 5 and 10 percent change in light extinction thresholds (equivalent to 0.5 deciview (dv) and 1.0 dv).

All Alternative A visibility impacts are predicted to be well below both the visibility impact assessment thresholds of 0.5 and 1.0 delta-deciview (ddv) for both Sensitive Class II areas.

Table 4.2-20. GMT1 Number of Days Greater Than 0.5 ddv

Area	Number of Days Greater Than 0.5 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0	0	0
Gates of the Arctic National Park	0	0	0

Table 4.2-21. GMT1 Number of Days Greater Than 1.0 ddv

Area	Number of Days Greater Than 1.0 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0	0	0
Gates of the Arctic National Park	0	0	0

Table 4.2-22. GMT1 Project Maximum ddv Impact

Area	Maximum ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0.061	0.075	0.080
Gates of the Arctic National Park	0.042	0.054	0.079

Table 4.2-23. GMT1 Project 98th Percentile ddv Impact

Area	98th Percentile ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0.032	0.031	0.045
Gates of the Arctic National Park	0.020	0.022	0.023

FLAG (2010) recommends that applicable sources assess impacts of nitrogen and sulfur deposition at Class I areas. This guidance recommends the use of deposition analysis thresholds (DATs) developed by the National Park Service and the USFWS. The DATs represent screening level values for nitrogen and sulfur deposition from project-alone emission sources below which estimated impacts are considered negligible. The DAT established for both nitrogen and sulfur in western Class I areas is 0.005 kg/ha/yr. The DAT is also used to assess impacts to Class II areas. For the deposition impacts analysis for GMT1, results for the project-alone sources were compared to these thresholds.

Alternative A deposition impacts are well below the DAT at both Sensitive Class II areas.

Table 4.2-24. GMT1 Project Deposition Impacts

Area	Pollutant	Averaging Period	Maximum Impact (kg/ha/yr)	DAT (kg/ha/yr)	Percent of DAT
Alaska National Wildlife Refuge	Nitrogen	Annual [1]	6.18E-05	0.005	1
Gates of the Arctic National Park	Nitrogen	Annual [1]	3.32E-05	0.005	1
Alaska National Wildlife Refuge	Sulfur	Annual [1]	2.13E-06	0.005	0.04
Gates of the Arctic National Park	Sulfur	Annual [1]	1.33E-06	0.005	0.03

[1] All maximum GMT deposition impacts occur in year 2008, thus represent a true annual impact.

Alternative B

A detailed ambient air quality impact analysis was not performed for Alternative B to assess near-field or far-field impacts. The detailed analysis performed for Alternative A is considered representative of the potential ambient air quality impacts which could result from Alternative B because the scenarios selected for modeling of Alternative A would be similar occurrences under Alternatives B, using the same equipment performing the same activities. While the specific locations and durations of construction activities may change, emissions are not expected to be dramatically different. Alternative B has a slightly longer access road.

The far-field emissions and AQRV analyses conducted for Alternative A are considered representative of Alternative B because the same types and numbers of emission sources and activities are proposed for the Infill Drilling scenario analyzed.

Emission Inventory

The construction, drilling, and operations emissions for Alternative B, which would avoid the Fish Creek Setback, would be similar to those described in Alternative A. A detailed emission inventory was not prepared for Alternative B, but emissions will be very similar to those in Alternative A. The access road under Alternative B is projected to be 0.8 mile longer, so construction emissions from land work and road construction could be expected to be slightly higher than those activities under Alternative A. In addition, ongoing operational fugitive dust emissions from traffic using the access road could be expected to be slightly higher due to the longer access road. As stated for Alternative A, 45-50 percent control of fugitive dust is assumed for Alternative B. Alternative B will have 0.7 acres of additional pad area and require an estimated 57,000 cubic yards of additional fill material. The maximum potential emissions for each pollutant under Alternative B were extrapolated from the Alternative A emission estimates using a ratio of access road lengths for road-related construction and operational emissions. Increased emissions from pad construction or fill material blasting were not extrapolated and are considered to be minor. The differences in emissions resulting from Alternative B in comparison to Alternative A are considered negligible. Operational emissions from stationary emission units at GMT1 (which require permitting) are expected to be the same as those shown under Alternative A.

Table 4.2-25. Maximum Potential 12-Month Construction Emissions for Alternative B

Pollutant	12 Month Time Period Ending	Tons Per Year[1]
NO_X	Year 1, Month 10	132
CO	Year 1, Month 10	132
SO_2	Year 1, Month 10	1.9
PM_{10}	Year 3, Month 2	270
$PM_{2.5}$	Year 3, Month 2	36.0
VOC	Year 3, Month 5	25.6
HAPs	Year 3, Month 5	2.0
GHG (CO_2e)	Year 3, Month 3	30,980
TRS	Year 3, Month 5	12.9

[1] Alternative A emissions related to road construction were scaled from 7.8 miles to 8.6 miles to calculate representative Alternative B emissions.

Table 4.2-26. Maximum Potential 12-Month Operational Emissions for Alternative B [1]

Pollutant	Production Year Type	Point Source and Mobile Equipment Emissions	Fugitive Emissions	Total Tons Per Year
NO_X	Typical Production Year		NA	93.4
CO	Typical Production Year		NA	43.1
SO_2	Infill Drilling Year		NA	0.82
PM_{10}	Infill Drilling Year	6	243.6	249.6
$PM_{2.5}$	Infill Drilling Year	5.5	47.1	52.6
VOC	Infill Drilling Year	10.5	27.4	37.9
HAPs	Infill Drilling Year	1.9	1.0	2.9
GHG (CO_2e)	Infill Drilling Year	33,555	521	34,076
TRS	Infill Drilling Year	0	0.1	0.1

[1] Alternative A emissions related to access road use were scaled from 7.8 miles to 8.6 miles to calculate representative Alternative B emissions.

Impacts Analysis

The detailed analysis performed for Alternative A is considered representative of the potential ambient air quality impacts which could result from Alternative B because the scenarios selected for modeling of Alternative A would also occur under Alternative B.

Alternative C

A detailed ambient air quality impact analysis was not performed for Alternative C to assess near-field or far-field impacts. The detailed analysis performed for Alternative A is considered representative of the potential ambient air quality impacts which could result from the Alternative C because the scenarios selected for modeling of Alternative A would be similar occurrences under AlternativeC, using the same equipment performing the same activities. While the specific locations and durations of construction activities may change, emissions are not expected to be dramatically different. Alternative C is the alternative with the longest permanent access road.

The far-field emissions and AQRV analyses conducted for Alternative A are considered representative of Alternative C because the same types and numbers of emission sources and activities are proposed for the Infill Drilling scenario analyzed.

Emission Inventory

The types of construction, drilling, and operations emission sources for Alternative C, Alternative Access via Nuiqsut, would be similar to those described in Alternative A, but the locations and magnitudes of emissions for the different source types would change under the Alternative C plan. Alternative C, with a Nuiqsut hub, would require improvements to infrastructure in Nuiqsut, which would result in construction emissions and higher ongoing mobile source emissions in Nuiqsut from use as the logistics center for the GMT1 pad. Personnel and certain supplies would be brought to Nuiqsut rather than APF, then transported to GMT1 by road vehicles. The diversion of air traffic from APF to Nuiqsut would potentially reduce aircraft emissions locally in APF and increase local aircraft operation emissions in Nuiqsut. Changes in aircraft operations have not been quantified for this PDSEIS because operations activities have not yet been defined enough for Alternative D to know how goods and services would be provided between Nuiqsut and APF. Under Alternative C, the Nuiqsut Spur Road and Nuiqsut Dump Road would be upgraded. A new 1.2 mile Airport Access Road would be constructed in addition to a new logistics pad at the airport and a 500-foot runway extension. Because the access road is longer than the access road proposed under Alternative A, both construction and operational emissions will be higher for this proposed roadway alignment. Construction emissions would also result in Nuiqsut from the construction of improvements including the upgrade of the Nuiqsut Spur Road, the Nuiqsut Dump Road, the new 1.2 mile Airport Access Road, the new logistics pad connecting to the airstrip, and the 500-foot airport runway extension. The higher Alternative C construction emissions would include combustion emissions from use of fuels in construction equipment and fugitive dust (particulate matter) emissions from earth work and material handling. As with Alternative A, 45-50 percent control of fugitive dust has been assumed in the analysis; and BLM will use a performance-based approach to road watering to ensure dust control efficiencies are maintained. Traffic on the new Airport Access Road could also be expected to increase fugitive dust over the levels projected in Alternative A. The entire route length for vehicles under Alternative C would be 17.4 miles.

A detailed emission inventory was not prepared for Alternative C, but estimated emissions have been extrapolated from Alternative A emissions. Operational emissions from sources located at GMT1 are expected to be the same as those shown under Alternative A because the pad design and equipment would not change under Alternative C. The Nuiqsut Spur Road, which will be constructed under a separate project during 2013-2014, would require widening from 24 feet to 32 feet. A simplified assumption was applied to assume construction emissions for the 9.6 miles of (future) existing roadway would increase by one-third expansion. Operational roadway-related emissions were scaled from the 7.8 mile access road proposed under Alternative A to a total length of 17.4 miles for vehicles accessing GMT1 from Nuiqsut.

Table 4.2-27. Maximum Potential 12-Month Construction Emissions for Alternative C

Pollutant	12 Month Time Period Ending	Tons Per Year[1]
NO_X	Year 1, Month 10	154
CO	Year 1, Month 10	147
SO_2	Year 1, Month 10	2.0
PM_{10}	Year 3, Month 2	343
$PM_{2.5}$	Year 3, Month 2	44.1
VOC	Year 3, Month 5	25.6
HAPs	Year 3, Month 5	2.0
GHG (CO_2e)	Year 1, Month 10 [2]	34,086
TRS	Year 3, Month 5	12.9

[1] Alternative A emissions related to improvements to the Nuiqsut Spur Road connecting with the GMT1 access road use were assumed to require a one third expansion (equivalent to constructing 3.2 miles of new access road in material volume and duration) to calculate representative Alternative C emissions.

[2] During this period emissions associated with construction were scaled to account for construction of a road length of 11 miles rather than 8.6 miles. This resulted in the maximum rolling yearly total for GHG.

Table 4.2-28. Maximum Potential 12-Month Operational Emissions for Alternative C [1]

Pollutant	Production Year Type	Point Source and Mobile Equipment Emissions	Fugitive Emissions	Total Tons Per Year
NO_X	Typical Production Year	93.4	NA	93.4
CO	Typical Production Year	43.1	NA	43.1
SO_2	Infill Drilling Year	0.82	NA	0.82
PM_{10}	Infill Drilling Year	5.7	293.6	299.3
$PM_{2.5}$	Infill Drilling Year	5.5	79.6	85.1
VOC	Infill Drilling Year	10.5	27.4	37.9
HAPs	Infill Drilling Year	1.9	1.0	2.9
GHG (CO_2e)	Infill Drilling Year	33,609	521	34,130
TRS	Infill Drilling Year	0	0.1	0.1

[1] Alternative A emissions related to access road use were scaled from 7.8 miles to 17.4 miles to calculate representative Alternative C emissions.

[2] Emissions may shift from APF related to aircraft, cargo, and camp activities. These emissions have not been quantified for Alternative C; net emission increases related to GMT1 development will be equal to those calculated under Alternative A.

Impacts Analysis

The detailed analysis performed for Alternative A is considered representative of the potential ambient air quality impacts which could result from Alternative C because the scenarios selected for modeling of Alternative A would also occur under Alternative C.

Alternative D

Air Emissions

The construction, drilling, and operations emissions for Alternative D would differ from those described in Alternative A for transportation sources because no permanent access road would be constructed. GMT1 pad access would be by fixed wing aircraft for 9 months of the year and by vehicles using ice roads during winter. Stationary source emissions from ongoing GMT1 operations would include a waste incinerator and two backup generators in addition to those operational sources proposed under Alternative A. Alternative D would also include emission

sources associated with the airstrip operations such as a portable heater in use seasonally. Construction emissions and transportation-related emissions would be higher at the GMT1 site because an airstrip facility, supporting storage, and a camp would be constructed, requiring a bigger site footprint of 87.3 acres. Due to additional power generation needs for a scenario with roadless GMT1 and GMT2 pads, a new gas-fired turbine would be installed at APF.

A detailed emission inventory has been prepared for Alternative D. The estimated emissions for Alternative D are shown in Table 4.2-29 for construction emissions and Table 4.2-30 for operational emissions. For each pollutant the highest rolling 12-month total emission in tons was selected for construction and for operations. These maximum 12-month emissions may not occur simultaneously but are presented to summarize the maximum possible emissions over the three-year construction period and future projected operations during any year.

Table 4.2-29. Maximum Potential 12-Month Construction Emissions for Alternative D

Pollutant	12 Month Time Period Ending	Tons Per Year
NO_X	Year 3, Month 7	155
CO	Year 1, Month 10	149
SO_2	Year 1, Month 10	2.3
PM_{10}	Year 3, Months 3-6	107
$PM_{2.5}$	Year 3, Month 7 & 11	24.5
VOC	Year 3, Month 5	38.4
HAPs	Year 3, Month 11	5.1
GHG (CO_2e)	Year 3, Month 7	45,246
TRS	Year 3, Month 5	12.9

Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Alternative D (Roadless) Air Quality Impact Analysis," AECOM, 2013

Table 4.2-30. Maximum Potential 12-Month Operational Emissions for Alternative D

Pollutant	Production Year Type	Tons Per Year
NO_X	Typical Production Year	178.9
CO	Typical Production Year	116
SO_2	Infill Drilling	1.8
PM_{10}	Infill Drilling	107
$PM_{2.5}$	Infill Drilling	28.7
VOC	Infill Drilling	50.9
HAPs	Infill Drilling	6
GHG (CO_2e)	Infill Drilling	51,338
TRS	Infill Drilling	0.1

Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Alternative D (Roadless) Air Quality Impact Analysis," AECOM, 2013

Alternative D Near-field Results

The ambient air quality impact analysis covered various activities related to the construction, and routine operation of a wellsite, airstrip, pipelines and ancillary facilities to support the development of GMT1 for Alternative D. For the near-field analysis impacts from criteria pollutant emissions of PM_{10}, $PM_{2.5}$, NO_2, SO_2, and CO, and emissions of air toxics (benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde) were evaluated.

Several factors were considered in selecting the modeled emission scenarios including the Alternative D construction and operation schedule, the location of the project related emissions

and their proximity to ambient air or sensitive receptors, and the relative magnitude and type of emissions for each activity. Four scenarios were selected for the near-field dispersion modeling analysis to cover the range of GMT1 project-related worst-case emissions for the various pollutants:

1. Access Road and Pad Construction
2. Mining the Clover Material Source
3. Infill Drilling
4. Well Intervention

The maximum ambient air quality impacts for all scenarios modeled for Alternative D are shown in Table 4.2-31.

Table 4.2-31. Alternative D Impacts Compared to Established Ambient Criteria

Pollutant	Averaging Period	Infill Drilling Max	Well Intervention	Road and Pad Construction	Clover Material Source	Maximum Total Concentration ($\mu g/m^3$)	NAAQS/ AAAQS ($\mu g/m^3$)	Percent of NAAQS/ AAAQS	Scenario Resulting in Highest Concentration
CO	1-hour	2,349	1,983	3,308	3,373	3,373	40,000	8	Clover Material Source
	8-hour	1,680	1,587	2,465	2,487	2,487	10,000	25	Clover Material Source
SO_2	1-hour	12	12	12	24	24	196	12	Clover Material Source
	3-hour	21	21	22	46	46	1,300	4	Clover Material Source
	24-hour	10	10	8.9	13	13	365	4	Clover Material Source
	Annual	0.81	0.76	0.45	0.46	0.81	80	1	Infill Drilling
NO_2	1-hour	155	165	166	183	183	188	97	Clover Material Source
	Annual	42	13	31	41	42	100	42	Infill Drilling
PM_{10}	24-hour	**152**	**152**	**152**	101	**152**	150	**101**	Infill Drilling, Well Intervention, or Road and Pad Construction
$PM_{2.5}$	24-hour	**35**	**35**	**44**	**35**	**44**	35	**126**	Road and Pad Construction
	Annual	**13**	7.0	8.3	6.2	**13**	12	**108**	Infill Drilling

Concentrations shown in bold and underlined exceed the NAAQS/AAAQS.

High 24-hour PM_{10} and $PM_{2.5}$ impacts are predicted from road and pad construction activities, well intervention and infill drilling. High 24-hour $PM_{2.5}$ emissions are also predicted for the Clover Material Source mining scenario. The modeling assumed 45-50 percent control of fugitive dust based on watering.

Modeling results for the Infill Drilling scenario are presented in Table 4.2-32 for Alternative D, compared to the Class II PSD increments. These comparisons are made for informational purposes only, and the analyses described herein are not intended to be, nor should they be interpreted as a regulatory increment consumption analysis.

Table 4.2-32. Alternative D Impacts Compared to PSD Class II Increments for Infill Drilling Scenario

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)
SO_2	3-hour	3.8	512
	24-hour	3.2	91
	Annual	0.47	20
NO_2	Annual	40	25
PM_{10}	24-hour	112	30
	Annual	101	17
$PM_{2.5}$	24-hour	73	9
	Annual	11	4

Ambient air quality impacts were also modeled for receptors in Nuiqsut to determine the effect of Alternative D on the closest residences. The highest modeled concentrations for each pollutant are presented in Table 4.2-33.

Table 4.2-33. Alternative D Impacts Compared to Established Ambient Criteria at the Community of Nuiqsut

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)	NAAQS/AAAQS ($\mu g/m^3$)	Percent of NAAQS/AAAQS	Scenario Resulting in Highest Concentration
CO	1-hour	1,664	40,000	4	Well Intervention
	8-hour	1,286	10,000	13	Well Intervention
SO_2	1-hour	9.1	196	5	Well Intervention
	3-hour	19	1,300	1	Well Intervention
	24-hour	7.0	365	2	Well Intervention
	Annual	0.34	80	0	Well Intervention
NO_2	1-hour	141	188	75	Well Intervention
	Annual	3.0	100	3	Well Intervention
PM_{10}	24-hour	49	150	33	Well Intervention
$PM_{2.5}$	24-hour	7.8	35	22	Well Intervention
	Annual	2.2	12	19	Pad and Access Road Construction

Alternative D results predict criteria pollutants will be in compliance in the community of Nuiqsut.

Air Toxics Impact Analysis

Results of the air toxics ambient analysis for Alternative D in the vicinity of the project activities are presented in Table 4.2-34, and results of the air toxics ambient analysis in the community of Nuiqsut are presented in Tables 4.2-35 and 4.2-36.

Tables 4.2-34 and 4.2-35 show maximum modeled 1-hour concentrations are below the criteria levels for each of the air toxics evaluated and that annual modeled concentrations are below the RfCs for each of the air toxics evaluated. Table 4.2-36 shows that the total cancer risk for both the MLE and MEI scenarios are 1.02E-06 and 4.63E-06, respectively, at receptors adjacent to the well pad, which represents a greater than one-in-one million cancer risk. These results are within the generally acceptable risk of 1 to 10 in a million. In addition, the public is not likely to access areas in close proximity to the GMT1 pad on a routine basis. Table 4.2-36 shows that the total cancer risk for both the MLE and MEI scenarios are less than 1.0E-06 in the community of Nuiqsut which represents a less than one-in-one million cancer risk.

Table 4.2-34. Alternative D Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment

Pollutant	REL (1-hour) (µg/m^3)	Maximum Modeled 1-hour Concentration (µg/m^3)	Non-carcinogenic RfC[3] (Annual) (µg/m^3)	Maximum Modeled Annual Concentration (µg/m^3)
Benzene	1,300 [1]	3.3	30	0.10
Ethyl benzene	350,000 [2]	0.52	1,000	0.013
Formaldehyde	55 [1]	8.1	9.8	0.43
n-Hexane	390,000 [2]	69	700	0.49
Toluene	37,000 [1]	2.6	5,000	0.040
Xylene	22,000 [1]	1.1	100	0.034

[1] USEPA Air Toxics Database, Table 2 (USEPA 2011).

[2] No REL available for these air toxics. Values shown are from (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA 2011).

[3] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

Table 4.2-35. Alternative D Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment for Nuiqsut Community Receptor

Pollutant	REL (1-hour) (µg/m^3)	Maximum Modeled 1-hour Concentration (µg/m^3)	Non-carcinogenic RfC[3] (Annual) (µg/m^3)	Maximum Modeled Annual Concentration (µg/m^3)
Benzene	1,300 [1]	0.20	30	1.40E-04
Ethyl benzene	350,000 [2]	0.03	1,000	1.00E-05
Formaldehyde	55 [1]	0.68	9.8	5.10E-04
n-Hexane	390,000 [2]	3.89	700	3.40E-04
Toluene	37,000 [1]	0.15	5,000	5.00E-05
Xylene	22,000 [1]	0.06	100	4.00E-05

[1] USEPA Air Toxics Database, Table 2 (USEPA 2011).

[2] No REL available for these air toxics. Values shown are from (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA 2011).

[3] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

Table 4.2-36. Alternative D Air Toxics Long-term Cancer Risk Analysis for Nuiqsut Community Receptor

Exposure Scenario[1]	Pollutant	Maximum Modeled Annual Concentration (µg/m^3)	Carcinogenic Unit Risk Factor[2] (1/µg/m^3)	Exposure Adjustment Factor	Cancer Risk
MLE	Benzene	1.1E-04	7.8E-06	0.43	3.7E-10
MLE	Ethyl benzene	1.0E-05	2.5E-06	0.43	1.1E-11
MLE	Formaldehyde	3.2E-04	1.3E-05	0.43	1.8E-09
Total Inhalation Cancer Risk					**7.35E-10**
MEI	4.70E-10	1.1E-04	7.8E-06	0.43	3.7E-10
MEI	1.08E-11	1.0E-05	2.5E-06	0.43	1.1E-11
MEI	2.85E-09	3.2E-04	1.3E-05	0.43	1.8E-09
Total Inhalation Cancer Risk					**3.33E-09**

[1] MLE = most likely exposure; MEI = maximally exposed individual. Duration = 30 years (life of project)

[2] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

Near-Field Analysis Conclusions for Alternative D

The dispersion modeling analysis of near-field project impacts indicates compliance with all criteria pollutant NAAQS/AAAQS for all averaging periods with the following exceptions:

- Predicted PM_{10} 24-hour and $PM_{2.5}$ 24-hour and annual impacts exceed the NAAQS/AAAQS for one or more of the scenarios (Infill drilling, Well Intervention, Access Road and Pad Construction and/or Clover Material Source Mining).
- 45-50 percent control of fugitive dust has been assumed in the analysis.

For the cases identified above, the near-field ambient air quality impacts analysis demonstrates that significant air quality impacts will result from the construction and operation of Alternative D for particulate matter. The project must meet all state and federal air quality standards and restricted access to project areas where significant air quality impacts are predicted (where project emissions will exceed the NAAQS/AAAQS) would be required under Alternative D. The impacts were predicted using dispersion modeling of ambient air quality impacts as directed under the Air Quality MOU.

Results of the near-field analysis indicate that air quality impacts are predicted to be higher than those predicted under Alternative A for 8-hour CO, 1-hour NO_2, 24-hour PM_{10}, 24-hour $PM_{2.5}$ and annual $PM_{2.5}$. Impacts from 1-hour CO and 3-hour SO_2 are predicted to be lower under Alternative D than Alternative A. Impacts are predicted to be the same for 1 hour SO_2, 24 hour SO_2, annual SO_2, and annual NO_2.

Alternative D Far-field Results

The analysis of air quality impacts from NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at the Alaska National Wildlife Refuge and Gates of the Arctic National Park indicated that total maximum ambient concentrations will be below the NAAQS/AAAQS for all pollutants examined for Alternative D.

Table 4.2-37. GMT1 Alternative D Air Quality Impacts at Alaska National Wildlife Refuge

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m^3)	Ambient Background (µg/m^3)	Total Impact (µg/m^3)	NAAQS/AAAQS (µg/m^3)	Percent of NAAQS/AAAQS
NO_2	1-hour [1]	5.6E-02	38	38.1	188	20
	Period [1,2]	5.9E-04	2.9	2.90	100	3
SO_2	1-hour [1]	4.5E-04	7.7	7.70	196	4
	3-hour [1]	3.2E-04	18	18.0	1,300	1
	24-hour [1]	1.4E-04	6.8	6.80	365	2
	Period [1,2]	5.6E-06	0.3	0.30	80	0
PM_{10}	24-hour [1]	5.2E-02	48	48.1	150	32
$PM_{2.5}$	24-hour [1]	5.2E-02	7.1	7.15	35	20
	Period [1,2]	2.6E-03	2.2	2.20	12	18

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

Table 4.2-38 GMT1 Alternative D Air Quality Impacts at Gates of the Arctic

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m^3)	Ambient Background (µg/m^3)	Total Impact (µg/m^3)	NAAQS/AAAQS (µg/m^3)	Percent of NAAQS/AAAQS
NO_2	1-hour [1]	2.7E-02	38	38.0	188	20
	Period [1,2]	7.8E-05	2.9	2.90	100	3
SO_2	1-hour [1]	3.3E-04	7.7	7.70	196	4
	3-hour [1]	3.0E-04	18	18.0	1,300	1
	24-hour [1]	1.2E-04	6.8	6.80	365	2
	Period [1,2]	2.1E-06	0.3	0.30	80	0
PM_{10}	24-hour [1]	7.0E-02	48	48.1	150	32
$PM_{2.5}$	24-hour [1]	7.0E-02	7.1	7.17	35	20
	Period [1,2]	1.3E-03	2.2	2.20	12	18

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

All Alternative D visibility impacts are predicted to be well below both the visibility impact assessment thresholds of 0.5 and 1.0 ddv for both Sensitive Class II areas.

Table 4.2-39. GMT1 Alternative D Number of Days Greater than 0.5 ddv

Area	Number of Days Greater Than 0.5 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0	0	0
Gates of the Arctic	0	0	0

Table 4.2-40. GMT1 Alternative D Number of Days Greater than 1.0 ddv

Area	Number of Days Greater Than 1.0 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0	0	0
Gates of the Arctic	0	0	0

Table 4.2-41. GMT1 Alternative D Maximum ddv Impact

Area	Maximum ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0.238	0.288	0.315
Gates of the Arctic	0.154	0.220	0.431

Table 4.2-42. GMT1 Alternative D 98th Percentile ddv Impact

Area	98th Percentile ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0.127	0.114	0.170
Gates of the Arctic	0.079	0.085	0.087

Alternative D deposition impacts are well below the DAT at both Sensitive Class II areas.

Table 4.2-43. GMT1 Alternative D Deposition Impacts

Area	Pollutant	Averaging Period	Maximum Impact (kg/ha/yr)	DAT (kg/ha/yr)	Percent of DAT
Alaska National Wildlife Refuge	Nitrogen	Annual [1]	1.92E-04	0.005	4
Gates of the Arctic	Nitrogen	Annual [1]	1.03E-04	0.005	2
Alaska National Wildlife Refuge	Sulfur	Annual [1]	2.79E-06	0.005	0.1
Gates of the Arctic	Sulfur	Annual [1]	1.72E-06	0.005	0.03

[1] All maximum GMT deposition impacts occur in year 2008, thus represent a true annual impact.

Alternative D far-field modeling demonstrates that Alternative D would have a slightly higher contribution to ambient concentrations, visibility impacts, and deposition impacts than Alternative A. Overall, the project contribution to these issues is negligible when the project is considered by itself.

Alternative E

Under Alternative E, the No Action Alternative, no air pollutant emissions would occur from the proposed project. Emissions in the area from the existing Alpine field would continue.

Summary of Air Quality Analysis Results

Estimated total project emissions for each GMT1 project alternative under consideration are summarized for construction in Table 4.2-44. Operational emissions are summarized in Table 4.2-45.

Table 4.2-44. Maximum Potential 12-Month Construction Emissions for Each Alternative Under Consideration (Tons per Year)

Pollutant	Alternative A[1]	Alternative B	Alternative C	Alternative D[2]	Alternative E
NO_X	125	132	154	152	0
CO	127	132	147	163	0
SO_2	1.9	1.9	2.0	2.25	0
PM_{10}	245	269	343	107	0
$PM_{2.5}$	33.2	36.0	44.1	24.4	0
VOC	25.6	25.6	25.6	34.9	0
HAPs	2.0	2.0	2.0	5.3	0
GHG (CO_2e)	30,980	30,980	34,086	43,761	0
TRS	12.9	12.9	12.9	12.9	0

[1] Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Air Quality Impact Analysis," AECOM, 2013

[2] Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Alternative D (Roadless) Air Quality Impact Analysis", AECOM, 2013

Alternative E, the no action alternative, would not result in any air emissions. Alternative A construction emissions are lower than estimated emissions for construction of Alternatives B and C because Alternative A has the shortest access road length. Construction would take a shorter amount of time resulting in the lowest emissions from combustion of fuel in construction equipment and the lowest fugitive dust emissions from material blasting and handling for road construction. Alternative D has much lower predicted particulate matter emissions because a permanent access roadway would not be constructed. Emissions of NO_X, CO, SO_2, VOC, HAPs, and GHG are predicted to be higher than the maximum 12-month emissions of those pollutants under Alternative A.

Table 4.2-45. Maximum Potential 12-Month Operational Emissions for Each Alternative Under Consideration (Tons per Year)

Pollutant	Alternative A[1]	Alternative B	Alternative C	Alternative D[2]	Alternative E
NO_X	93.4	93.4	93.4	179.6	0
CO	43.1	43.1	43.1	159.3	0
SO_2	0.82	0.82	0.82	1.85	0
PM_{10}	244	249	299.3	108	0
$PM_{2.5}$	52.6	55.3	85.1	29.4	0
VOC	37.9	37.9	37.9	52.8	0
HAPs	2.9	2.9	2.9	6	0
GHG (CO_2e)	34,071	34,076	34,130	50,121	0
TRS	0.1	0.1	0.1	0.1	0

[1] Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Air Quality Impact Analysis," AECOM, 2013

[2] Source: "ConocoPhillips Alaska, Inc. Greater Mooses Tooth 1 Alternative D (Roadless) Air Quality Impact Analysis", AECOM, 2013

Operational emissions would not result from Alternative E, the no action alternative. Alternative A emissions are predicted to be the lowest of all action alternatives for the maximum 12-month emissions for each pollutant. Operations at the GMT1 well pad would be identical under Alternatives A, B, and C; the only differences in operational emissions for these scenarios is the use of a longer access road. Alternative D has greater emissions for all pollutants except PM_{10} and $PM_{2.5}$ because fugitive roadway dust emissions are avoided for the roadless alternative but increased combustion emissions will result from additional stationary source equipment required at the pad under the roadless alternative as well as aircraft accessing the site.

The dispersion modeling analysis of near-field project impacts indicates compliance with all criteria pollutant NAAQS/AAAQS for all averaging periods with the following exceptions:

- 24-hour $PM_{2.5}$ emissions are predicted to exceed the NAAQS/AAAQS for Alternative D during Infill Drilling, Well Intervention, Road and Pad Construction, and Clover Material Source Mining.
- Annual $PM_{2.5}$ emissions are predicted to exceed the NAAQS/AAAQS for Alternative D during Infill Drilling.
- 24-hour PM_{10} emissions are predicted to exceed the NAAQS/AAAQS for Alternative D during Infill Drilling, Well Intervention, and Road and Pad Construction.
- Alternative D has predicted NAAQS/AAAQS exceedances in some scenarios; whereas, Alternative A is not predicted to result in emissions which exceed the NAAQS/AAAQS.

The air toxics analysis indicates a less than a one-in-a-million cancer risk for all scenarios.

The dispersion modeling analysis of far-field project impacts indicates compliance with all criteria pollutant standards at both the Sensitive Class II areas and the community of Nuiqsut. The AQRVs analysis indicates the project-only impacts are below thresholds.

Impact Criteria

For this DSEIS, the Air Quality impact criteria presented in Table 4.2-46 were developed to guide the evaluation of impacts from the proposed GMT1 development. The nature of an impact is generally defined by the intensity or magnitude of the impact, the duration, the potential for the impact to occur, and the geographic extent.

Table 4.2-46. Impact Criteria—Air Quality

Impact Category	Magnitude	Definition
Intensity	High	• Causing modeled pollutant concentrations of greater than or equal to the NAAQS/AAAQS; • Modeled project impacts exceed thresholds listed in NPS FLAG guidance, perceptible visibility impacts will occur and be visible from many areas of the park, occur many days over the course of a year, or be visible to a majority of park visitors on the days that they occur; and/or, • Nitrogen and sulfur deposition loading levels exceed screening thresholds listed in NPS DAT guidance, and available scientific information indicates that deposition may harm the integrity of resources in the park.
	Medium	• Causing modeled pollutant concentrations of >50% but <100% of the NAAQS/AAAQS; • Modeled project impacts exceed thresholds listed in NPS FLAG guidance, perceptible visibility impacts will occur and be visible from many areas of the park, occur between one and several days per year, or be visible to many park visitors on the days that they occur; and/or, • Nitrogen and sulfur deposition loading levels exceed screening thresholds listed in NPS DAT guidance, and available scientific information indicates that deposition will not, or is not, harming integrity of resources in the park.
	Low	• Causing modeled pollutant concentrations of <50% of the NAAQS/AAAQS; and/or, • Predicted visibility impacts and nitrogen and sulfur deposition loading levels are approaching (between 90-100%) of thresholds listed in NPS FLAG and DAT guidance.
	Negligible	• Causing modeled pollutant concentrations of <50% of the NAAQS/AAAQS; and/or, • Predicted visibility impacts and nitrogen and sulfur deposition loading levels are below thresholds listed in NPS FLAG and DAT guidance.
Duration	Long term	Irreversible impacts to air quality that extend beyond the life of the project.
	Medium term	Impacts last longer than 24 months through the life of the project.
	Temporary	Impacts last 24 months or less.
Potential to Occur	Probable	Unavoidable.
	Possible	Potential to occur (may be able to mitigate).
	Unlikely	May occur, but unlikely to occur.
Geographic Extent	Statewide	Project area and beyond.
	Local	Within GMT1 Project area footprint.
	Limited	Within 100 yards of project pad ambient air boundaries.

The Air Quality impact criteria of Table 4.2-46 were used to evaluate each proposed alternative. The assessment of impacts is presented in Tables 4.2-47 through 4.2-51.

Table 4.2-47. Alternative A—Impact Evaluation for Air Quality

Phase	Magnitude	Duration	Potential	Extent
Construction	Moderate	Temporary	Probable	Local
Drilling	Moderate	Temporary	Probable	Limited
Operations	Minor	Medium term	Probable	Local
Overall	Moderate	Medium term	Probable	Local

Table 4.2-48. Alternative B—Impact Evaluation for Air Quality

Phase	Magnitude	Duration	Potential	Extent
Construction	Moderate	Temporary	Probable	Local
Drilling	Moderate	Temporary	Probable	Limited
Operations	Minor	Medium term	Probable	Local
Overall	Moderate	Medium term	Probable	Local

Table 4.2-49. Alternative C—Impact Evaluation for Air Quality

Phase	Magnitude	Duration	Potential	Extent
Construction	Moderate	Temporary	Probable	Local
Drilling	Moderate	Temporary	Probable	Limited
Operations	Minor	Medium term	Probable	Local
Overall	Moderate	Medium term	Probable	Local

Table 4.2-50. Alternative D—Impact Evaluation for Air Quality

Phase	Magnitude	Duration	Potential	Extent
Construction	Major	Temporary	Probable	Local
Drilling	Major	Temporary	Probable	Limited
Operations	Minor	Medium term	Probable	Local
Overall	Major	Medium term	Probable	Local

Table 4.2-51. Alternative E—Impact Evaluation for Air Quality

Phase	Magnitude	Duration	Potential	Extent
Construction	NA	NA	NA	NA
Drilling	NA	NA	NA	NA
Operations	NA	NA	NA	NA
Overall	NA	NA	NA	NA

Mitigation Measures

Potential Mitigation Measure 1 — Air Quality (new subparagraph to BMP A-10)

Objective: Prevent unnecessary or undue degradation of the lands and protect health.

Requirement/Standard: To the extent practicable, all oil and gas operations (vehicles and equipment) must be powered by natural gas or electric power rather than diesel fuel.

Potential Benefits and Residual/Unavoidable Impacts: Natural gas has fewer impurities, is less chemically complex, and generally results in less pollution when combusted than diesel fuel. In most applications, using natural gas produces less CO_2, SO_2, and particulate matter, than diesel fuel, resulting in reduced health risks from fuel combustion in equipment associated with oil and gas operations. Natural gas is an available fuel for stationary combustion sources on the North Slope; however, vehicle fueling with natural gas may not be currently feasible because infrastructure and availability of appropriate vehicles. Use of natural gas-generated electric power to operate GMT1 sources, rather than diesel-fired electric power generation, is environmentally beneficial.

4.2.3.3 Noise

Potential impacts of noise generated by oil and gas industry activities in the NPR-A are discussed by BLM (2012, § 4.4.21.2) and for the project study area by BLM (2004, § 4F.2.3.3). The findings presented in these BLM documents regarding the potential impacts from noise are adopted in this analysis. In addition, a summary of the results of noise impact analysis presented in the Point Thomson Project Final EIS is presented in this section to provide background noise data for construction and operation activities that are similar to the GMT1 project action alternatives (Corps 2012, Appendix O).

Impact analysis criteria used in this assessment for transportation systems are presented below in Table 4.2-52. These impact criteria were developed based on a range of possible outcomes and to provide a frame of reference for impacts.

Table 4.2-52. Impact Criteria—Noise

Impact Category	Magnitude	Definition
Intensity	High	Dominates the soundscape
	Medium	Occasionally punctuates the soundscape
	Low	Calculated noise levels are comparable to periods of quietest natural sound (i.e., when no wind occurs)
Duration	Long-term	Irreversible impact on soundscape
	Interim	Impact lasts through operational phase of project
	Temporary	Impact lasts only through project construction and/or drilling
Context	Unique	Impacts to residential communities, concentrated subsistence use areas, biological resources listed as threatened or endangered (or proposed for listing) under the ESA and/or depleted under the MMPA and the portion of the resource affected fills a unique ecosystem role within the locality or region.
	Important	Impacts to individual residences, dispersed subsistence use areas, or depleted biological resources within the locality or region or resources protected by legislation.
	Common	Impacts to oilfield workers and usual or ordinary resources in the project study area; resource is not depleted in the locality or protected by legislation.
Geographic Extent	Statewide	Extending beyond the project study area
	Regional	Within the project study area
	Local	Within or adjacent to project components

This section describes results of analyses of noise that would be generated by the action alternatives and potential effects on receptors, which, for purposes of this SEIS, are defined as communities (human receptors), and wildlife (birds, mammals, and fish). Noise associated with construction, drilling, and operations have the potential to impact both people and wildlife in the project study area as described below.

Nuiqsut is the community nearest the proposed project (11.5 miles east south-east of the proposed GMT1 drill site). However, local residents travel widely over the project study area, pursuing subsistence activities. Additional information regarding the impacts of noise on subsistence users is presented in Section 4.4.3.

As described previously in Section 3.2.3.3, noise is defined as unwanted sound. Sound is made up of tiny fluctuations in air pressure. Sound, within the range of human hearing, can vary greatly intensity. A logarithmic scale, known as the decibel scale (dB), is used to quantify sound intensity and to compress the scale to a more manageable range. Sound is characterized by both its amplitude (how loud it is) and frequency (or pitch). The human ear does not hear all frequencies equally. The A-weighted scale (dBA) is used to reflect this selective sensitivity of human hearing. This scale puts more weight on the range of frequencies where the average human ear is most sensitive, and less weight on those frequencies we do not hear as well. The human range of hearing extends from approximately 3 dBA to around 140 dBA (Corps 2012, Appendix O, § 2.1, p. 3).

The ambient sound level of a region is defined by the total noise generated, including sounds from both natural and artificial sources. The magnitude and frequency of environmental noise can vary considerably in part because of changing weather conditions throughout a day or over the course of several days or weeks (BLM 2004, § 4F.2.3.3, p. 1103). The noise analysis conducted for this SEIS considers residents of Nuiqsut and areas where local residents travel for subsistence activities, and the wildlife that inhabit the same area.

Noise sources will include construction activities, drilling, and gravel mining; stationary sources such as generators and compressors; and mobile sources including heavy earth-moving equipment, large gravel-haul trucks, tractor-trailers, oil field service trucks, pickups, and other vehicles. Noise from aircraft overflights, landings, and takeoffs will be also be generated (BLM 2012, § 4.4.21.2, p. 349).

Noise and vibration measurements have been collected and analyzed in separate studies for the Northstar Production project and the Point Thomson project located on the North Slope. This information is used as introduction to the types of noise that could be expected from the GMT1 action alternatives.

The Northstar Production project is an artificial drilling island approximately 6 miles offshore of Prudhoe Bay. Field measurements were collected and analyzed of noise and vibrations created by heavy equipment and other sources from the final construction phases of the project. Noise sources from the construction included ice augers, water pumps for ice road construction, a bulldozer plowing snow, a trencher cutting ice, trucks hauling gravel over an ice road, a large excavator trenching the seafloor for a subsea pipeline, and driving sheet pile. In-air sounds generated by construction were reported to reach background levels within 2 miles of the activities (Greene et al. 2008).

The noise impact analysis for the Point Thomson Project, a large natural gas production project, included noise generated at central production facility (CPF), drill pads, roads, and an airstrip (Corps 2012, Appendix O, pp. 49-50). The Point Thomson Project is substantially larger, and includes more noise-generating equipment than the proposed GMT1 project. Noise analyses for the Point Thomson Project, gathered in 2010, are summarized below to provide context for the currently proposed GMT1 Project:

- Ambient noise levels at a coastal plain monitoring site, located approximately 9 miles inland, were measured at 32 dBA in winter and 31 dBA in summer, and were dominated by the sound of weather events. During summer ambient noise is dominated by sounds of wind and animals including caribou, bears, and insects.
- Noise has the potential to dominate the ambient soundscape in the immediate vicinity (within 0.5 mile) of the noise sources;
- The drill rig is a large noise emission source during the construction and drilling phase and power turbines used during operations would be the greatest noise source during operations;
- Noise in the Point Thomson project area (a 2.5-mile buffer from facilities) would increase between 0 to 21 dBA depending on existing conditions and distance from the noise sources.
- Construction and drilling noise may be audible, estimated at 5 dBA over ambient levels, up to 8 miles away. Increases of less than 2 dBA are generally considered to be below the threshold of human perception (depending upon the spectral distribution of the sound; low frequency sounds may be audible during periods of low or no wind).

Construction

Construction of the GMT1 project will be typical of other ACP oilfield development projects in terms of schedule, equipment used, and other types of activities. Construction of the proposed facilities is expected to temporarily increase noise levels within the project study area. Noise levels would vary during the construction period, depending on the type of activity. There would

be a temporary increase in noise levels in the immediate vicinity (within 0.5 mile) of the construction activities, occurring at a specific location for only part of a single winter season (BLM 2004, § 4F.2.3.3, p. 1104).

The Clover site is located 5.8 miles west of Nuiqsut. The blasting and earthmoving activity necessary to extract gravel will result in short-term, low-intensity noise impacts to Nuiqsut, depending upon the season and environmental conditions. Wind is a prevalent environmental condition. Noise from the blasting taking place at the Clover site would be expected to be audible at Nuiqsut.

The construction of the GMT1 project gravel roads, drill pads and production pads, and pipelines would cause temporary increases in noise in the immediate vicinity of the construction sites. Dispersed subsistence activities could place individuals or small groups within a zone of noise levels above background for short periods.

Summer construction related activities, during which birds and other wildlife are present and active, may occur. The level of disturbance that may be encountered will vary depending upon species of bird, the nature of the disturbance, the location, and the distance of the bird from the disturbance. The range of bird responses to noise may include temporary or permanent displacement from preferred habitats and increased energy expenditures, which could have other effects. Disturbances from noise would also have similar effects on mammals. If noise results in displacement from preferred habitats, the animals may be required to expend energy responding to the noise disturbance. If unable to compensate for the expended energy, the animal's survival and reproduction could be effected depending on the timing of the noise disturbance. The potential disturbance of birds and mammals are discussed in Section 4.3.3 and 4.3.4, respectively.

Pile-driving work for bridge construction at the Tiŋmiaqsiġvik (Ublutuoch) River and Crea Creek will occur during winter at locations where the ice is grounded to the bottom of the channel and the transmission of vibratory sounds into or through water is avoided. Noise and vibration resulting from pile-driving work can extend thousands of feet away from the origin of the activity with vibration and noise disturbances occurring with each blow delivered to the pile. Pile driving is known as one of the noisiest construction operations with a 90 dBA level at 300 feet from the source for the noisiest hammer (Marr 2014). The intensity of both vibration and noise related to pile-driving work decreases with the log distance away from the source. The primary complaint associated with pile-driving is the annoyance caused to people and potentially wildlife.

Pile driving produces underwater noise audible to species in the area and is likely to be one of the noisiest onsite activities. In underwater environments, pile driving is known to produce strong noise levels. The level of underwater noise is dependent upon the depth of the water or ice into which piles are driven, the density/resistance of the substrate, bottom topography and composition, physical properties and dimensions of the pile, and type of pile-driver used (BLM 2012, § 5.11, p. 5-346). Noise from pile-driving can result in hearing loss, masking of biologically important sounds, increased stress levels, impacts to immune systems, and death to fish, larvae, and eggs. Larger fish can be startled while smaller fish can be injured or die (BLM 2012, § 5.12, p. 5-379). Piles driving during the winter months would reduce the impact as fish would be in overwintering areas and possibly away from pile-driving activities.

In 2012 laboratory-based studies were conducted on the effects of pile-driving sounds on non-auditory tissues of fish. The studies indicated that the severity of injury in different fish species

was related to the sound exposure level of each strike and the total number of strikes. At the maximum level tested, mortal injuries were observed. Impulsive sounds travel great distances from their source and fish will likely hear these sounds out to a distance that is substantially greater than the distance over which fish may suffer barotrauma. Indeed, fish have a higher probability of hearing pile driving sounds before they are close enough to be injured. It is often theorized that fish would swim away from impulsive sounds when the signals are below those that cause damage. However, at this time there is no data to support those theories (Popper et al. 2013).

Special studies may be conducted during one or more phases of the proposed project. During these studies, helicopters may be utilized. The noise level from passing helicopters varies by aircraft type and conditions with a range of 68 to 78 DBA during flight (approximately 1300 feet); this noise however is only detectable for approximately 30 seconds (BLM 2004, § 4F.2.3.3, p. 1105).

Drilling and Operation

During the drilling phase of the project, the predominant sources of noise will include diesel engines used for power generation and the drill rig operation, with equipment dB ratings of 85 dBA and 110 dBA, respectively (BLM 2004, § 4F.2.3.3, p. 1105). Generally, the drilling equipment in the project study area will operate at about 70 dBA from less than 1,000 feet if properly mitigated by noise minimization measures such as mufflers on the exhaust systems of engines and turbines (BLM 2004, § 4F.2.3.3, p. 1105).

Noise from drilling activities at the GMT1 drill site is unlikely to be heard at the village of Nuiqsut located 11.4 miles away. Under typical weather conditions, background noise from the wind is expected to mask the noise generated at the drill site before reaching the community.

Comparison of Alternatives

The project action alternatives differ in the configuration of facilities and activities that produce noise and would result in different noise impacts to the community of Nuiqsut and to residents travelling in the project study area pursuing subsistence activities and wildlife.

The four action alternatives include some common elements that would produce similar noise impacts, including the drill site location and the use of ice roads during construction. These noise impacts would be distributed along similar ice road access routes for construction of the GMT1 drill pad and other gravel infrastructure. Alternatives A, B, and C would involve road construction from the CD5 access road to GMT1 drill pad, whereas Alternative D would involve construction of an airstrip and a pad for housing and additional storage space. Although the estimated volumes of gravel differ for these facilities, the transport of gravel over similar routes and durations to deliver this material would produce noise impacts to Nuiqsut at approximately the same intensity, but for a longer period of time for Alternative C, which requires the most gravel to construct. If the ASRC mine site is used, there would be higher levels of noise impact to Nuiqsut as the ice road route linking the mine site with the CD5 road would be within approximately 3 miles of the nearest residence in Nuiqsut.

Alternative C, which involves placement of gravel along the entire Nuiqsut Spur Road and Dump Road, would result in the highest intensity of construction noise impact to Nuiqsut residents among the four action alternatives. Gravel trucks, loaders, graders, and other equipment would be working adjacent to the community to place gravel for the airport access road and upgrade of the Dump Road. This noise impact would be in addition to that of

Alternative A, because the road construction west, from the junction of the Nuiqsut Spur Road, is common to both Alternatives A and C.

Alternative C, which would utilize the Nuiqsut airport for access, would introduce additional aircraft noise into the soundscape and increase the overall duration of impact, though the intensity would be similar to the existing noise sources. The types of aircraft that would deliver workers under this scenario are expected to be similar to existing commercial flights from Deadhorse.

Alternatives A and B differ by the location of the access road, with the Alternative B road alignment shifted to the south. The two road routes differ by a small amount in the potential road noise exposure to the community of Nuiqsut: Alternative A will have approximately 2.1 miles of the access road within 7.5 miles of the nearest residence in Nuiqsut. This road would be used for construction, drill rig transport, drilling support, operations, and spill response/training activities. In comparison, Alternative B would have 2.7 miles within the same distance (7.5 miles) from the nearest residence in Nuiqsut, a difference of 0.6 mile. This minor difference is unlikely to add a measureable increase in noise impact to Nuiqsut with Alternative B.

Alternative D would use aircraft to transport personnel and equipment to the GMT1 drill site, which would pose an additional noise impact mechanism not present with Alternatives A, B, and C. Small, twin-engine aircraft would be the primary transportation link to the APF when ice road travel is not available (typically nine months of the year). Noise impacts from aircraft are well documented with respect to wildlife in natural environments and human populations residing in proximity to busy airports. Twin-engine propellers at 1,000 feet elevation emit a noise level of 69 to 81 dBA (BLM 2004, § 4F.2.3.3, p. 1105). In a rural and generally non-human dominated soundscape such as the project study area, aircraft have the potential to create noise levels above background levels over large areas of landscape. However, the ambient level of natural sound produced by the wind is expected to mask aircraft noise for much of the time in the project study area.

Under Alternative D, aircraft noise would be audible to drill site workers housed at GMT1 on a regular basis because the living quarters would be located at a pad adjacent to the airstrip. Noise from aircraft flying between APF and GMT1 under Alternative D may be audible at Nuiqsut. The direct route between these facilities, a distance of 12.1 miles, would pass within 5.5 miles of Nuiqsut at its nearest point. About half of this flight path, would pass within 7 miles of Nuiqsut. Environmental conditions favoring sound transmission such as cold temperatures and calm winds would provide the greatest likelihood of noise impacts to Nuiqsut. The frequency of these conditions corresponding to flight times is potentially lower during the winter ice road season when flights would be replaced by ice road traffic. Nuiqsut is adjacent to its airport and experiences moderate to high levels of aircraft noise for short periods of time.

Takeoffs and landings would produce the highest levels of aircraft noise; potential noise impacts at Nuiqsut may result from flights at APF, located 8.1 miles from the nearest residence in the community. In comparison, takeoffs and landings at the GMT1 airstrip under Alternative D are unlikely to be audible 9.6 miles away at the nearest residence in Nuiqsut, although the flight path may pass with audible range of the community.

Fixed-wing aircraft (Dash-8, CASA, DC-3) are used to transport cargo and/or personnel to and from APF from Deadhorse and/or Kuparuk. These aircraft do not transit over the Beaufort Sea and maintain a minimum altitude of 1,500 feet (weather permitting) when flying over the main

channel of the Colville River. Fixed-wing aircraft operated by CPAI would not be flying near the GMT1 project study area under Alternatives A, B, and C. Helicopters managed by CPAI would be used during the summer season to support compliance-related and other associated with GMT1. Helicopters would only fly inland at considerable distance away from Harrison Bay and, as such, would only have the very limited potential to impact marine mammals hauled out on land or ice along the flight route.

Mitigation

Reduction of potential noise impacts is provided through design and operations, mitigation described in Section 4.7, and Protective Measure F-1 of the BLM (2013). Workers in the project study area would be subject to Occupational Safety and Health Administration (OSHA) standards for hearing protection if, and as, necessary.

Conclusion

In summary, noise generated by the construction, drilling, and operation of the project action alternatives would have impacts to the community of Nuiqsut and subsistence resources including caribou, birds, and other wildlife. The impacts are expected to be temporary and within the range described in BLM (2004, § 4F.2.3.3).

Except for drilling operations, which may occur at any time of the year, construction noise will be confined to 2 winter seasons. Noise from the operation of production facilities at GMT1 would have an adverse impact to subsistence users, wildlife and non-subsistence users near these two sites. The relative impact to increased noise from facility operation would be of high intensity, long-term duration, and local in spatial extent. Likewise, the increase in noise generated by vehicle traffic on 7.8 miles (GMT1) of gravel road would have a low intensity, be localized to the road area and have traffic volumes and timing reflecting maintenance and monitoring schedules. Noise associated with gravel mining at the ASRC and the Clover sites would be limited to the winter. Alternatives A and B would have similar noise generation activities. Alternative C is different in the long-term type and location of noise generation from a long-term, regular year-around increase in vehicle traffic between Nuiqsut and the APF. There would be an increase in aircraft traffic using the Nuiqsut Airport and a small decrease in the number of aircraft traffic to the APF. Alternative D would eliminate vehicle summer traffic between CD5 and GMT1 and the conceptual GMT2; access to the two drill sites would be by aircraft to a new airport at each site. Winter access would include use of vehicles using a new ice road constructed each year.

Based on a BLM conclusion that wilderness characteristics of naturalness, outstanding opportunities for solitude or primitive unconfined recreation in NPR-A are essentially intact at a distance of 5 miles from communities (BLM 2012, § 4.8.7.18, p. 276), noise increases associated with the GMT1 Project would likely be within ambient conditions at a distance of 5 miles from a noise generator.

There are differences among the project alternatives with regard to potential noise impacts to the community of Nuiqsut. Alternative D, which would require the use of aircraft to transport personnel and supplies to the GMT1 drill site for most of the year, would have the greatest potential noise impact to the community during drilling and operations. During construction, Alternative C, which involves gravel infrastructure development at the Nuiqsut airport and around the community, would have the highest levels of noise impact as a result of gravel hauling and earthwork to construct pads, roads, and the airstrip extension. Incremental noise impacts from increased air traffic at the Nuiqsut airport would be expected under Alternative C.

Based on data collected for the Point Thompson project (Corps 2012, Appendix O, pp. 49-50), noise levels are expected to be similar in summer and winter. Certain activities that take place, such as piling driving, will have a greater impact on the level of noise generated. Noise levels are expected to be highest during the construction phase of the project.

The noise impacts for Alternatives A, B, and C are all anticipated to be of medium intensity, temporary duration, local extent, and important context. The overall anticipated noise impact for these three alternatives is considered minor. For Alternative D, the noise impacts are anticipated to be high intensity, temporary durations, regional in extent, and unique in context. The overall anticipated noise impact for alternative D is moderate.

4.2.4 Project Effects on Climate Change

This section discusses the potential effects of the project alternatives on climate change. The effects of climate change on the environmental resources in the project study area are discussed elsewhere in this SEIS.

The proposed GMT1 Project would produce direct and indirect GHG emissions that contribute to climate change.

The BLM (2012, §§ 4.4 and 4.5; and Appendix C) provides updated analyses and conclusions about the effects of oil and gas development in NPR-A, including the GMT1 Project study area, from BLM (2004). These updated evaluations and conclusions are incorporated by reference and summarized below.

The BLM concluded that:

"Air quality impacts from oil development in the NPR-A would contribute some greenhouse gas emissions, including carbon dioxide, methane, and other gases. Although the cumulative effects of global greenhouse gas emissions are well understood, our current scientific understanding of climate change does not allow us to relate specific sources of GHG emissions to any specific climate-related regional or global impacts. Further, since the specific effects of the proposed action, which may or may not contribute to climate change, cannot be determined, it is equally impossible to determine whether any particular action will lead to significant climate-related environmental effects. While it is not possible to know with confidence the impact of increased greenhouse gas emissions due to proposed operations within the planning area on global climate change, the total GHG emissions would be minuscule in comparison with total global emissions and the contribution to climate change would be very small.

Oil development in the NPR-A would also release particulate matter (PM). Fine particles ($PM_{2.5}$) can exist in the atmosphere for several weeks and have local short-term impacts on climate. Light-colored particles reflect and scatter incoming solar radiation, having a mild cooling effect, while dark-colored particles (often referred to as "soot" or "black carbon") absorb radiation and have a warming effect. The IPCC (2007) has recognized the potential for "black carbon" (light-absorbing carbon) to deposit on snow and ice, altering the albedo, and enhancing melting. However, there is considerable uncertainty regarding the net impact of atmospheric particles on climate. It is not currently possible to associate the impact of PM emissions from any particular activity on global climate change, although the total PM emissions would be minuscule in comparison with total global emissions and the contribution to climate change would be very small" (BLM 2013c, Vol. 2, § 4.3.1.2).

Given BLM's conclusions regarding the project's effect on climate change, it is expected the impacts of the proposed GMT1 on climate change from the emission of GHGs are negligible.

4.3 Biological Environment

The following discussion of potential environmental consequences to the biological environment is generally categorized and organized as it is in BLM (2004).

4.3.1 Vegetation and Wetlands

The proposed project and the action alternatives would result in impacts to vegetation and wetlands during construction and operation. These impacts are described specifically for the 2004 proposed project by BLM (2004, § 4A.3.1), in general for the Northeast NPR-A (BLM 2008b, §§ 4.4.5 - 4.4.6), and for the entire NPR-A (BLM 2012, § 4.5.5 - 4.5.6). The following discussion summarizes the impacts and is supplemented with information from the Point Thomson FEIS related to potential vegetation and wetland impacts (Corps 2012, § 5.8).

The impact evaluation criteria used for this analysis are summarized in Table 4.3-1 and impact summary tables are provided with each alternative. In circumstances where more than one intensity type may apply to an impact category, the most severe intensity type was used for evaluating impacts.

Table 4.3-1. Impact Criteria—Vegetation and Wetlands

Impact Category	Magnitude	Definition
Intensity	High	Impacting >25% of a vegetation type or more than 10% of the total area Functional Category I and II wetlands within the project study area.
	Medium	Impacting 5 to 25% of a vegetation type or 5% to 10% of the total area of Functional Category I and II wetlands within the project study area.
	Low	Impacting < 5% of any vegetation type or <5% of the total area of Functional Category I and II wetlands within the project study area.
Duration	Long term	Impact would be permanent, rehabilitation[1] or restoration[1] not possible.
	Interim	Impact would last for the life of the project, rehabilitation possible, restoration not possible.
	Temporary	Impact would last through project construction or would be incidental in other project phases, rehabilitation likely, restoration possible.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality and is not protected by legislation.
Geographic Extent	Statewide	Extends beyond project study area.
	Regional	Extends beyond 300 ft from project components but within project study area.
	Local	Within the footprint and extending 300 ft from project components.

[1] Rehabilitation means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area. Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. (73 Federal Register 70 [April 10, 2008], p. 19672).

The effects on vegetation and wetlands may also affect related resources such as soils, hydrology, water quality, and wildlife habitat described in other parts of Section 4. This section focuses on the potential effects on vegetation and wetland ecosystems that are not covered in other sections of this SEIS.

Impacts to vegetation and wetlands could also occur as a result of an oil spill. Potential effects of oil spills are described in BLM (2012, § 4.3.4.2). Spills are also discussed in Section 4.5 of this SEIS. The extent of environmental impacts of a spill would depend upon the type and amount of material spilled, the location of the spill, and the effectiveness of the cleanup. It is anticipated, based on North Slope spill history, that the majority of spills would be contained on a gravel road or pad with little or no impacts to wetlands or vegetation.

Potential impacts to vegetation and wetlands have been analyzed for direct and indirect impacts for each alternative using GIS to overlay the project infrastructure such as gravel roads, pads, and airstrips onto the integrated terrain unit mapping (ITU) available for most but not all of the project study area (approximately 12 percent is not covered by ITU mapping). The potential impacts within the footprints of project components were calculated by overlaying the project component footprints for each alternative onto the baseline vegetation and wetland mapping described in Section 3.3.1 (Vegetation and Wetlands), and determining the areas of each vegetation and wetland type within the footprints. See Appendix E, Wetland Functional Assessment.

The combined footprint of direct impact on the tundra for each of the action alternatives is summarized in Table 4.3-2 by vegetation and wetland classes. Table 4.3-2 also compares the portion of impacted vegetation type under each alternative to the total acreage of the corresponding vegetation type found in the mapped portion of the project study area (this analysis assumes that the unmapped portion of the project study area contains similar proportions of each vegetation type as found in the mapped areas). Table 4.3-3 provides details of the vegetation and wetland impacts by common components of each alternative.

4.3.1.1 Construction

Gravel placed on the tundra surface for the construction of roads and pads would smother the vegetation and permanently alter the natural soil horizon by compression. Gravel must be a minimum of 5 feet thick to maintain the integrity of the underlying permafrost, producing a large amount of weight (e.g., gravel weighs about 2,750 pounds per cubic yard, a 5 feet thick layer would weigh 4,565 pounds per square yard).

The VSMs installed to elevate pipelines would displace approximately a 12-inch diameter footprint each on the tundra surface. Pipelines would alter snow accumulation patterns and shade vegetation.

Surface vegetation and overburden would be removed during excavation of gravel (Clover and/or ASRC Mine Site). Overburden from the mine would be temporarily stockpiled on an adjacent ice pad. This ice pad would be built once and the gravel mined from the site would be hauled directly to the construction sites.

Excavation of the Clover site or expansion of the ASRC Mine Site would result in loss of the existing vegetation and wetlands within the mine footprint. The gravel mine would fill slightly with water over the course of the summer and would require dewatering. Water discharged to the tundra surface or into a natural drainage for this duration during the late growing season

would temporarily alter the hydrologic regime and may affect vegetation or wetlands. If discharge rates were not controlled, or the flows not appropriately dissipated, vegetation could be destroyed and surface soil erosion could occur (BLM 2004, § 4F.3.1, p. 5-137). After cessation of gravel mining, the site would be closed and rehabilitated. Rehabilitation would include replacement of overburden, contouring, and creating stable sidewalls. Over the course of time, natural sheet flow would fill the mine site with water and create open water habitat.

Construction activities would require seasonal ice roads and seasonal ice pads, which would be built over consecutive years depending upon the alternative. A summary of ice road construction parameters is provided in Table 2.3-2. When compared to gravel roads and pads, seasonal ice infrastructure has less of an impact to tundra vegetation communities; however, seasonal ice infrastructure may still cause disturbance such as delayed plant development, plant stress, freezing of plant tissues, and physical damage resulting in visible traces on the tundra surface (Corps 2012, p. 5-148). Plant communities dominated by shrubs and other woody species are the most susceptible to physical damage and stress caused by construction. Flooded and wet tundra types generally exhibit little or no impact from ice road construction (Corps 2012, § 5.8.3.1, p. 5-148). New ice road construction methods, such as using aggregate chips shaved from frozen lakes, substantially decrease both water demands and construction time (BLM 2012, § 4.2.1.2, p.18). The impacts to wetlands and vegetation from seasonal ice pads would be similar to those of ice roads. Generally, changes in the thermal regime or compaction of soil have not been found to result from ice road construction. The effects of seasonal ice roads that are constructed within the same footprint each year may have additive effects, although there is limited documentation of this occurring (Corps 2012, p. 5-149).

Standard ice road construction practices have improved over time and include preconstruction routing surveys and road designs to avoid tussock tundra areas, steep stream banks, and deep water holes. As-built data from previous year's ice roads are considered in design and construction crews deviate alignments in the field if unexpected environmental conditions are encountered. Impoundment of snowmelt runoff upgradient of ice roads is expected to be of such short duration each year that its effects would be negligible (Corps 2012, p. 5-149).

Water removal from freshwater sources would occur throughout the life of the project for use in building ice infrastructure. Water removal from freshwater sources is a permitted activity and would be regulated by permit stipulations intended to ensure recharge during spring snowmelt. Future water withdrawals would not be permitted until lakes have fully recharged. If complete recharge did not occur, the decreased water levels of ponds and lakes could result in exposure of bare substrate and potential decreased vigor of associated aquatic and shoreline vegetation until the pond refilled the following season (Corps 2012, p. 5-149).

4.3.1.2 Drilling and Operation

Drilling activities would not have specific impacts to wetlands and vegetation different than those discussed for construction. Discussion of potential impacts to wetlands and vegetation from hydrocarbon spills or leaks that could occur during drilling is presented in Section 4.5.

During operations, there would be indirect impacts to vegetation and wetlands adjacent to gravel roads, pads, and airstrips resulting from dust deposition and gravel spray, altered snow distribution, hydrologic impoundments, and thermokarst (Table 4.3-3). The effects of these impacts are likely to occur most often within 300 feet from the source, based on data presented in Auerbach et al. (1997). Gravel and dust could smother vegetation and cause early snowmelt, reduced soil nutrients, lower moisture, an altered soil organic horizon, higher bulk density, and

greater depth of thaw. Other potential effects identified by the Corps (2012, § 5.8.3.1) include: reduction in vegetation biomass, early green-up of plants, increases in graminoid composition, decreases in sphagnum and other mosses and lichens, shallower organic horizon, and changes to soil pH. A 300-foot zone of indirect impact to vegetation and wetlands is considered a high estimate of impact magnitude, as it is double the 150 feet used previously to estimate indirect gravel impacts by BLM (2012, § 4.3.3.2, p. 109) and nearly double the 164 feet used recently for the Pt. Thomson EIS by the Corps (2012 § 5.8.3.1, p. 5-138). For this analysis, the area of indirect impact was determined by applying a 300-foot-wide buffer to the perimeter of gravel-filled areas and calculating the area of each vegetation and wetland type within the zone using GIS.

Impoundment of water has been identified as a potential impact where gravel roads are constructed across areas susceptible to sheet flow during the intense spring snowmelt and runoff period. After snowmelt, surface flow is expected to be limited to drainageways, and culverts would be placed in those locations to prevent or limit impoundment. Potential vegetation inundation caused by impoundment was evaluated by the Corps (2012) for Pt Thomson on the North Slope, which generally predicted that within a 500-foot-wide zone downgradient of a gravel road, approximately half the area would experience greater surface water flow and half would experience less surface water flow during the short-lived snowmelt period (Corps 2012, p. 5-133). A site-specific analysis of potential inundation by road fill is presented in Section 4.2, *Water Resources*.

Off-road tundra travel during the snow-free season using tundra-safe vehicles (e.g., low-ground-pressure vehicles) may occur for regular and emergency maintenance of pipelines and other infrastructure. The frequency of tundra travel cannot be estimated at this time, but could occur under a variety of circumstances, such as to investigate or clean up a pipeline leak or if there was need to access an existing pad or other site with no gravel or ice road access. Impacts to vegetation may range from light impacts such as compression to more severe impacts such as displacement or removal. The degree of impacts generally depends on the vegetation type and the number of passes over the tundra (Corps 2012, p. 5-151). Several stipulations apply to summer off-road tundra travel to protect wetlands and vegetation.

Discharges of treated domestic wastewater could occur in the tundra in accordance with APDES requirements. This applies to all action alternatives.

Maintenance of gravel roads would include periodic watering to aid in dust suppression.

The indirect impacts summarized in Table 4.3-3 do not include the potential effects of annual melt water inundation that is expected to occur beyond the 300 feet indirect impact zone for brief periods of time during the spring snow melt. Culverts would be placed in low spots to control drainage and prevent damage to the roadway, spaced at approximately 500 feet intervals along roads, or more frequently as needed and/or stipulated by permit, to minimize surface water impoundments. During spring snowmelt, after construction, the need for additional culverts to minimize impoundments would need to be evaluated. At 500 feet spacing, the altered moisture regimes would extend an estimated average of 500 feet on the downgradient side of a gravel road. Culverts can become clogged with snow and ice during the snow melt period, increasing flooding potential (Corps 2012, p. 5-147). Infield gravel roads would also cross small tundra streams with culverts planned for small tundra streams, and bridges would be used to cross two of the drainages along the GMT1 access road system (see Hydrology impacts discussion in Section 4.2).

Table 4.3-2. Direct Impacts of Construction on Vegetation and Wetlands (acre)

Vegetation Type	Wetland Type[1] (Cowardin Code / Functional Category)	Mapped Project Study Area[2]		Alternative A		Alternative B		Alternative C		Alternative D	
		Acres	(%)	Acres	(%)	Acres	(%)	Acres	(%)	Acres	(%)
Cassiope Dwarf Shrub Tundra	PSS3B / NA	86	0.1%								
Fresh Grass Marsh	PEM1H, R2AB3H / II	438	0.5%	<0.1		<0.1		<0.1		<0.1	
Fresh Sedge Marsh	PEM1H / II	970	1.1%	0.8	0.1%	1.2	0.1%	0.9	0.1%	<0.1	
Moist Sedge–Shrub Tundra	PEM/SS1B / III	15,187	17%	19.2	0.1%	26.5	0.2%	26.1	0.2%	24.8	0.2%
Old Basin Wetland Complex	PEM1F, PUBH, PEM1B / II	5,508	6.1%	5.5	0.1%	8.6	0.2%	5.7	0.1%	2.0	<0.1%
Open Low Willow	PSS1B / II	2,685	3.0%	0.1	<0.1%	0.1	<0.1%	0.1	<0.1%	<0.1	
Open Tall Willow	PSS1B / II	67	0.07%	0.3	0.5%	0.3	0.4%	0.3	0.4%	<0.1	
Riverine Complex	R2UBH, R2AB3H / II	162	0.2%	0.2	0.1%	<0.1		0.3	0.2%	<0.1	
Tussock Tundra	PEM/SS1B / III	15,973	18%	41.1	0.3%	29.5	0.2%	56.0	0.4%	50.2	0.3%
Water	PUBH, R2UBH / II	18,100	20%	0.1	<0.1%	1.5	<0.1%	0.1	<0.1%	0.8	<0.1%
Wet Sedge Meadow Tundra	PEM1E, PEM1F, PEM1F / II	23,814	26%	5.2	0.0%	11.6	<0.1%	6.8	0.0%	9.6	<0.1%
Total Potential Wetlands		**82,989**	**92%**	**72.5**	**0.1%**	**79.3**	**0.1%**	**96.3**	**0.1%**	**87.3**	**0.1%**
Barren	Us (upland)	3,019	3%					1.2	<0.1%		
Total Project Study Area	**102,487**			**72.5**	**0.07%**	**79.3**	**0.08%**	**97.5**	**0.10%**	**87.3**	**0.09%**

[1] Wetland types are from the Cowardin classification system used by the National Wetland Inventory (http://www.fws.gov/wetlands/). Functional Category ratings were interpreted from Table 4 of the Wetland Functional Assessment for the Greater Mooses Tooth Unit Development Project – 2013. Prepared for ConocoPhillips Alaska, Inc. by Wendy Davis, ABR, Inc., Anchorage, AK. December 2013. The Functional Category ratings reflect the particular functions and their magnitude (e.g., Low, Moderate, High) assigned by the author, resulting in Functional Categories of I (high), II (moderate), or III (low). The wetland functions these ratings represent are discussed in Section 3.3 Vegetation and Wetlands. "NA" indicates no functional ratings available for this wetland type.

[2] Percent of vegetation type acreage within the mapped vegetation portion of the project study area. Note that 12,428 acre (12%) of the project study area extends outside of the vegetation map coverage. All the project facilities under all the alternatives are within areas of mapped vegetation.

Table 4.3-3. Direct Impacts (acre) of Construction on Vegetation and Wetlands by Project Components

Vegetation Type	Wetland Type[1] (Cowardin Code Code / Functional Category)	Mapped Project Study Area		A, B, & C	A & C	A, C, & D	All Alternatives	
		Acres	(%)	GMT1 Pad	GMT1 – CD5 Road	GMT1-CD5 VSM	CD1-CD4N VSM	Valve Pads
Cassiope Dwarf Shrub Tundra	PSS3B / NA	85.6	0.1%					
Fresh Grass Marsh	PEM1H, R2AB3H / II	438.2	0.5%				<0.01	
Fresh Sedge Marsh	PEM1H / II	969.8	1.1%		0.8	<0.01		
Moist Sedge–Shrub Tundra	PEM/SS1B / III	15,187.1	17%		18.9	0.03	0.01	0.25
Old Basin Wetland Complex	PEM1F, PUBH, PEM1B / II	5,507.6	6.1%		5.5	0.01		
Open Low Willow	PSS1B / II	2,685.2	3.0%		0.1	<0.01	0.00	
Open Tall Willow	PSS1B / II	66.7	0%		0.3	<0.01		
Riverine Complex	R2UBH, R2AB3H / II	162.5	0.2%		0.2	<0.01		
Tussock Tundra	PEM/SS1B / III	15,973.3	18%	11.8	29.0	0.03		0.45
Water	PUBH, R2UBH / II	18,099.6	20%		0.1	<0.01		
Wet Sedge Meadow Tundra	PEM1E, PEM1F, PEM1F / II	23,813.8	26%		5.2	0.01	0.01	
Total Potential Wetlands		**82,989**	**92%**	**11.8**	**60.0**	**0.07**	**0.02**	**0.70**
Barren	Us (upland)	3,019	3.4%					
Total Project Study Area	**102,487**			**11.8**	**60.0**	**0.07**	**0.03**	**0.70**

See notes in Table 4.3-2.

Table 4.3-3. Direct Impacts (acre) of Construction on Vegetation and Wetlands by Project Components (Continued)

Vegetation Type	B			C			D		
	GMT1 - CD5 Road	GMT1-CD5 VSM	CD5 Road Tie-In	Spur Road Upgrade	Airport Access Road	Runway Extension	Pad	Airstrip	Road
Cassiope Dwarf Shrub Tundra									
Fresh Grass Marsh									
Fresh Sedge Marsh	1.2	<0.01		0.1					
Moist Sedge–Shrub Tundra	26.2	0.03		5.3	0.5	0	0	21.1	3.4
Old Basin Wetland Complex	8.7	0.02		0.4				2.0	
Open Low Willow	0.1	<0.01							
Open Tall Willow	0.3	<0.01							
Riverine Complex		0.02		0.1					
Tussock Tundra	16.6	<0.01		3.8	3.8	8.4	15.7	27.6	6.4
Water	1.4	0.01						0.8	
Wet Sedge Meadow Tundra	11.6	0.08	0.7	1.3		0.2		9.6	
Total Potential Wetlands		**0.15**	**0.7**	**10.9**	**4.3**	**8.7**	**15.7**	**61.0**	**9.8**
Barren				0.7	0.03	0.3			
Total Project Study Area 102,487	**66.1**	**0.3**	**0.7**	**11.7**	**4.3**	**9.0**	**15.7**	**61.0**	**9.8**

See notes in Table 4.3-2.

Table 4.3-4. Indirect Impacts (acre) of Construction on Vegetation and Wetlands Based on a 300-Foot Zone of Impact

Vegetation Type	Wetland Type[1] (Cowardin Code Code / Functional Category)	Mapped Project Study Area[2]		Alternative A		Alternative B		Alternative C		Alternative D	
		Acres	(%)	Acres	(%)	Acres	(%)	Acres	(%)	Acres	(%)
Cassiope Dwarf Shrub Tundra	PSS3B / NA	85.6	0.1%	5.2	6.1%	1.1	1.2%	5.2	6.1%	0.5	0.6%
Fresh Grass Marsh	PEM1H, R2AB3H / II	438.2	0.5%	1.4	0.3%			1.4	0.3%		
Fresh Sedge Marsh	PEM1H / II	969.8	1.1%	16.5	1.7%	17.8	1.8%	19.7	2.0%		
Moist Sedge–Shrub Tundra	PEM/SS1B / III	15,187.1	17%	181.4	1.2%	211.2	1.4%	477.4	3.1%	75.1	0.5%
Old Basin Wetland Complex	PEM1F, PUBH, PEM1B / II	5,507.6	6.1%	67.8	1.2%	108.1	2.0%	119.0	2.2%	30.0	0.5%
Open Low Willow	PSS1B / II	2,685.2	3.0%	1.5	0.1%	0.6	0.02%	1.5	0.1%		
Open Tall Willow	PSS1B / II	66.7	0.1%	2.1	3.1%	2.1	3.1%	2.1	3.1%		
Riverine Complex	R2UBH, R2AB3H / II	162.5	0.2%	2.8	1.7%			5.9	3.6%		
Tussock Tundra	PEM/SS1B / III	15,973.3	18%	253.1	1.6%	154.7	1.0%	508.3	3.2%	155.4	1.0%
Water	PUBH, R2UBH / II	18,099.6	20%	7.7	0.04%	29.1	0.2%	17.8	0.1%	3.5	0.0%
Wet Sedge Meadow Tundra	PEM1E, PEM1F, PEM1F / II	23,813.8	26%	55.8	0.2%	89.1	0.4%	184.1	0.8%	11.5	0.0%
Total Potential Wetlands		**82,989**	**92%**	**595.3**	**0.7%**	**613.7**	**0.7%**	**1,342.3**	**1.6%**	**275.9**	**0.3%**
Barren	Us (upland)	3,019	3%					26.4	0.9%		
Total Project Study Area	**102,487**			**595.3**	**0.58%**	**613.7**	**0.60%**	**1,368.7**	**1.34%**	**275.9**	**0.27%**

See notes in Table 4.3-2.

Equipment used to haul and place gravel fill could harbor nonnative plant seeds, and the placement of fill would create barren areas that pose the greatest risks for establishment of invasive nonnative species, which could become established and spread in the NPR-A. Such establishment and spread would be at the expense of other, naturally occurring plant species that would be displaced, as well as to the wildlife species that use those plants (BLM 2012, § 4.3.5.5, p.136). Although non-native, invasive plant species have become a concern in the nation and Alaska, there are questions that remain about measurement and quantification of the environmental impact these species may cause (Barney et al. 2013).

Some of the impacts begun during construction would continue during operations, including ice road construction. Additionally, operations may require off-road tundra travel (as permitted) for regular and emergency maintenance along pipelines.

4.3.1.3 Comparison of Alternatives

Alternative A would have a direct impact to vegetation totaling 72.5 acres, with the largest amount consisting of tussock tundra vegetation class (41.1 acres) followed by moist sedge-shrub tundra (19.2 acres). The GMT1 pad would occupy 11.8 acres entirely within tussock tundra vegetation. The road would cross several vegetation types, including tussock tundra (29.0 acres), moist sedge-shrub tundra (18.9 acres), old basin wetland complex (5.5 acres), and wet sedge meadow tundra (5.2 acres); minor amounts (<1.0 acre) of other vegetation classes would also be impacted directly by the road. The impact of VSMs and valve pads are estimated to incur less than 1.0 acre of total impact, with the highest amounts occurring within tussock tundra and moist sedge-shrub tundra (Table 4.3-3). The direct footprint of Alternative A would impact less than 0.1 percent of the approximately 100,000-acre project study area. The direct impacts would affect minor amounts of each vegetation type within the project study area, with the greatest relative impact of 0.5 percent occurring to the Open Tall Willow vegetation class.

The indirect impacts of Alternative A, which may occur as a result of gravel spray and dust deposition extending up to 300 feet from the edge of the gravel footprint, total 595.3 acre. The vegetation classes include tussock tundra (253.1 acres), moist sedge-shrub tundra (181.4 acre), wet sedge meadow tundra (55.8 acres), old basin wetland complex (67.8 acres), and less amounts of other vegetation types. An estimated 7.7 acres of water (e.g., ponds, lakes, and streams) could be within the 300-foot dust shadow under Alternative A. The indirect footprint of Alternative A would impact less than 1.0 percent of the total project study area. The indirect impacts would affect certain vegetation types within the project study area more than others, with 6.1 percent of the Cassiope dwarf shrub tundra vegetation class in the project study area impacted by Alternative A. This exceeds the 5 percent threshold for medium intensity under the vegetation impact criteria.

All 72.5 acres of the direct impact of Alternative A are within potential wetlands and all 595.3 acres of the indirect impact of Alternative A is within potential wetlands. The wetland areas impacted by Alternative A are predominantly of Functional Category III (low to moderate functioning). No impacts to Functional Category I (high functioning) wetlands would occur under Alternative A. Overall, less than 1 percent of the total area of Functional Category I and II wetlands in the project study area would be impacted by Alternative A.

The impacts of Alternative A to vegetation and wetlands are characterized as moderate magnitude because more than 5 percent of a vegetation type in the project study area would be impacted; long-term duration; the resource is important in context as wetlands are protected by legislation; and, the geographic extent is considered local, since the indirect effects are expected

to be limited to within 300 feet of the project components. Overall, Alternative A is rated moderate for impacts to vegetation and wetlands.

The direct impacts of Alternative B on vegetation are estimated to total 79.3 acres, with the highest amount on tussock tundra (29.5 acres), moist sedge-shrub tundra (26.5 acres), and wet sedge meadow tundra (11.6 acres). The GMT1 pad would be located at the same location as Alternative A and impact 11.8 acres of tussock tundra. The indirect impacts of Alternative B are estimated to total 613.7 acres, with moist sedge-shrub tundra predicted with the greatest impact (211.2 acres), followed by tussock tundra (154.7acres), old basin wetland complex (108.1 acres), and wet sedge meadow tundra (89.1 acres). Other vegetation classes would have lower amounts of indirect impacts of gravel spray and dust deposition, including 29.1 acres classified as water. The direct footprint of Alternative B would impact less than 0.1 percent of the approximately 100,000 acre project study area. The direct impacts would affect minor amounts of specific vegetation types within the project study area, with the greatest relative impact of 0.4 percent to the Open Tall Willow vegetation class. The indirect impacts of Alternative B would impact less than 1.0 percent of the total project study area. The indirect impacts would not affect 5 percent or more of a specific vegetation types within the project study area.

All 79.3 acres of the direct impact of Alternative B are within potential wetlands as indicated by the ITU mapping. All 613.7 acres of the indirect impact zone of Alternative B is within potential wetlands. The wetland areas impacted by Alternative B are predominantly of Functional Category III (low to moderate functioning). No impacts to Functional Category I (high functioning) wetlands would occur under Alternative B. Overall, less than 1 percent of the total area of Functional Category I and II wetlands in the project study area would be impacted by Alternative B.

The impacts of Alternative B to vegetation and wetlands are characterized as minor in magnitude since less than 5 percent of each vegetation type would be impacted; long-term duration; the resource is important in context as wetlands are protected by legislation; and the geographic extent is considered local, since the indirect effects are expected to be limited to within 300 feet of the project components. Overall, Alternative B is rated minor for impacts to vegetation and wetlands.

Alternative C is estimated to cause a total of 97.5 acres of direct impact, with the highest amount occurring on tussock tundra (56.0 acres), moist sedge-shrub tundra (26.1 acres), and wet sedge meadow tundra (6.8 acres). The facilities at the Nuiqsut airport would directly impact 9.0 acres of mostly tussock tundra for the airstrip extension, apron and pad; the new road extending from the pad around the village and connecting to the dump road would involve 4.3 acres of impact of tussock tundra. Widening of the planned Nuiqsut Spur Road and dump road would involve 11.7 acres of impact, mostly on moist sedge-shrub tundra (5.3 acres) and tussock tundra (3.8 acres); a portion of wet sedge meadow tundra (1.3 acres) would be filled by the road widening. A small amount (0.1 acre) of features classified as water would be directly impacted by Alternative C. The indirect impacts of gravel spray and dust under Alternative C could impact an estimated 1368.7 acres, consisting mostly of moist sedge-shrub tundra (477.4 acres), tussock tundra (508.3 acres), and wet sedge meadow tundra (184.1 acres). An estimated 119.0 acres of old basin wetland complex and 17.8 acres of water features including lakes, ponds, and streams could be impacted by indirect effects of gravel spray and dust under Alternative C.

The direct footprint of Alternative C would impact 0.1 percent of the total project study area. The direct impacts would affect minor amounts of specific vegetation types within the project study area, with the greatest relative impact of 0.4 percent to the Open Tall Willow vegetation

class. The indirect impacts of Alternative C would affect approximately 1.3 percent of the total project study area. The indirect impacts would affect specific vegetation types within the project study area, with 6.1 percent of the Cassiope dwarf shrub tundra vegetation class in the project study area. This exceeds the 5 percent threshold for medium intensity under the vegetation impact criteria.

A total of 96.3 acres of the direct impact of Alternative C are within potential wetlands as indicated by the ITU mapping; 1.2 acres of the direct impact are classified as upland barrens. A total of 1,342.3 acres of the indirect impact zone of Alternative C is within potential wetlands; 26.4 acre of indirect impact are classified as upland barrens. The wetland areas impacted by Alternative C are predominantly of Functional Category III (low to moderate functioning). No impacts to Functional Category I (high functioning) wetlands would occur under Alternative B. Overall, less than 1 percent of the total area of Functional Category I and II wetlands in the project study area would be impacted by Alternative C.

The impacts of Alternative C to vegetation and wetlands are characterized as moderate magnitude because more than 5 percent of a specific vegetation type would be impacted; long-term duration; the resource is important in context as wetlands are protected by legislation; and the geographic extent is considered local, since the indirect effects are expected to be limited to within 300 feet of the project components. Overall, Alternative C is rated moderate for impacts to vegetation and wetlands.

Alternative D would have direct impact to 87.3 acres of tundra, with the greatest amounts involving tussock tundra (50.2 acres), moist sedge-shrub tundra (24.8 acres), and wet sedge meadow tundra (9.6 acres). Alternative D would not include a road from CD5 but instead would involve construction of an airstrip and associated housing pad at the GMT1 drill site, which would have total gravel footprint of 61.0 acres. The airstrip facility would impact tussock tundra (27.6 acres), moist sedge-shrub tundra (21.1 acres), wet sedge meadow tundra (9.6 acres), and old basin wetland complex (2.0 acres). An access road connecting the GMT1 drill site to the airstrip would impact 9.8 acres in area, consisting of tussock tundra (6.4 acres) and moist sedge-shrub tundra (3.4 acres). The indirect impacts caused by gravel spray and dust could affect 275.9 acres, including tussock tundra (155.4 acres), moist sedge-shrub tundra (75.1 acres), and wet sedge meadow tundra (11.5 acres).

The direct footprint of Alternative D would impact less than 0.1 percent of the project study area. The direct impacts would affect minor amounts of specific vegetation types within the project study area, with the greatest relative impact of less than 0.3 percent to the tussock tundra vegetation class. The indirect footprint of Alternative D would impact approximately 0.3 percent of project study area. The indirect impacts would affect less than 5 percent of specific vegetation types within the project study area.

All 87.3 acres of the direct impact of Alternative D are within potential wetlands as indicated by the ITU mapping. All 275.9 acres of the indirect impact zone of Alternative D is within potential wetlands. The wetland areas impacted by Alternative D are predominantly of Functional Category III (low to moderate functioning). No impacts to Functional Category I (high functioning) wetlands would occur under Alternative D. Overall, less than 1 percent of the total area of Functional Category I and II wetlands in the project study area would be impacted by Alternative D.

The airstrip under Alternative D would likely be oriented in an east-west alignment, which aligns with the prevailing wind directions, but this is perpendicular to the local north-south

topographic gradient. The gravel fill could intercept movement of sheet flow, runoff, and possibly water moving through the active layer in the same way that a roadway may cause such impacts. Culverts could not be placed through the airstrip because of geotechnical constraints, the effects on vegetation and wetlands from interrupting natural drainage patterns may occur in the vicinity of the airstrip. Refer to Section 4.2.2 Water Resources for additional information about potential inundation caused by gravel fill.

The impacts of Alternative D to vegetation and wetlands are characterized as minor in magnitude; long-term duration; the resource is important in context as wetlands are protected by legislation; and the geographic extent is considered local, since the indirect effects are expected to be limited to within 300 feet of the project components. Overall, Alternative D is rated minor for impacts to vegetation and wetlands.

Gravel mining would be required to construct each of the action alternatives. Estimates of the surface area of tundra that would be excavated to produce the volume of gravel needed for each alternative are not readily available, because the gravel sources may include either or both the Clover site or the existing ASRC Mine Site. Some gravel would be taken from areas of the pits that have already been excavated and there would not be new tundra disturbance. Development of the Clover site would involve excavation of tundra during the initial development. A general relationship of one acre disturbed for a gravel mine to meet the gravel needs for five acres of gravel pad, road, airstrip, or other development is identified in BLM (2012, § 4.2.2, p. 26). The estimated gravel mine site impact for each alternative based on this relationship is listed in Table 4.1-1. The vegetation types at the Clover site are dominated by tussock tundra. All of the impacts at the Clover site would be within potential wetlands (tussock tundra vegetation type includes Cowardin Codes PEM/SS1B, PEM1F, PUBH, PEM1B, PEM1H, and PSS1B)

All four action alternatives have the potential for spills to vegetation and wetlands resulting from pipelines, storage tanks, production facilities/infrastructure, drilling rigs, vehicles, and/or vessels. The potential for spills would be present under all of the action alternatives. Because the location and length of oil transit pipelines under the four action alternatives are similar, the potential risk from a pipeline spill is also expected to be similar.

There are no known occurrences of BLM sensitive plant species near the proposed facilities of the action alternatives. The nearest documented occurrence is approximately 2.5 miles away as described in Section 3.2.1. Overall, potential impacts to sensitive plant species are expected to be negligible under all the alternatives.

Alternative E, No Action, would have no new impacts on vegetation and wetlands from the GMT1 Project.

4.3.1.4 Mitigation

Mitigation measures including design features and activities would be implemented in all the action alternatives. Lease Stipulations, BMPs and permit requirements would provide protection measures.

Lease stipulations and best management practices described in Appendix H, if properly implemented, should effectively reduce the impacts of development on vegetation (BLM 2012, § 4.3.5.3, p. 124). Specific Best Management Practices A-1 through A-7 on solid and liquid-waste disposal, fuel handling, and spill cleanup would be expected to reduce the potential effects of intentional releases, spills, and solid waste on vegetation. Best Management Practices A-9 and

A-10 would reduce air pollution. Best Management Practice C-2 regarding overland moves (and seismic work) would also effectively minimize impacts to vegetation.

Lease stipulations on activities associated with oil and gas exploration (D-1 and D-2) and best management practices affecting development (E-4, E-5, E-6, and E-12), such as facility design and construction of pipelines, roads, drill pads, airstrips, and other facilities, are expected to effectively minimize the amount of habitat that would be altered by gravel pads and other surface disturbances. Lease stipulation G-1 would facilitate the regrowth of native vegetation following facility abandonment. The setbacks outlined in lease stipulations (K-1, K-2, K-3, K-4, K-7, K-8, and K-11) associated with development near rivers, lakes, and other specified habitats would be effective at minimizing impacts in high-value wetlands, such as areas dominated by pendant grass and riparian and floodplain habitats. Best Management Practice L-1 would minimize the impacts to vegetation of summer tundra travel, if such an action is permitted.

New Potential Mitigation Measure 1 — Oil Field Abandonment (new subparagraph to BMP G-1)

Objective: Ensure long-term reclamation of land to its previous condition and use.

Requirement/Standard: The plan shall provide that as wells or facilities are permanently abandoned; interim surface reclamation requirements will be incorporated whenever feasible.

Potential Benefits and Residual/Unavoidable Impacts: Reclamation on portions of a development site shall begin once the BLM determines that environmental conditions are favorable for the replacement and reestablishment of natural soils and vegetation and such reclamation is feasible. Reclamation on portions of a development site that are no longer being used for development will decrease the short term impacts to surface resources directly caused by infrastructure. This would have benefits to vegetation and wetlands by replacing gravel fill and other disturbed areas with productive and functioning wetland habitats that contribute to ecological services, including support of subsistence resources.

Another potential mitigation measure identified by BLM (2012, 4.3.5.5, p. 136) to prevent the introduction or spread of non-native, invasive plant species into the NPR-A would require that all equipment and vehicles are weed-free prior to transporting them into the area. In addition, annual monitoring along roads would be required and if non-native, invasive species are located, effective weed control measures would be required (which by purpose are not defined, allowing the Applicant to design the measures). A plan for implementing these controls would be submitted to BLM for approval.

Additional design measures required by state and federal permit conditions would contribute toward the avoidance and minimization of impacts to vegetation and wetlands, including:

- Minimizing gravel fill to the extent practicable.
- Minimizing the size of the gravel pads through optimizing project design and equipment layout.
- Designing pads, roads, bridges, and culverts to maintain natural drainage patterns and stream flows to the extent possible.
- Routing the gravel access roads to minimize overall length and footprint, with consideration for hydrologic impacts and project needs.
- Utilizing ice roads and pads for project access, pipeline construction, and temporary storage of mine site overburden.

- Watering gravel roads and pads, as necessary, to control dust generation.
- Slotting ice roads at designated stream crossings to facilitate drainage during breakup.
- Requiring workers to stay on gravel surfaces unless their job duties require them to be on the tundra.
- Requiring strict guidelines for travel on ice roads to avoid tundra damage, including ice road training, establishing speed and weight limits, and installing delineators along both sides of the road.
- Reducing surface discharge of wastewaters through use of a disposal well, including zero discharge of produced water and drilling wastes.
- Implementing spill prevention and response programs.

4.3.1.5 Conclusions

The direct effects of construction and operation of the project alternatives include destruction of vegetation and wetlands during construction of gravel pads, roads and airstrips; from excavation of material sites and construction of VSMs; and the potential for colonization by non-native, invasive species. These impacts are characterized as long-term. The direct impacts would be similar among all the action Alternatives A, B, C, and D, with slightly greater areas of fill under Alternatives C and D compared to Alternatives A and B.

Plant communities and wetlands could also be altered by dust deposition, salinity of gravel fill used in construction, snowdrifts, and blockage of or change to natural drainage patterns. The indirect impacts would also be long-term and are expected to be greater under Alternatives A, B, and C, which include a road between CD5 and GMT1 with a relatively large area contained within the 300-foot-wide indirect impact zone, whereas Alternative D would have less indirect impact.

Overall, Alternatives A and C are predicted to have moderate impacts to vegetation and wetlands. The impacts of Alternatives B and D are characterized as minor. The primary differentiator is the relative intensity of impact, with Alternatives A and C each impacting greater than 5 percent of the total acreage of a single vegetation type occurring within the project study area. The impacts of Alternatives B and D would be less than this 5 percent threshold for each vegetation type. Alternative E would have no impacts to vegetation and wetlands.

The wetland areas impacted by all action alternatives are predominantly of Functional Category III (low to moderate functioning). No impacts to Functional Category I (high functioning) wetlands would occur under any of the action alternatives. Overall, less than 1 percent of the total area of Functional Category I and II wetlands in the project study area would be impacted by any of the action alternatives.

There would be no new impacts to vegetation and wetlands under Alternative E, No Action.

Studies of climate change in the Arctic under the current conditions have shown that warming temperatures affect the distributions and growth rates of plant species, resulting in a northward expansion of the range of shrubs; increased growth rates of shrubs and graminoids; and decreased cover of mosses and lichens. Warming may also increase the potential for thermokarst development resulting from disturbance of organic mats or creation of impoundments.

As the climate warms, spread of invasive plants northward would be possible, and project components would provide vectors and establishment sites for such plants (BLM 2012, § 4.3.6.4, p. 143; Corps 2012, § 5.8.8.1, p. 5-203). There would be interaction between project impacts and climate change effects, in particular, climate change could cause vegetation changes and wetland drying that could exacerbate the indirect effects of gravel fill, including dust deposition and tundra drying that may occur on the downgradient sides of gravel fills. Other effects of climate change are discussed above in Section 3.2.4, *Climate Change*.

4.3.2 Fish

The potential impacts caused by construction and operation of the project action alternatives to fish and fish habitat within the project study area are discussed in this section. Impacts of oil and gas development on fish and fish habitat in the NPR-A, which includes the project study area, are discussed in BLM (2012, § 4.3.7, p. 143). The potential impacts of the proposed project on fish and fish habitat within the project study area are addressed in BLM (2004, § 4F.3.2, p. 1119).

Impact analysis criteria used in this assessment for fish and fish habitat are presented below in Table 4.3-5. These impact criteria were developed based on a range of possible outcomes and to provide a frame of reference for impacts.

Table 4.3-5. Impact Criteria—Fish and Fish Habitat

Impact Category	Magnitude	Definition
Intensity	High	FISH: Would impact normal movements of fish populations, or survival or reproductive success, resulting in population-level impacts, or the distribution of fish populations. HABITAT: Would impact > 25% of a water body (stream length or lake area) in the project study area used as fish habitat (including spawning and overwintering).
	Medium	FISH: Impact would be measureable but would not affect normal fish/invertebrate movement, or would have the potential to impact individual fish survival or reproductive success, but population-level effects not expected. HABITAT: Would impact a limited area of spawning or overwintering habitat, or spawning or overwintering habitat outside of spawning or overwintering activity periods, or 5 to 25% of a water body within the project study area used as fish habitat.
	Low	FISH: An impact that cannot be measured or detected. HABITAT: Would impact less than 5% of a water body in the project study area that provides fish habitat.
Duration	Long Term	FISH: Impact would last longer than two life cycles of an affected species. HABITAT: Impact would extend beyond the life of the project; restoration not possible.
	Interim	FISH: Impact would last longer than 2 years but less than two life cycles of affected species. HABITAT: Impact would last for life of project; restoration possible.
	Temporary	FISH: Impact would last 2 years (24 months) or less. HABITAT: Impact would last through project construction, restoration possible or not needed.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality and is not protected by legislation.
Geographic Extent	Statewide	Extends beyond the project study area.
	Regional	Extends beyond project components but within project study area
	Local	Within footprint of project components

Fish and fish habitat within the project study area may be affected by several types of project-related activities, including construction of ice roads and pads, water withdrawals from fish-bearing waters, gravel mining, development of gravel infrastructure (roads, pads, airstrips), pipeline construction, summer tundra travel, and oil spills. The nature of potential impacts is discussed according to project activity in the following sections.

4.3.2.1 Construction

The construction and use of ice roads in the project study area has the potential to alter fish habitat by direct impact to streams and lakes, affecting overwintering fish habitat and impeding fish migrations during spring breakup (BLM 2012, § 4.3.7.2, p. 147). Snow trails and ice roads commonly require reinforced bridges made from ice and/or snow across stream channels. However, if placed above overwintering habitat out of necessity, the increased ice thickness associated with these crossings will result in a reduction of habitat where conditions may already be marginal. This can have a negative impact on fish, unless the under-ice water is substantially deep and expansive, as with the Colville River. Overwintering habitat is critical for fish in the Arctic, as it has been estimated that by late winter ice formation can decrease available habitat in rivers and streams by approximately 97 percent (BLM 2012, § 4.3.7.2, p. 147). A marked reduction in overwintering habitat at a given location would lead to increased fish densities, and overcrowding can increase stress, deplete oxygen supplies, and increase the concentration of metabolic byproducts to a point that may be fatal to the fish.

Once streams and rivers begin to thaw in the spring, increased ice thickness and density at snow trail or ice road channel crossings can cause the “bridges” to remain intact longer than the surrounding ice and create a potential impediment to fish movements. Mature arctic grayling are reported to make an upstream spawning migration prior to occupying feeding habitat and the timing of this migration is strongly associated with ice breakup. Delayed access to spawning habitat or increased energetic demand could affect spawning success of grayling, which could be carried over to the next year because arctic grayling spawn in their natal areas. In-stream barriers could also affect other Arctic fish attempting to migrate from overwintering areas to feeding habitat during the early part of the open-water season. Energy reserves are already typically low for most fish and additional stress or delayed access to preferred habitats could have a detrimental impact. A barrier to movement could alter migration patterns to lower quality feeding habitat and increased energetic demands could compromise survival (BLM 2012, § 4.3.7.2, p. 147-148). Ineffective breaching or slotting of ice bridges prior to breakup can also lead to ice damming and impede upstream fish movements. Remnant ice bridges can impact habitat, as well, either by deflecting flow into streambanks or causing streambed scour. Monitoring of slotted ice bridges in the NPR-A since 2004 indicated most crossings did not adversely affect fish passage (BLM 2012, § 4.3.7.2, p. 148).

Ice pads would be used to support construction activities and if located near fish-bearing waters could have indirect impacts to water quality from spills. Fish could be directly impacted by degradation of water quality caused by leaks of petroleum products or other industrial fluids from vehicles and equipment traveling the ice road routes (BLM 2012, § 4.3.7.2, p. 147). The impacts of spills are discussed in Section 4.5.

Ice pads of 10 acres or less are unlikely to alter flow patterns to an extent that would affect fish, unless the pad was positioned in an extremely small catchment (BLM 2012, § 4.3.7.2, p. 149).

Water withdrawal to support the construction of production pads, roads, and airstrips represents the greatest risk of construction impact to fish and fish habitat. Water is needed for

building ice roads along the proposed pipeline route, ice pads, and for camp operations. In addition to water withdrawal, frozen lakes would be utilized to harvest ice chips for construction of ice roads and pads (BLM 2004, § 4F.3.2.1, p. 1120).

The limited amount of available overwintering habitat may be the single most important factor affecting Arctic fish population size and abundance (BLM 2012, § 4.3.7.2, p. 149). Water depths of approximately 7 feet are considered the minimum for supporting overwintering freshwater fish. Lowered lake water levels can affect total winter habitat space, summer accessibility, and habitat characteristics, and ultimately reduce survival. In the existing areas of oil exploration and development on the North Slope, lakes pumped solely for winter exploration activities have recharged in the spring, including lakes where ice chips were utilized in addition to water withdrawal (BLM 2012, § 4.3.7.2, p. 149).

Winter water withdrawals may reduce the amount of dissolved oxygen available for fish although changes are not apparent at current levels of withdrawal on the North Slope (BLM 2012, § 4.3.7.2, p. 150). Excessive withdrawals from North Slope lakes in the past have been attributed to misidentification of lakes in the field and poor recordkeeping. The potential impacts of water withdrawal on fish would be much less during periods of open water because dissolved oxygen is typically near saturation due to frequent wind mixing. Reduced water levels would still be a concern, particularly as it relates to connecting a lake to other lakes or streams (BLM 2012, § 4.3.7.2, p. 150).

Concerns have been raised by Nuiqsut residents[10] about the potential for water withdrawals and ice road construction spreading a genus of freshwater mold, *Saprolegnia*, which feeds on waste from fish, dead cells or on live fish that have been injured. When it inhabits a live fish, it produces a fungal infection that is usually fatal. The extensive mortalities of salmon and migratory trout in the rivers of western Europe in the mid-1960s and 1980s in the ulcerative dermal necrosis (UDN; a chronic dermatological disease of cold water salmonid fish) outbreak have been associated with secondary *Saprolegnia* infections[11]. The NSB is conducting research to identify the potential source of the fungus (i.e., whether it is naturally occurring in the ACP or an introduced organism) through genetic testing of fungal samples[10]. The potential impact of water withdrawals and ice road construction on the spread of this fungus and the impact to fish in the project study area is not known.

Gravel is required for construction of pads, roads, and airstrips. The available sources of gravel are generally limited to streams and floodplains in NPR-A (BLM 2012, § 4.3.7.2, p. 151). Gravel mining within stream channels and active floodplains can impact channel structure (e.g., upstream head-cutting, downstream channel incision), increase turbidity and sedimentation, cause shifts in invertebrate communities, and impact spawning gravels, which can degrade local fish habitat conditions. Channel incision (i.e., bed lowering) can lead to subsequent channel widening (reducing pool habitat), contribute to further increases in sediment loads through streambed and stream bank erosion, and cause landscape-level impacts by lowering base flow in tributaries. Channel incision from gravel mining has the potential to impact downstream infrastructure such as buried gas pipelines and bridge piers (BLM 2012, § 4.3.7.2, p. 151).

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[10] Comment received from NSB December 2013.

[11] Pickering, A. D., Willoughby L. G. (1982). *Saprolegnia Infections of Salmonid Fish*. Fiftieth annual report for the year ended 31st March 1982. Annual Report, Freshwater Biological Association. 50th ed., p. 38-48; Meyer, F. P. (1991). Aquaculture disease and health management. Journal of Animal Science, 69(10), 4201-4208.

The Clover site is proposed for gravel mining as part of the action alternatives. The site is located within a small tributary that drains to the Tiŋmiaqsiġvik (Ublutuoch) River, although little or no surface water connection is apparent during the ice-free period (based on aerial imagery). The relatively narrow Tiŋmiaqsiġvik (Ublutuoch) River contains the only extensive reaches of gravel in the entire Fish Creek watershed, and is likely used for spawning by arctic grayling and other fish species (BLM 2012, § 4.3.7.2, p. 152). Channel incision has the potential to affect conditions downstream; the Clover site is approximately 0.5 mile upgradient from the Tiŋmiaqsiġvik (Ublutuoch) River. The small tributary itself is unlikely to provide fish habitat due to the absence of a continuous surface water connection with the Tiŋmiaqsiġvik (Ublutuoch) River and the small size of the tributary.

Construction of pads, roads, airstrips, and pipelines has the potential to impact fish and fish habitat related to runoff patterns, runoff content, and stream crossings. Improper placement of pads, roads, and airstrips could affect runoff patterns by eliminating, diverting, impeding, or constricting flow from small tributaries that connect rivers, streams, and lakes. Altered water flow characteristics could interfere with fish migrations to and from overwintering, spawning, and feeding grounds. This could be particularly adverse to many Arctic fish that rely on multiple seasonal movements to optimize habitat suitability at various life-history stages (BLM 2012, § 4.3.7.2, p. 153).

Impervious surface areas, such as pads and roads, can also increase flood intensity and reduce base flow, which can affect fish survival. Runoff content is potentially affected by vehicle and equipment traffic on pads, roads, and airstrips, personnel camps on pads, and production drilling on pads. Petroleum products and mechanical fluids could leak from vehicles and equipment and compromise water quality. Traffic or natural weathering and erosion processes could cause increased stream turbidity and sedimentation, depending upon materials used in constructing and surfacing of pads, roads, and airstrips. On pads, water quality concerns are related to handling wastewater from personnel camps and produced fluids from drilling. Effects of pollutants on fish include increasing sensitivity to diseases; reducing tolerance to fluctuating temperatures; blocking senses important to foraging, predator avoidance, and decreasing survival; and reducing the abundance of invertebrate prey (BLM 2012, § 4.3.7.2, p. 153).

Roadway stream crossings may create barriers to fish movements. Culvert crossings of streams may be permitted where fish passage is not restricted (see BMP E-6). Culverts can be obstructed during periods of either high or low stream flow and impede fish movements as found in studies of stream-crossing structures in the North Slope oil fields, which also identified fish passage problems beyond the structures (BLM 2012, § 4.3.7.2, p. 154). Complete barriers to movement could force fish to utilize less suitable habitat and alter the demographics of the affected fish population.

For pipelines, there are concerns regarding stream crossings, oil spills, and maintenance (BLM 2012, § 4.3.7.2, p. 153). The placement of fill into fish-bearing lakes and streams is prohibited. Spills are discussed separately in Section 4.5 and below as they relate to impacts on fish and fish habitat. The construction phase for permanent infrastructure would largely occur during the winter months and potential effects on fish from winter construction activities are described above for ice roads. Pipelines suspended over streams should have no effect on stream habitat and flow characteristics provided these are elevated sufficiently to avoid flooding (BLM 2012, § 4.3.7.2, p. 154). Pipelines would also be used to transport seawater to inland facilities. A leak in a seawater pipeline could potentially spill highly saline water into freshwater habitat.

Construction of bridges would involve pile driving to install the pier pilings and sheet piles. Blasting would be used to excavate the gravel mine. Noise from pile driving and blasting has been documented to cause hearing loss, mask biologically important sounds, increase stress levels, impact immune systems, and kill fish, larvae, and eggs. Impacts to larger fish can include startling by waves. Impacts to smaller fish can include injury or death due to internal swim bladder rupture or a stun response to waves, which makes them more susceptible to predation. During winter, when pile driving and blasting would occur, most fish would be physically excluded from freshwater impact areas because the waters would be frozen to the substrate. In addition to BMPs and Lease Stipulations, ADF&G fish habitat Permit Stipulations would limit impacts to fish because blasting in anadromous streams is limited to no more than 2.7 psi and a peak particle velocity of no more than 0.5 inches per second, unless the water body, including the substrate, is frozen. Invertebrates, if present, would likely be in a dormant state (Corps 2012, § 5.12, p. 5-379).

Oil spills have been observed to have a range of effects on fish, depending on the concentration of petroleum present, the timing of the spill, the length of exposure, and the stage of fish development. Eggs, larvae, and juveniles are the most sensitive. Although initial fish mortality can occur at lethal concentrations, effects of sub-lethal concentrations can also ultimately lead to mortality. Spilled oil may also impact spawning gravels (BLM 2012, § 4.3.7.2, p. 157).

Stream flow in the project study area begins in late May to early June as a rapid flood event that can inundate large areas. While this hydrologic event could spread oil if a spill were to occur during this brief period, the flooding could create a flushing effect and reduce contaminant concentrations in the water. Spills during the open water period would place fish at greater risk than during times of ice cover, which provides an impermeable barrier to oil contacting free water and fish habitat (Cater 2010; BLM 2012, § 4.3.7.2, p. 157).

Most of the small North Slope industry spills have been contained on gravel pads or roads or occurred during winter when cleanup is relatively easy and there were no risks of impacts to fish. Other small spills, presumably associated with pipeline leaks, are more prone to reach the environment and potentially contaminate aquatic habitat. Regardless of the source, large spills may have a greater likelihood of impacting fish. Although the GC-2 spill from a pipeline (5,054 bbl in Prudhoe Bay in 2006) was limited to approximately 2 acres, other large spills could be much greater in size (BLM 2012, § 4.3.7.2, p. 157). Large spills with the most potential to negatively impact fish would most likely occur from pipelines, especially at stream and river crossings or in floodplains.

4.3.2.2 Drilling and Operation

During the operations phase of the project, maintenance activities for aboveground pipelines could require off-road travel areas where pipelines are set back or distant from roads. Potential effects of winter travel operations on fish for this purpose would be the same as those described for ice roads.

Summer tundra travel is not planned for the action alternatives although it could be necessary under emergency situations. The potential impacts on fish from summer tundra travel with low-ground-pressure vehicles could include sedimentation and degraded water quality. If vehicles cross streams, increased sedimentation could occur from stream bank damage and disturbance of the streambed, and small leaks from equipment (e.g., fuel or mechanical fluids) could degrade water quality. These impacts are likely to occur infrequently and expected to be short-lived

(BLM 2012, § 4.3.7.2, p. 154). The case-by-case evaluation for permitting this type of travel under BMP L-1 would provide the opportunity to avoid sensitive areas.

4.3.2.3 Comparison of Alternatives

In general, the potential effects of each alternative on fish and fish habitat are related to the project components associated with each alternative, as summarized in Table 4.3-6.

Table 4.3-6. Comparison of Project Components Relevant to Fish Resources

Project	Alternative			
Component	**A**	**B**	**C**	**D**
Years of ice roads	**2**	**2**	**2**	**30**
Estimated winter water needs (ice roads and pads)[a]	33.0 MG - Year 1 39.0 MG - Year 2	38.3 MG - Year 1 27.0 MG - Year 2	45.8 MG - Year 1 16.5 MG - Year 2	30.0 MG - Year 1 40.5 MG - Year 2 20.0 MG - Years 3-30
Ice road stream crossings (year 1)	4 - Ublutuoch R.(2), Barely Cr., Crea Cr.	2 - Ublutuoch R.(2)	4 - Ublutuoch R.(2), Barely Cr., Crea Cr.	4 - Ublutuoch R.(2), Barely Cr., Crea Cr.
Ice road stream crossings (year 2)	3 - Ublutuoch R., Barely Cr., Crea Cr.	1 - Ublutuoch R.	3 - Ublutuoch R., Barely Cr., Crea Cr.	3 - Ublutuoch R., Barely Cr., Crea Cr.
Ice road stream crossings (years 3-30)	none	none	none	3 - Ublutuoch R., Barely Cr., Crea Cr.
Gravel mine needs[b]	625,000 cy	682,000 cy	859,700 cy	845,600 cy
GMT1 to CD5 road: stream crossings with bridge	2 - Ublutuoch R., Crea Cr.	1 - Ublutuoch R.	2 - Ublutuoch R., Crea Cr.	none
GMT1 to CD5 road: stream crossings with culvert	1 - Barely Cr.	none	1 - Barely Cr.	none
GMT1 to CD5 road: fish-bearing lakes within 500 ft	3 - L9824, L9819, L9820	1 - L9824	3 - L9824, L9819, L9820	none
GMT1 drill pad	11.8 acres	11.8 acres	11.8 acres	15.7 acres
GMT1 drill pad: fish-bearing lakes within 500 ft	1 - M9925	1 - M9925	1 - M9925	1 - M9925
GMT1 area airstrip/road/pads	None	none	none	70.9 acres
GMT1 to CD5 pipeline: stream crossings	3 - Ublutuoch R., Barely Cr., Crea Cr.	1 - Ublutuoch R.	3 - Ublutuoch R., Barely Cr., Crea Cr.	3 - Ublutuoch R., Barely Cr., Crea Cr.
GMT1 to CD5 pipeline: fish-bearing lakes within 500 ft	1 - L9824	2 - L9824, L9819	1 - L9824	1 - L9824
Additional pipeline components?	None	none	none	2 - diesel line, water line

[a] MG = million gallons

[b] cy = cubic yards

The potential effects of ice roads and pads on fish and the associated activities that take place on this temporary infrastructure, such as vehicle travel, industrial equipment transport and use, exploratory drilling, and supporting work camps, would likely be localized to a number of discrete locations (BLM 2012, § 4.3.7.2, p. 149). Across the action alternatives, the anticipated length of ice roads and snow trails is a reasonable relative index of potential effects on fish from winter oil and gas activities.

In general, the greater the transportation network, the more supporting infrastructure and associated activities (see Table 2.4-2). The demand for water withdrawal is also directly related to the amount of ice road and pad construction. From this perspective, the potential impacts on fish from winter activities is highest under Alternative D with an estimated 59 total miles of ice

road (90.5 million gallons of water) for two years of construction and four years of drilling. In addition, Alternative D is the only action alternative that requires annual construction of an ice bridge on the Tiŋmiaqsiġvik (Ublutuoch) River during drilling years. Alternatives A, B, and C are estimated to involve relatively similar total lengths of ice roads and water demands during the two construction years, ranging from 41.5 miles to 48 miles (total over both years; 62.5 to 72 million gallons of water, respectively). No ice road construction would be necessary for Alternative A, B, or C during the drilling phase (years 3-6) due to availability of road access (see Table 2.4-2).

Based on total miles of ice road, the water withdrawal demand and associated potential impacts to fish across construction (years 1 and 2) and drilling phases (years 3 through 6) is greatest with Alternative D (59 miles, 90.5 million gallons of water). The total area of ice pad construction is estimated to be the same for all action alternatives (see Table 2.4-2). The potential effects of water withdrawals on fish are expected to be limited to local, short-term impacts considering the associated protective guidelines.

Because the location and length of oil transit pipelines under the four project alternatives are similar, the potential risk to fish and fish habitat resulting from a pipeline spill is also expected to be similar. Alternative B would avoid pipeline crossings of two Tiŋmiaqsiġvik (Ublutuoch) River tributary streams, potentially reducing the likelihood of a large spill reaching the river compared to Alternatives A, C, and D. Each of the four alternatives would cross the Tiŋmiaqsiġvik (Ublutuoch) River at the same location with block valves at each side of the crossing.

One important distinction between the alternatives is that Alternative D would not have a road between GMT1 and CD5 that crosses the Tiŋmiaqsiġvik (Ublutuoch) River, Crea Creek, and Barely Creek as do the other action alternatives. This would avoid potential disruptions to fish and fish habitats in these watercourses caused by culverts and bridges, which could limit fish passage during certain times of the year. Alternative D would require a diesel pipeline to provide fuel to the GMT1 drill site, which would pose incremental spill risk along the pipeline system. Diesel fuel is highly toxic to fish and is difficult to cleanup in tundra habitats (Cater 2010).

Direct impacts to fish or fish habitat are not expected to result from development of the Clover site as a result of its location and the application of regulations associated with this activity. Although differences in gravel requirements and the associated footprint of mining activity exist for the project action alternatives, the potential impacts to fish are expected to be similar among the alternatives. In each case the maximum extent of gravel mining would be limited by permit.

The ASRC Mine Site may be used as an alternative gravel source, which would eliminate gravel mining activity in the Tiŋmiaqsiġvik (Ublutuoch) River setback area, including the small drainage crossing through the Clover site.

The length of roads and pipelines, along with the surface area of impervious gravel surface provide a relative scale of expected development under each project alternative. From this standpoint, the potential for impacts on fish from those structures and associated activities under Alternative C (7.8 miles of road and 97.5 acres of gravel fill) is expected to be greater than Alternative A (7.8 miles and 72.5 acres); Alternative D (1.2 miles road and 87.3 acres) is expected to be less than Alternative A; and, Alternative B (8.6 miles of road and 79.3 acres) would be comparable to Alternative A.

4.3.2.4 Mitigation

The risk of impacts to fish and fish habitat related to project activities would be reduced by adherence to BMPs and Lease Stipulations. BMPs and lease stipulations include requirements and guidelines for locating pads, roads, and pipelines, and associated refueling operations that reduce the risk of spills or gas releases entering fish habitat. A list of BMPs and Lease Stipulations designed to reduce the risk of impacts to fish and fish habitats include:

- BMP A-2 (pumpable waste be injected and that mud and cuttings be stored only temporarily until they are used to facilitate injection or backhauled);
- BMPs A-3 and A-4 (require impermeable containment, spill prevention, and response planning);
- BMP A-5 (prohibits equipment refueling within 500 feet of the active floodplain of any waterbody and fuel storage exceeding 210 gallons must also be outside of this setback).
- BMP A-6 (prohibits surface discharge of reserve-pit fluids);
- BMP B-1 (prohibits winter water withdrawals from rivers and streams);
- BMP B-2 (limits withdrawal based on maximum depth and fish species present; requires intake screens on water withdrawals and screen design must be approved by ADF&G, Division of Habitat; sets restrictions on withdrawals during ice-free periods; limits compaction or removal of snow from an area of grounded ice);
- BMP C-3 (streambank protection; removal, breaching or slotting of snow and ice bridges before spring breakup);
- BMP C-4 (location of winter transportation bridges);
- BMP E-4 (requires that pipelines be built and operated with the best available technology for detecting and preventing corrosion or mechanical defects);
- BMP E-5 (minimization of impervious surfaces by encouraging a reduced development footprint);
- BMP E-6 (mandates fish passage and emphasizes that bridges, rather than culverts, are the preferred method for channel crossings; addresses stream and marsh crossings, is to reduce the potential for altering natural drainage patterns); (*Examples of fish-passage culvert design are provided as Attachment 1 of Appendix A*).
- BMP E-8 (requires approval of the gravel mine site design and reclamation in consultation with other appropriate federal, state, and NSB agencies and would be subject to additional protections under AS 16.05.871);
- BMP E-14 (requires hydrology and fish studies to determine the appropriate structures at stream channel crossings to reduce impacts on fish);
- Lease Stipulation D-1 (restricts drilling in rivers, streams, and fish-bearing lakes);
- Lease Stipulation E-2 (requires that permanent oil and gas facilities and infrastructure be more than 500 feet from lakes, with essential pipeline and road crossings evaluated on a case-by-case basis; limits pipelines within 500 feet of fish-bearing waters and crossing of lakes; restricts discharge of pollutants from vehicle and equipment use, personnel camps, and produced fluids);

- Lease Stipulation K-1 (establishes setbacks from major rivers, including Fish Creek and Tiŋmiaqsiġvik (Ublutuoch) River; exceptions for essential road and pipeline crossings); and,
- Lease Stipulation K-2 (establishes a 0.25-mile development setback from deep water lakes, defined as those greater than 13 feet except essential road and pipeline crossings considered on a case-by-case basis).

In addition to the BMPs and Lease Stipulations, one new potential mitigation measure, related to water use for permitted activities has been proposed as outlined below.

New Potential Mitigation Measure 1 – Water Intake (new subparagraph to BMP B-2)

Objective: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish, invertebrates, and waterfowl.

Requirement/Standard: Water intake pipes used to remove water from fish-bearing water bodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Screen mesh size shall not exceed 0.04 inches unless another size has been approved by the authorizing officer. The maximum water velocity at the surface of the screen enclosure may be no greater than 0.1 foot per second. The authorizing officer may, based on a written determination, impose additional restrictions on industrial water withdrawals from water bodies when further reduction of the water level would result in immitigable adverse impacts to species depending on or inhabiting in the water bodies.

Potential Benefits and Residual/Unavoidable Impacts: This potential BMP would provide additional protections to fish beyond the existing BMPs and ADF&G regulations for water withdrawals.

4.3.2.5 Conclusion

The overall anticipated impacts for Alternatives A, B, C, and D with respect to fish and fish habitat are expected to be similar with respect to intensity (moderate), extent (local), and context (important). Fish and fish habit in the project study area are considered important in context as these are protected by legislation and they provide important ecosystem services to the region as subsistence resources. With respect to duration, Alternatives A, B, and C are anticipated to have long-term duration while Alternative D is expected to have an interim duration. Overall, all of the action alternatives are expected to have a minor overall impact on fish and fish habitat. Alternative E, No Action, would have no impacts to fish or fish habitat.

As described above, the potential impacts to fish include injury at water-use intakes, altered water quality, physical habitat changes (water quantity, flow patterns, and geomorphology), point and non-point source pollution, increased turbidity and sedimentation, and barriers to fish movements. Collectively, these could contribute to reduced success at different life history stages, behavioral changes, diminished condition, susceptibility to pollutants or disease, shifts in fish species distribution, and mortality.

The predicted shifts in physical and chemical characteristics of the environment occur with climate change, impacts on fish from oil and gas activities in NPR-A could be greater or less than expected (BLM 2012, § 4.3.7.4, p. 161). The magnitude of shifts in these habitat characteristics will ultimately determine how habitats may change and how different fish species respond. For example, if water temperatures increase excessively, metabolic stress for many fish species would be greater and could result in lower tolerance thresholds to land-use

impacts. Conversely, a moderate increase in water temperature could contribute to a more productive feeding season and enable fish to better survive the winter and additional stress. Future hydrologic patterns will strongly influence fish habitat conditions, as well, but the trajectory of these patterns is unclear (BLM 2012, § 4.3.7.4, p. 161). A change in the timing and quantity of water flow could also contribute to fish passage problems at stream channel or wetland road crossings that are designed based on past flow regimes.

4.3.3 Birds

The potential direct and indirect effects to birds from the activities and infrastructure associated with the proposed GMT1 Project are outlined in this section.

The GMT1 project has the potential to affect birds, bird behavior, and their nesting, brood-rearing, foraging, and molting habitats through habitat loss and alteration, disturbance from noise and visual activity, displacement from habitats, or attraction to habitats altered by thermokarst and early green-up adjacent to gravel infrastructure (BLM 2012, § 4.3.8.2, p. 170; Corps 2012, § 5.9, p. 5-209).

The impact evaluation criteria for birds are presented below in Table 4.3-7, which are based on the general impact criteria described in Section 4.1.1, Impact Criteria.

Table 4.3-7. Impact Criteria—Birds

Impact Category	Magnitude	Definition
Intensity	High	Potentially affecting 25 percent or more of a high value bird habitat or bird population.
	Medium	Potentially affecting more than 5 percent but less than 25 percent of a high value bird habitat or bird population.
	Low	Potentially affecting 5 percent or less of a high value bird habitat or bird population.
Duration	Long term	Lasting longer than 10 breeding seasons.
	Interim	Lasting longer than 2 breeding seasons but less than 10 breeding seasons.
	Temporary	Lasting less than 2 breeding seasons.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region, and is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality or region and is not protected by legislation.
Geographic Extent	Statewide	Extends beyond project study area.
	Regional	Extends beyond 300 ft from project components but within project study area.
	Local	Within the footprint and extending 300 ft from project components.

As indicated by the impact criteria, this evaluation utilizes habitat to make impact rating determinations. Potential high value bird habitats are summarized in Table 4.3-8, which are used in evaluation of direct and indirect impacts. The evaluation of birds is divided into the project phases, 1) construction, and 2) drilling and operations; these are discussed in the following sections.

Table 4.3-8. Potential High Value Bird Habitats in the GMT1 Project Study Area

Bird Groups	Use	Habitats
Waterfowl[1] (W)	Nesting Brood Rearing/Molting	Open Nearshore Water Brackish Water Tidal Flat Barrens Salt Marsh Shallow Open Water with Islands or Polygonized Margins Grass Marsh Young Basin Wetland Complex Old Basin Wetland Complex Tapped lake with Low-water Connection Deep Open Water without Islands Deep Open Water with Islands or Polygonized Margins River or Stream
King Eider[2] (KE)	Pre-nesting Nesting Brood Rearing/Molting	Brackish Water Tapped Lake with Low Water Connection Salt Marsh Deep Open Water without Island Shallow Open Water without Islands Shallow Open Water with Islands or Polygonized Margins River or Stream Sedge Marsh Old Basin Wetland Complex Aquatic Grass Marsh
Gull[3] (G)	Nesting	Brackish Water Tapped lake with High-water Connection Shallow Open Water with Islands or Polygonized Margins Sedge Marsh Patterned Wet Meadow
Raptors and Owls[4] (RO)	Nesting and Roosting	Cliffs and Bluffs along the Colville River
Passerines[5] (P)	Nesting and Foraging	Open Sedge Tundra, Willow Shrub Tundra/ Shrub Thickets, Open Tundra, Tundra Habitats
Shorebirds[6] (S)	Nesting, Brood Rearing, Foraging	Shoreline silt barrens Wet tundra habitats Wet sedge meadows and aquatic sedge and grass marshes Patterned Wet Meadow Moist Sedge-Shrub Meadow Moist Tussock Tundra Drained Lake Basins

[1, 3] From Johnson et al., 2013 (Table 23).

[2] From Johnson et al., 2013 (Table 8) and BLM (2004, § 3.3.3.1, Tables 3.3.3-4 through 3.3.3-6, pp. 240-246).

[4] From BLM (2012, § 3.3.5.7, p. 270).

[5] From BLM (2004, Table 3.3.3-8, p. 257).

[6] From Johnson et al. (2005).

4.3.3.1 Construction

Birds and bird habitats could be impacted during construction by habitat loss and alteration, disturbance and displacement, mortality, and predation, as discussed below.

Habitat Loss and Alteration

Long-term bird habitat loss and alteration would be initiated during gravel extraction and placement of fill. These activities would be completed during the winter, when most birds are absent from the ACP, so no birds or nests would be lost as a direct result of gravel mining or fill. During construction of roads and pads, gravel mine sites and tundra covered by gravel would be lost to use by birds. This loss of habitat would continue through the duration of the construction and operation of the development, and would be permanent unless habitat restoration measures

were successfully implemented after abandonment of the infrastructure (BLM 2012, § 4.3.8.2, p. 170).

In addition to permanent habitat loss, temporary loss of habitat associated with gravel placement could occur on tundra adjacent to gravel structures, where accumulated snow from snow-plowing activities or snowdrifts would become compacted and lead to a delayed snowmelt. Delayed snowmelt persisting into the nesting season could preclude tundra-nesting birds from nesting in those areas (BLM 2012, § 4.3.8.2, p. 171).

Gravel infrastructure such as roads and pads can result in dust deposition, which can affect bird habitat by causing early snowmelt, and thus, early green-up on tundra adjacent to roads, pads, and airstrips which could attract waterfowl and shorebirds early in the season when other areas are not yet snow-free. Dust deposition could also increase thermokarst and soil pH, and reduce the photosynthetic capabilities of plants in areas adjacent to roads (Auerbach et al. 1997). Ground and air traffic (including helicopters), and wind can influence the amount of dust that may be deposited adjacent to roads and pads (BLM 2012, § 4.3.5.2, p. 129). For this analysis, a distance of 300 feet from the edge of gravel roads and pads was used to estimate the zone of impact for dust deposition, as discussed in Section 4.3.1, Vegetation and Wetlands.

Tundra ice roads would cause temporary bird habitat loss and habitat alteration. These ice roads remain until after most birds have initiated nesting, causing temporary nesting habitat loss. Ice roads also compress the vegetation, especially standing dead vegetation used for concealment by some nesting birds. Standing dead vegetation would require multiple growing seasons to reestablish, likely resulting in interim duration habitat alteration. (Corps 2012, § 5.9.3.1, p. 5-221).

Melting of ice roads could be delayed compared to surrounding tundra, causing impoundments of water. Impoundments created by ice roads or gravel structures could be ephemeral (drying up early during the summer) and could cause temporary or permanent flooding on adjacent tundra, or they could become permanent water that would persist from year to year. Hydrological impacts along roads and pads, such as impoundments are discussed in Section 4.2.2, *Hydrology*, and depicted in Figure 4.2-1. Tundra covered by impounded water could result in a loss of nesting and foraging habitat for some birds. However, impoundments could also create new feeding and brood-rearing habitat that would be beneficial to some bird species (BLM 2012, § 4.3.8.2, p. 172).

Water withdrawal from lakes during ice road construction has the potential to lower the level of lakes and affect waterfowl and shorebirds that use adjacent habitats, particularly small islands and shoreline areas that loons and waterfowl use for nesting. Changes in the surface levels of lakes due to water withdrawal would be dependent on the amount of water withdrawn, the volume of the lake, and the recharge rate. There is also potential for impacts to birds resulting from potential impacts to invertebrate and fish food resources from varying winter water levels if pumped lakes do not fully recharge (BLM 2012, § 4.3.8.2, p. 171).

Disturbance and Displacement

Gravel mining and placement of gravel fill would be completed during winter when most birds are not present. Road work such as grading, compacting, and reshaping of roads and pads would occur during summer when birds are present. The noise and vehicle traffic during these activities would likely disturb and displace birds away from gravel roads and pads. Disturbance causes birds to expend energy in responding, although it may not necessarily reduce survival or productivity (Corps 2012, § 5.9.3.1, p. 5-221). Noise would likely cause the greatest disturbance

to birds between June 1 and July 15 when birds on nests would be unable to move away from the disturbance (Corps 2012, § 5.9.3.1, p. 5-222). Construction-related disturbances to birds are also discussed in BLM (2004, § 4F.3.3, pp. 1138-1140).

Some birds that may have nested at sites previously not covered by gravel could be displaced and move to adjacent areas to nest. Johnson et al. (2003) reported that waterbirds nesting near the Alpine oil field that were displaced from nesting sites by gravel placement probably moved their nests to nearby adjacent habitats. In addition, there may be a functional loss of habitat in areas near roads and pads, if development-related disturbances preclude birds from utilizing these habitats. Impacts related to habitat loss may be more severe for species that have specific habitat requirements (BLM 2012, § 4.3.8.2, p. 170).

Noise and visual cues from air traffic would disturb birds. Bird responses to aircraft include alert and concealment postures, interrupted foraging behavior, flight, and a reduction in nest attendance (Corps 2012, § 5.9.3.1, p. 5-222). The effects of routine aircraft flights could range from bird avoidance of certain areas to abandonment of nesting attempts or lowered survival of young. The potential impact to birds from aircraft noise would probably be greatest during the nesting period when the movements of incubating birds are restricted and the molting period when, in addition to being a period of restricted movements, birds may be energetically stressed and sensitive to disturbance (BLM 2012, § 4.3.8.2, p. 176).

Aircraft noise levels would be highest during take offs and landings, and most aircraft-related disturbance would be concentrated around the airstrips for brief time periods. The behavioral response of birds to aircraft disturbances near the existing and planned airstrips (see Section 2.0, Proposed Action and Alternatives) would not necessarily result in lowered nest success. Johnson et al. (2003) reported that birds nesting in proximity to the Alpine oil field airstrip, including tundra swans and yellow-billed loons, were not negatively affected by aircraft operations at that time.

Although the potential exists for displacement of some nesting birds near routinely used airstrips, as a result of numerous over flights, landings, and takeoffs, some birds may habituate to routine air traffic. Routine flights would be of short duration and occur in a particular area, and would likely cause minimal disturbance to birds. However, temporary displacement from preferred habitats could affect energy budgets of some birds, and incubating birds could be temporarily displaced from nests. (BLM 2012, § 4.3.8.2, p. 176).

Oil spill response training activities using watercraft could be conducted on rivers and lakes several times during the open-water season. Spill response training activities would have the potential to disturb foraging, nesting, or brood-rearing waterfowl and other birds. Suggested set-back distances for minimizing the potential for boat disturbance range from 325 feet for shorebirds to 600 feet for wading birds (BLM 2012, § 4.3.8.2, p. 177).

Disturbance to birds could result in temporary or permanent displacement from preferred habitats, potentially resulting in decreased nesting and nest attendance, nest abandonment, nest predation, and increased energy expenditures that could affect an individual bird's survival or reproduction. Disturbances could displace birds from feeding habitats and negatively impact energy budgets. Disturbances would be most impactful during the pre-nesting period when birds gather to feed in open areas near roads, and during brood-rearing and fall staging when some geese exhibit higher rates of alertness in areas near roads than do birds in undisturbed areas. Some evidence suggests that pedestrian traffic may have a greater impact on some species of birds than vehicular traffic (BLM 2012, § 4.3.8.2, p. 173).

Mortality

Birds may collide with structures necessary for operation such as communication towers, flare towers, buildings, antenna guy-wires, and elevated pipelines. Satellite dishes, elevated radio antennae, radio repeater sites would also add potential collision hazards. Although bird collisions with oil field structures are expected to be infrequent, some collisions and resultant mortality are probable. When visibility is poor birds can be attracted to lighted facilities (Corps 2012, § 5.9.3.1, p. 5-223).

Bird collision events with infrastructure during poor weather conditions are rare and episodic, but would have the potential to occur for the life of the project (long term). Facilities would always be lighted, which can attract birds. Poor visibility due to fog and low light conditions, which are common in the project study area (See Section 3.1.2, Climate and Meteorology) would contribute to the risk of collisions with infrastructure. The potential for impact is lessened by the mitigative measure of downward shielded lighting. Most infrastructure collisions would involve individual birds or several birds from small flocks, but under certain conditions could involve large flocks.

Vehicle traffic on infield gravel roads poses the greatest threat to birds during the summer, when the largest numbers of birds are present in the project study area, possibly resulting in bird collision mortality. Geese attracted to roadsides by early vegetation sprouting, brood-rearing waterfowl, and ptarmigan using roadside grit are susceptible to collisions with vehicles. Although geese may gain access to nutritious forage near roads, their exposure to vehicle disturbances also increases. Overall, collision mortality is generally thought to be low within North Slope oil fields, although this is poorly documented (Corps 2012, § 5.9.3.1, p. 5-223).

Predation

Ravens, gulls, arctic fox, bears and other predators may be attracted to areas of human activity where anthropogenic sources of food and shelter are present. Survival of these predators could increase due to the availability of anthropogenic food sources, particularly during the winter. Increased levels of predation due to elevated numbers of predators could, in turn, impact bird populations (BLM 2012, § 4.3.8.2, p. 177). Elevated structures (pipelines or facilities) can provide sites for ravens to roost or nest.

Oil field operators have installed predator-proof dumpsters at camps and implemented new refuse handling techniques in recent years to minimize the attraction of predators. In addition, oil field workers undergo training to make them aware of the problems associated with feeding wildlife. At the Alpine oil field, Johnson et al. (2003) reported that except for one pair of nesting ravens, the numbers of predators and levels of predation after development did not increase in the area compared to pre-development levels. Ravens have nested or attempted to nest at the Alpine field in recent years.

4.3.3.2 Drilling and Operation

Habitat Loss and Alteration

After initial placement of gravel to construct roads and pads in the project study area, some habitat alterations from the indirect impacts of snowdrifts, dust fallout, thermokarst, and ponding would continue during project operation as described above (Section 4.3.4.1, *Construction*). An oil spill could impact birds using terrestrial or aquatic habitats, and could have an effect on congregations of shorebirds and waterfowl. Potential impacts to birds would depend on the location and size of the spill and on the time of year.

Disturbance and Displacement

The types of disturbance and displacement impacts that occur during the construction phase of this project (Section 4.3.4.1, *Construction*) would continue through the drilling and operations phase of the project, including noise and visual cues from vehicles, aircraft, pedestrians, and other disturbances. The potential displacement of birds caused by the installation of infrastructure, including gravel fill, pipelines, and other facilities would continue through the drilling and operations phase; the effects of physical displacement by these structures would be exacerbated by the addition of traffic noise and visual activity on and near these facilities.

Mortality

The potential for mortality such as direct collisions with ground vehicles would be highest during the drilling and operations phase as road traffic during summer season when large numbers of birds are present on the ACP. Birds attracted to the roadside by altered habitat, described above, would be at risk of mortality by vehicle strikes (BLM 2012, § 4.3.8.2, p. 173). Mortality impacts that occur during the construction phase of this project, such as collisions with infrastructure (see Section 4.3.4.1, *Construction*) would continue through the drilling and operations phase of the project.

An oil discharge in molting or brood rearing habitat could impact large numbers of birds that congregate in these areas. Increased predation on nests from predators attracted to development is a concern for birds nesting in the GMT1 Project study area. Predators such as fox, bear, and predatory birds are drawn to the increased scavenging opportunities associated with development and humans.

Abandonment and Reclamation

The abandonment and reclamation of project facilities may involve removing gravel pads and roads or alternatively leaving these in place indefinitely. Revegetation of abandoned facilities could be accomplished by seeding with native vegetation or by allowing natural colonization. Winter activities would cause little disturbance or displacement, because most species would be absent from the area. Summer road and air traffic generated by abandonment and reclamation activities could cause disturbance, displacement, and mortality to birds that would be similar in type, but at much lower intensity levels and shorter durations than caused by traffic during construction and operations.

Gravel pads, roads, and airstrips that are not revegetated would have less value to birds. Revegetation without gravel removal would not return the site to its current utility for most birds. If gravel was removed, habitat similar to that currently existing in the area could be created and used by birds, although the precise mix of habitat types would likely not be the same as what prevailed at the time of disturbance (BLM 2012, § 4.3.8.2, p. 179).

4.3.3.3 Comparison of Alternatives

Habitat loss and alteration would be variable among the four action alternatives. The direct impacts of gravel placement on all habitats and potential high value bird habitats are summarized in Table 4.3-9 for direct impacts. Table 4.3-10 presents the predicted indirect impacts to habitats within 300 feet of gravel infrastructure due to dust and gravel spray.

All of the action alternatives would have a total gravel fill footprint representing less than one percent each of the total area of the available habitat project study area, and would directly impact less than five percent of specific habitats identified as potential high value bird habitats.

Alternative C would have the largest direct gravel impact to all habitats and potential high value bird habitats

Indirect impacts based on a 300-foot zone surrounding gravel infrastructure would impact less than one percent of the total habitats under Alternatives A, B, and D. Alternative C would have the largest indirect gravel impact to all habitats, 1,368.7 acres, corresponding to less than five percent of the project study area. Alternatives A, B, and C would each have indirect gravel impacts to one potential high value passerine bird habitat, Moist Tall Shrub, of slightly more than eight percent. Alternative D would not impact more than five percent of any one potential high value bird habitat from indirect gravel effects.

Alternative C would impact more than one percent (but less than five percent) of the total available habitats with indirect gravel effects, and Alternative C would impact more than three percent of the Moist Sedge-Shrub Tundra habitat that occurs within the project study area; the other action alternatives would impact lower percentages of this habitat by indirect gravel effects. Overall, Alternative C would impact the highest portion of potential bird habitats (1.7 percent) of all the action alternatives.

Gravel mining at the Clover site would also impact potential habitat for birds; the footprint of impact would vary according to the gravel demand for each Alternative: Alternative A (18.7 acre), Alternative B (19.8 acre), Alternative C (25.0 acre), and Alternative D (24.5 acre). The habitats that would be impacted at Clover include Moist Tussock Tundra, Old Basin Wetland Complex, Patterned Wet Meadow, which are potential high value bird habitats, and Lowland Wet Sedge Meadow.

Disturbance and displacement impacts to birds from ground transportation would be similar for Alternatives A and C, which share a common road route between CD5 and GMT1, crossing the same potential bird habitats. Alternative B would have a different route for the access road and would impact greater amounts of one potential high value bird habitat compared to the other action alternatives, the Moist Sedge-Shrub Meadow type (see Table 4.3-8).

Alternative C would include airport improvements at Nuiqsut, which would impact potential high value bird habitats but also result in an incremental increase in the length of the airstrip, which would extend the zone of potential noise impact from aircraft using the extended runway. Alternative C would in concept divert air traffic from APF to Nuiqsut to deliver workers and supplies for the GMT1 project; however, the volume of air traffic that would in fact be diverted, and the associated changes to noise impact to local birds is unknown.

Overall, Alternatives A, B , and C are predicted to have habitat loss and alteration rated as being of low intensity, long-term duration, and local extent (Table 4.3-11). The affected resource, which in this case include migratory birds, are rated as important in context due to their protection under federal legislation and because migratory birds fill a distinctive ecosystem and ecological service role within the locality and region.

Overall, Alternatives A, B, and C are expected to result in minor impacts to birds and their habitats.

Alternative D differs from the other action alternatives in the potential impacts to birds due to the lack of a gravel road and associated habitat loss and alteration, but includes the use of aircraft to access the GMT1 drill site during the non-ice road season, roughly eight months of the year. The number of flights required for transport of personnel and supplies needed for

operation of the drill site and facilities for Alternative D (see Table 2.4-3) is expected to result in impacts of low intensity disturbance and displacement to birds in the project study area, although the effects could extend into adjacent areas beyond the project study area, depending upon the flight paths for airstrip approach and altitudes, resulting in a limited, regional level extent of impact.

The air traffic at the GMT1 facility under Alternative D would be additional to the existing activity in the APF and Nuiqsut airspaces, and would continue for long term. Under Alternatives A, B, and C, an estimated 162 to 223 additional new flights at the Alpine airstrip per month during the summer would be required during construction and, as indicated by the Applicant, would drop to no additional flights after construction is completed.

Under Alternative D, flights into Alpine airstrip for construction would be similar to those required for the other action alternatives. Alternative D would differ from the other action alternatives during drilling and operation, as flights would increase to 540 new flights per month during May and June, and 282 new flights added for July and August for the life of the project, all landing and taking off at an airstrip located at the GMT1 site. The air traffic specific to Alternative D would likely follow the general route of the proposed access road to GMT1. Annual ice roads would require construction activity and potentially disturb birds throughout the project life, and re-use of ice annual road routes and ice pad locations could damage tundra, a potential long term impact to potential high value bird habitats. The impacts of Alternative D are expected to be of low intensity, long-term duration, and local extent. The affected resource is also rated important for impacts under Alternative D (Table 4.3-12).

Overall, Alternative D is expected to result in minor to birds.

Alternative E, No Action, would result in no impacts to birds.

Table 4.3-9. Direct Impacts to Potential High Value Bird Habitats from Gravel and Pipeline Infrastructure

Habitat (Bird Group)[1]	Project Study Area Mapped[2]		Impacts by Alternative (acre and percent of project study area mapped[2])								
			A		B		C		D		E
	acre	%	acre	%	acre	%	acre	%	acre	%	acre
Barrens	3,670	4%	<0.01	<0.1%	--	--	--	--	--	--	0
Grass Marsh (W)	438	0.5%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	0
Human Modified	312	0.3%	--	--	--	--	1.2	0.4%	--	--	0
Moist Low Shrub	4,613	5%	0.1	<0.1%	0.07	<0.1%	0.1	<0.1%	<0.01	<0.1%	0
Moist Sedge-Shrub Meadow (S)	15,187	17%	19.2	0.1%	26.5	0.2%	26.1	0.2%	24.8	0.2%	0
Moist Tall Shrub (P)	25	0.0%	0.3	1.2%	0.3	1.3%	0.3	1.1%	<0.01	<0.1%	0
Moist Tussock Tundra (P)	15,973	18%	41.1	0.3%	29.5	0.2%	56.0	0.4%	50.2	0.3%	0
Non-patterned Wet Meadow (P,S)	4,707	5%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	0
Old Basin Wetland Complex (W,KE)	5,508	6%	5.5	0.1%	8.7	0.2%	5.7	0.1%	2.0	0.1%	0
Patterned Wet Meadow (P)	19,107	21%	5.1	0.03%	11.6	0.1%	6.8	0.04%	9.6	0.1%	0
River or Stream (W,KE)	2,464	3%	0.1	<0.1%	0.1	<0.1%	0.1	<0.1%	<0.01	<0.1%	0
Riverine Complex (W,KE)	162	0.2%	0.2	0.1%	--	--	0.3	0.2%	<0.01	<0.1%	0
Salt Marsh (KE)	625	1%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	0
Sedge Marsh (KE)	970	1%	0.8	0.1%	1.2	0.1%	0.9	0.1%	<0.01	<0.1%	0
Shallow Open Water w/IPM[3] (W,KE,G)	968	1%	<0.01	<0.1%	<0.01	<0.1%	<0.01	<0.1%	0.8	0.1%	0
Shallow Open Water w/o Islands (KE)	669	1%	<0.01	<0.1%	1.3	0.2%	<0.01	<0.1%	<0.01	<0.1%	0
Total	**75,398**	**84%**	**72.5**	**0.1%**	**79.3**	**0.1%**	**97.5**	**0.1%**	**87.3**	**0.1%**	**0**

[1] Potential high value wetland bird habitats identified in Table 4.3-8 and also identified as *Key Wetland Habitats* in BLM (2004, Table 4F.3.3.2, Summary of Affected Habitat Types Used by Waterfowl, Loons, and Seabirds); identified by bird group: (W) Waterfowl, (KE) King Eider, (G) Gull, (RO) Raptors and Owls, (P) Passerines, (S) Shorebirds.

[2] Percent of vegetation type acreage within the mapped vegetation portion of the project study area. Note that 12,428 acre (12%) of the project study area extends outside of the vegetation map coverage. All the project facilities under all the alternatives are within areas of mapped vegetation. This area also represents the 2.5-mile indirect impact zone.

[3] With Islands or Polygonized Margins.

"—"= No Impact to this Habitat.

Table 4.3-10. Indirect Impacts to Potential High Value Bird Habitats from Gravel Infrastructure (300 feet)

Habitat (Bird Group)[1]	Project Study Area Mapped[2]		Impacts by Alternative (acre and percent of project study area mapped)								
			A		B		C		D		E
	acre	%	acre	%	acre	%	acre	%	acre	%	acre
Deep Open Water (w/IPM)3 (W,KE)	2,805	3%	0.4	<0.1%	--	--	0.4	<0.1%	--	--	0
Deep Open Water without Islands (W)	6,834	8%	1.8	<0.1%	1.5	<0.1%	4.9	0.1%	0.3	<0.1%	0
Grass Marsh (W)	438	0%	1.4	0.3%	--	--	1.4	0.3%	--	--	0
Human Modified	312	0%	--	--	--	--	27.2	8.7%	--	--	0
Moist Dwarf Shrub	86	0%	5.2	6.1%	1.1	1.2%	5.2	6.1%	0.5	0.6%	0
Moist Low Shrub	4,613	5%	1.5	<0.1%	0.6	0.0%	1.5	<0.1%	--	--	0
Moist Sedge-Shrub Meadow (S)	15,187	17%	181.4	1.2%	211.2	1.4%	477.4	3.1%	75.1	0.5%	0
Moist Tall Shrub (P)	25	0%	2.1	8.3%	2.1	8.3%	2.1	8.3%	--	--	0
Moist Tussock Tundra (P)	15,973	18%	253.1	1.6%	154.7	1.0%	508.3	3.2%	155.4	1.0%	0
Non-patterned Wet Meadow (P,S)	4,707	5%	0.8	<0.1%	--	--	7.1	0.2%	--	--	0
Old Basin Wetland Complex (W,KE)	5,508	6%	67.8	1.2%	108.1	1.96%	119.0	2.2%	30.0	0.5%	0
Patterned Wet Meadow (P)	19,107	21%	55.0	0.29%	89.1	0.5%	177.0	0.9%	11.5	0.1%	0
River or Stream (W,KE)	2,464	3%	1.2	<0.1%	1.2	<0.1%	1.2	<0.1%	--	--	0
Riverine Complex (W,KE)	162	0%	2.8	1.7%	--	--	5.9	3.6%	--	--	0
Sedge Marsh (W,KE,G)	970	1%	16.5	1.7%	17.8	1.8%	19.7	2.0%	--	--	0
Shallow Open Water w/IPM3 (W,KE,G)	968	1%	2.5	0.3%	12.9	1.3%	8.6	0.9%	2.4	0.3%	0
Shallow Open Water without Islands (KE)	669	1%	1.8	0.3%	13.4	2.0%	1.9	0.3%	0.8	0.1%	0
Total	**80,828**	**90%**	**595.3**	**0.7%**	**613.7**	**0.8%**	**1,368.7**	**1.7%**	**275.9**	**0.3%**	**0**

See notes in Table 4.3-9.

Table 4.3-11. Impact Criteria Summary for Birds – Alternatives A, B, and C

Alternatives A, B, and C				
Impact Type and Affected Population	**Intensity**	**Duration**	**Context**	**Geographic Extent**
Habitat Loss and Alteration	Low	Long term	Important	Local
Disturbance and Displacement	Low	Long term	Important	Local
Mortality and Predation	Low	Long term	Important	Local

Table 4.3-12. Impact Criteria Summary for Birds – Alternative D

Alternative D				
Impact Type and Affected Population	**Intensity**	**Duration**	**Context**	**Geographic Extent**
Habitat Loss and Alteration	Low	Long term	Important	Local
Disturbance and Displacement	Low	Long term	Important	Regional
Mortality and Predation	Low	Long term	Important	Local

4.3.3.4 Mitigation

Numerous stipulations and BMPs are in place to effectively protect birds and their habitats within the NPR-A. These include BMPs A-1 through A-7 and E-9, which ensure that solid, liquid, and hazardous wastes (including fuels) do not impact birds or their habitats, and to reduce the potential for garbage and shelters that attract predators. The protection of bird habitats and food sources are addressed by BMPs B-1, C-3, C-4, and Stipulations E-2 and L-1, among others. In addition, there are BMPs and stipulations that regulate the types of activities that can occur near waterbodies, including rivers and streams, types of equipment that can be used in the planning area, will serve to protect birds and their habitats. A list of BMPs is provided in Section 4.7 Mitigation.

A Wildlife Avoidance and Interaction Plan and a Predator Management Plan, incorporating federal, state, and local stipulations on wildlife interactions would be developed as part of the operational permitting process.

The following design measures are recommended as part of the project design to avoid or minimize impacts on birds (Corps 2012, §5.9.7, p. 5-266):

- Implementing controls to minimize nesting opportunities for predatory/nuisance birds, including the following:
  - Blocking off nooks and crannies with fabric/netting or other bird-nest deterrent.
  - Using scare devices to deter birds when they land in places likely to be nesting sites.
  - Removing nests as the birds try to construct them (before they have a chance to lay eggs).
- Designing facilities to minimize potential for bird strikes, including the following measures:
  - Careful consideration will be given to facility lighting (e.g., light hoods to reduce outward radiating light) that reduces the potential for disorienting migrating birds and reduces bird strikes.
  - Buildings and stack heights will be the minimum needed to perform their functions, with consideration for associated footprint. The flares will be free standing (no guy wires).

  - Communications towers will avoid the use of guy wires and will be attached to camps or other, larger structures when possible.
  - Power lines and fiber-optic cables will either be buried or placed on the pipeline VSMs.
  - Aircraft will generally maintain a 1,500-foot altitude to avoid impacts on ground nesting and foraging birds, except as required for takeoff and landing, safety, weather, and operational needs, or as directed by air traffic control.
- Rehabilitating the gravel mine to enhance habitat for waterfowl.
- Limiting removal of water from freshwater lakes during the summer to minimize reductions in amount or quality of nesting and brood-rearing habitat through diminished water levels.
- Monitoring water withdrawal volumes and water body recharge, as needed or directed, by ADNR and/or ADF&G in the future.
- Gravel placement on the tundra will primarily occur during the winter; however, if site preparation and/or construction activities occur on the tundra during the summer, prior to July 31 (when most arctic nesting birds have hatched), areas in the vicinity of such field activities will be searched for nesting birds by a qualified biologist prior to the start of work. If an active nest is found (even after July 31), the appropriate USFWS Field Office will be contacted for instructions on how to avoid or mitigate the potential loss of the active nest.

4.3.3.5 Conclusion

Overall, Alternatives A, B, C, and D are predicted to result in minor impacts to birds and bird habitats. Alternative E, No Action, would result in no impacts to birds or bird habitats.

Birds that could be affected by the action alternatives include loons, waterfowl, shorebirds, raptors, passerines, seabirds, and ptarmigan. Most species in these groups migrate to wintering areas located outside of the NPR-A, and would not be directly affected by winter construction activities, although their habitats could be affected. A few species, such as ptarmigan, gyrfalcon, and snowy owl, may remain in the project study area during the winter, and could be temporarily displaced from preferred feeding or resting habitats by winter exploration or construction activities.

Activities related to the action alternatives, such as vehicle, aircraft, pedestrian and boat traffic, summer tundra travel, routine maintenance activities, heavy equipment use, facility noise, and oil spill cleanup activities, could cause disturbances that would affect birds. Summer fixed-wing or helicopter aircraft activity in support of the GMT1 Project, including related research, could result in disturbance to birds, causing temporary or permanent displacement from preferred feeding, nesting, staging, or brood-rearing habitats in localized areas near areas of activity.

Permanent habitat loss would result from gravel placement for roads and pads, and at gravel mine sites. Temporary habitat loss or alteration could also occur in areas adjacent to gravel roads due to snow and/or dust deposition, thermokarst, and the formation of impoundments. Some types of habitat alteration, such as the formation of impoundments, could be beneficial to some species, while having a negative impact on others. Withdrawal of water from source lakes during winter could impact birds if water levels or prey availability in source lakes were affected. Lake surveys conducted prior to water withdrawal, limits on the amount of water that

may be withdrawn from lakes due to Lease Stipulations, and the ability of lakes to naturally recharge, would likely negate any potential negative impacts related to water withdrawal.

Bird mortality could result from collisions with ground or air vehicle or vessel traffic, or with towers, buildings, pipelines, power lines suspended from pipelines, bridges, or other facilities. It is expected that collisions would only be a minor source of bird mortality; however, over the course of the life of the GMT1 project these mortalities may accumulate for some species. Predators attracted to areas of human activity could also impact tundra-nesting birds by causing depredation of eggs and young; however, Lease Stipulations designed to eliminate attraction of predators to camps or equipment maintenance sites would help mitigate potential increases in predators. Adherence to Lease Stipulations that require proper disposal of garbage to avoid human-caused changes in predator populations would likely minimize potential impacts to birds from increased predation pressure.

Although impacts to birds could occur as a result of the action alternatives, long-term studies of bird density and abundance in the Prudhoe Bay oilfield, located on the ACP, indicate that oil production, as practiced in Prudhoe Bay, does not necessarily lead to substantial declines in bird density or productivity in or near the developed area (Bart et al. 2013).

Effects to birds from climate warming may include a suite of effects, both positive and negative. A longer open-water season may increase productivity of some species of shorebirds and increase productivity in aquatic and semi-aquatic systems, which provide food for many species of birds. Warmer soil temperatures are likely to increase thermokarst and may inundate low-lying tundra areas, increasing aquatic and wet tundra vegetation types. The increasing thickness of the active layer of soil above Arctic permafrost is likely to cause changes in moisture regimes and the distribution of vegetation types over much of the Arctic in coming years. Drying of wetlands would result in negative effects to those species that relay on shallow water and wet meadows, and shrub expansion may reduce the quality and availability of some types of habitats. Such impacts could accelerate or exacerbate changes in soil thermal regimes that occur with development, potentially leading to greater impacts to bird habitat (BLM 2012, § 4.3.8.4, p. 186).

4.3.4 Mammals

This section presents the potential impacts to terrestrial and marine mammals that would result from implementation of the proposed projects' action alternatives. When applicable, impacts to habitat were used to determine potential impacts to individual species.

4.3.4.1 Terrestrial Mammals

The proposed GMT1 project has the potential to affect terrestrial mammals as described in BLM (2004, § 4F.3.4.1) in the project study and in BLM (2012, § 4.5.8.2) for the entire NPR-A, both of which are incorporated by reference. The following discussion summarizes the impacts and is supplemented with information from the Point Thomson EIS related to terrestrial mammal impacts (Corps 2012, § 5.10).

Methodology

Terrestrial mammals occurring in the project study area are evaluated for potential impacts in this analysis. Caribou are particularly important with respect to subsistence and are a focus of the impact analysis. Other terrestrial mammals and their habitats, including grizzly bear, muskoxen, fox, wolverine, and small mammals are included. The general mechanisms of impact

are expected to be similar to that described in BLM (2004, § 4F.3.4.1; 2012, § 4.5.8.2), and for the Pt. Thomson Project by the Corps (2012, § 5.10), which are incorporated by reference in this evaluation.

The analysis presented in this section evaluated potential impacts to terrestrial mammals based on habitat use, seasonal distributions, and seasonal movement patterns. For quantification of potential impacts to terrestrial mammals, a project study area was established that includes all gravel components for all alternatives with a surrounding buffer of approximately 2.5 miles, totaling approximately 100,000 acre (150 square miles). Terrestrial mammal habitat loss was based on the analyses described in Section 4.3.1, Vegetation and Wetlands. Terrestrial mammal habitat alteration was evaluated by using a 300-foot indirect impact zone (based on Auerbach et al. 1997), from proposed gravel infrastructure in response to possible physical changes caused by dust deposition, snow drifting and piling, thermokarst, and altered wetland hydrology, as discussed in Section 4.3.1, Vegetation and Wetlands. Loss, alteration, and disturbance of forage habitats were evaluated based on estimated acreages obtained from GIS analysis of Applicant-provided project facility dimensions.

Previous research conducted by the Applicant was evaluated for caribou distribution and movements throughout the project study area. Caribou research areas, shown in Section 3.3.4.1, Figure 3.3-8, delineate geographic locations of surveys in the Colville River Delta and the northeastern part of the NPR-A.

Impact analysis criteria used in this assessment for terrestrial mammals are presented below in Table 4.3-13. These impact criteria were developed based on the terrestrial mammal analysis presented in the Pt. Thomson EIS (Corps 2012, § 5.10, p. 5-273).

The direct and indirect impacts are evaluated by comparing the infrastructure footprints for the alternatives, including proposed routes for roads and the locations of pads, airstrips, and pipeline VSMs. The types of habitats that each of these facilities directly impact is evaluated and used to compare alternatives. Gravel fill is expected to alter terrestrial mammal habitat and use in areas adjacent to the actual footprints of roads and pads due to dust deposition, snow drifting and piling, thermokarst, altered wetland hydrology, and increased human disturbance. In addition to impacts from gravel fill and road usage, disturbance from aircraft are expected to occur within the project study area.

Alterations to habitats adjacent to gravel infrastructure footprint were estimated using a 300 feet indirect impact zone extending from the edge of gravel infrastructure such as roads, pads, and airstrips. Habitats used by caribou were identified from information provided in Wilson (2012, p. 7-8 *in* BLM 2012; Teshekpuk Herd (TH), calving, post calving, oestrid fly and mosquito seasons), and BLM (2004, § 4F, p. 1159); herd unspecified, calving, post calving, oestrid fly and mosquito seasons, winter and spring use areas). Habitat classifications within the project study area are presented in this document as the area within which caribou behavior may be altered by the existence and utilization of infrastructure.

Table 4.3-13. Impact Criteria for Terrestrial Mammals

Impact Category	Magnitude	Definition
Intensity	High	Potentially affecting more than 25% of all terrestrial habitat or specific habitat in the project study area, or a population of animals.
	Medium	Potentially affecting more than 5% and less than 25% of all terrestrial habitat or specific habitat in the project study area, or a population of animals.
	Low	Potentially affecting 5% or less of all terrestrial habitat or a specific habitat in the project study area, or a population of animals.
Duration	Long term	Lasting five or longer than five breeding seasons.
	Interim	Lasting two or longer than two breeding seasons, but less than 5 breeding seasons.
	Temporary	Lasting less than two breeding seasons.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region. Impacts will occur in times or areas of specific importance for affected species (e.g. foraging, calving areas, migratory corridor) or across a large portion of the range of a resident population.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region. Impacts will not occur in times or areas of specific importance for affected species (e.g. foraging, calving areas, migratory corridor) or across a large portion of the range of a resident population.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality and is not protected by legislation. Impacts will not occur in times or areas of specific importance for affected species (e.g. foraging, calving areas, migratory corridor) or across a large portion of the range of a resident population.
Geographic Extent	Statewide	Arctic Coastal Plain.
	Regional	Habitat Loss and Alteration: Extending beyond the 300 ft indirect impact zone; Disturbance: Extending beyond project study area to include known ranges of major caribou herds using project study area.
	Local	Habitat Loss and Alteration: Within the gravel footprint and 300 ft indirect impact zone; Disturbance: Within project study area (2.5-mile buffer around project footprint).

A summary of potential impacts to terrestrial mammals, including caribou, moose, muskoxen, grizzly bear, wolf, wolverine, and foxes may be locally affected by GMT1-related activities as outlined in Table 4.3-14.

Table 4.3-14. Summary of the Types of Potential Impacts to Terrestrial Mammals

Project Activity	Facilities and Activities	Potential Impacts
Construction	Ice Roads and Pads	Physical habitat changes, including hydrologic alteration long-term vegetation loss, dust impacts Displacement from (or attraction to) altered habitats Disturbance from noise or activity Obstruction of Movements
	Gravel Placement for Roads, Pads, Airstrips	Physical habitat changes, including hydrologic alteration, long-term vegetation loss, dust impacts Displacement from (or attraction to) altered habitats Disturbance from noise or activity Obstruction of Movements
	Gravel Mining	Physical habitat changes, including hydrologic alteration and long-term vegetation loss Displacement from (or attraction to) altered habitats Disturbance from noise or activity
Drilling and Operation	Vehicle Traffic Aircraft Traffic Human Activity	Collisions (mortality) Disturbance and Obstruction of Movements from vehicles or air traffic Defense of Life and Property (mortality) Increased Hunting Premature Den Emergence (Grizzly Bear)
	Pipelines	Obstruction of Movements Spills or leaks causing exposure to toxic materials

Construction

Construction of project action alternatives would affect terrestrial mammals and their habitats through medium- and long-term habitat loss and alteration; medium- and long-term habitat fragmentation; medium-term construction, vehicle collision, and human safety mortality; and medium-term altered survival or productivity. Construction and use of ice roads, gravel roads, pipelines and other infrastructure will primarily occur during the winter, however some construction activities would occur in the summer months. Construction related impacts to terrestrial mammals are evaluated for the project study area by BLM (2004, § 4A, 4F.3.4.1) and for oil and gas activities for the entire NPR-A in BLM (2012, § 4.5.9.2).

Habitat Loss and Alteration

Construction of the project action alternatives would result in long-term, direct and indirect habitat loss due to gravel extraction and the placement of gravel for roads, pads, and an airstrip (Table 4.3-15). The potential forage provided by the lost habitat is considered an impact to caribou and other terrestrial mammals. Forage habitat lost to gravel fill may provide insect relief habitat for caribou and possibly also for muskoxen (Corps 2012, § 5.10.3.1, p. 5-277). Gravel mining would also impact terrestrial mammal habitat within the footprint of the mined area (see Section 4.2.1 Terrestrial Resources).

Development of the proposed project's action alternatives could potentially disturb and impact arctic fox dens that occur within the area. Habitats suitable for arctic fox dens have not been identified as limiting fox populations on the North Slope, and some foxes are likely to use culverts and other artificial habitat as den sites and for temporary shelter (Corps 2012, § 5.10.3.1, p. 5-283). Arctic ground squirrels and other small mammals would also lose minor amounts of foraging and burrow habitat due to gravel fill and mining. Grizzly bears would lose minor amounts of foraging habitat and could lose minor amounts of den habitat. Gravel fill and facility construction may create denning habitat for bears and fox.

Construction of ice roads across tundra habitats would cause temporary loss of winter forage for both small and large herbivores, and would also cause temporary subnivean habitat loss for small mammals. Clearing and piling of snow from the pads, roads, and airstrips during the winter could result in the collapse of subnivean tunnel systems used by small mammals. Ice roads and snow drifts would not melt before most birds begin nesting in late May to early June, altering the distribution and availability to mammalian predators of nests and prey under and near the ice roads and snow piles.

Ice road construction would crush standing dead vegetation, reducing concealment cover for small mammals and potentially increasing their risk of predation. Compaction of standing dead vegetation would be medium-term, requiring several growing seasons to reestablish. Damage to dwarf shrubs and tussock tundra from ice road construction could result in long-term impacts to vegetation cover (Corps 2012, § 5.10.3.1, p. 5-283). Tundra ice roads to support pipeline construction would be required for two winter construction periods, resulting in medium-term loss of winter forage and subnivean habitat. Snow pile habitat losses would be seasonal, but snow piling would likely occur annually in the same locations and would continue as long as the facilities were maintained, resulting in long-term habitat alteration. Winter construction of gravel and ice roads with associated vehicle traffic has the potential to disturb hibernating grizzly bears in dens (Corps 2012, § 5.10.3.1, p. 5-286).

Small and large terrestrial mammals could be affected by reduced forage and habitat loss in areas near gravel fill by deposition of snow piles and drifts, dust spray, altered hydrology, and thermokarst. In addition, snow would drift around buildings, roads, and pipelines. Deep drifts

would likely reduce the availability of winter forage for caribou or muskoxen, but might provide additional protection for small animals using subnivean habitats. Dust spray on snow caused by vehicle traffic on gravel roads would lead to early melt and green-up that may attract caribou or muskoxen, as well as small herbivores. Dust spray may be increased during construction, when vehicle traffic would be expected to be highest; although disturbance from human presence and noise may reduce caribou or muskoxen use of these areas. Terrestrial mammals attracted by early vegetation sprouting along roadways may also increase the risk of predation and vehicle collision mortality (Corps 2012, § 5.10.3.1, p. 5-283).

Disturbance

Equipment noise during construction of ice roads and from traffic on ice roads has the potential to disturb and displace arctic fox, caribou, and muskoxen, which may occur near ice roads during winter. Construction traffic on ice and gravel roads in winter and summer with associated human activity would likely be greater than other project phases and would potentially cause displacement of small mammals, caribou, and muskoxen, as well as attraction of arctic foxes and food-conditioned grizzly bears. Project activities would disturb terrestrial mammals if they cause a change in behavior or stress in the animals. Some project activities would cause animals to avoid an area or be completely displaced from an area such that they would not return (Corps 2012, § 5.10.3.1, p. 5-285).

Caribou are disturbed by oil and gas infrastructure and associated human activity when they are sufficiently close to perceive the disturbance, but tend to move to a comfortable distance from the disturbance; they may be more likely to approach infrastructure during reduced traffic periods in late evening or overnight (Corps 2012, § 5.10.3.1, p. 5-285). Such disturbance would most likely affect maternal caribou and muskoxen and may result in some displacement from the area of the gravel roads and pads. Displacement would be most pronounced during construction when traffic levels would likely be heaviest; but would continue for the life of the project as long as traffic and human activity continued (Corps 2012, § 5.10.3.1, p. 5-285).

Hazing animals away from airstrips is another potential source of disturbance to caribou, which are known to gather on these areas for insect relief. Hazing would be conducted if necessary for safe aircraft operations.

The most common disturbing stimulus associated with roads is traffic, and traffic volumes of 15 vehicles per hour or more may deflect caribou movements or delay successful road crossing for several hours (Corps 2012, § 5.10.3.1, p. 5-286). Under Alternatives A, B, and C, granting locals hunting access to the developed road system may lead to an increased avoidance response for caribou and other terrestrial mammals beyond those normally observed in the Prudhoe Bay oil fields where hunting is not allowed. Caribou may distance themselves farther from infrastructure and roads as an anti-predator response to interactions with hunters. The road system could also change hunters' access for caribou harvest. Road systems that are accessible by the general public (e.g., Nuiqsut residents) have the potential for increased hunting pressure, although oil field employees (including those who are Nuiqsut residents) are not allowed to hunt while on work status (comment provided by CPAI).

Most of the construction associated with the GMT1 Project would occur during winter, when caribou may be present in the project study area. The proposed developments would bring year-round facilities and activities within caribou summer range. Caribou could be disturbed by traffic, humans on foot, and low-flying aircraft (BLM 2012, § 4.3.9.2, p. 191). The response of caribou to disturbance would be highly variable, ranging from no reaction to violent escape reactions, depending on: distance from human activity; speed of the approaching disturbance

source; frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Caribou cow and calf groups appear to be the most sensitive to traffic, especially in early summer during and immediately after calving, while bulls appear to be least sensitive year-round (BLM 2012, § 4.3.9.2, p. 191).

Low-level helicopter overflights for permit-required studies, routine maintenance, and surveillance of pipelines may cause flight responses, especially in maternal caribou, large caribou groups, and grizzly bears, and would cause the animals to expend extra energy (Corps 2012, § 5.10.3.1, p. 5-286).

Aircraft noise during take offs and landings could result in the inability of affected animals to hear biologically important sounds such as mating calls, predator alarm calls and approaching predators. This could lead to increased stress levels, decreased reproductive capacity, and decreased survivorship in noisy areas such as airstrips and helipads. Repeated low-level aircraft flights over calving concentration areas at less than 1,000 feet above ground level and over early post-calving concentration areas at less than 500 feet above ground level may reduce calf survival (Corps 2012, § 5.10.3.1, p. 5-286). Landings and takeoffs during the caribou calving period in late May through late June would also potentially disturb caribou.

Tolerance to aircraft, ground vehicle traffic, and other human activities has been reported in several studies of caribou, and it appears that caribou can habituate to structures, noise, and odors, but habituate slowly or not at all to humans on foot or large moving objects such as vehicles (BLM 2012, § 4.3.9.2, p. 191). Most of the caribou in the NPR-A are from the Teshekpuk Herd (TH) and Western Arctic Herd (WAH) caribou herds, however, and have had less exposure to human activities and thus are less likely to be tolerant of disturbances than animals habituated to activities at Prudhoe Bay. The use of the GMT1 road to access subsistence hunting areas could displace caribou and other mammals further than what is observed in the Prudhoe Bay region, as the caribou may exhibit predator avoidance behaviors around roads that are associated with hunting activities (Corps 2012, § 5.10.3.1, p. 5-305).

The calving grounds of the TH are primarily near Teshekpuk Lake (BLM 2012, § 3.3.6, p. 284 and Map 3.3.6-5). The Central Arctic Herd calves between the Colville and Canning rivers to the east of the NPR-A (BLM 2012, § 3.3.6, p. 292 and Map 3.3.6-3). Little or no caribou calving is expected to occur within the project study area.

Habitat Fragmentation

The movements of small mammals such as lemmings and voles may be blocked by gravel fill during both winter and summer. Although movement may be inhibited by physical barriers, behavioral avoidance of the increased predation risk that open environments pose may lead to increased avoidance of gravel roads. Additionally, small mammals crossing gravel roads during winter would be exposed to decreased air temperatures and higher winds compared to the protected environments of subnivean tunnels, which could also increase their risk of predation (Corps 2012, § 5.10.3.1, p. 5-286).

Gravel roads would potentially affect the movements of caribou in the project study area, which could prevent or delay access between inland and coastal insect-relief habitats. Gravel road berms 4 feet or more in height create a visual barrier that can lead to deflection of caribou movements (Corps 2012, § 5.10.3.1, p. 5-286). As discussed in Section 2, all proposed gravel roads associated with the proposed project would have an average thickness of 7 feet. Some caribou movement could be obstructed between CD5 and GMT1 during construction of the road and pipeline (Lawhead et al. 2013).

Mortality

Construction of ice and gravel roads would likely result in some small mammal mortality. Some winter active small mammals (e.g., lemmings, voles, shrews) may be able to avoid being covered by gravel or ice, while those animals in hibernation during construction would be lost if gravel or ice construction were to occur over occupied burrows. Arctic ground squirrels would be in hibernation during winter gravel and ice road construction and would not be able to avoid the construction area. Terrestrial mammals would also likely be lost due to collisions with vehicles each year, including small mammals (e.g., arctic ground squirrels), arctic foxes, and caribou.

During winter, vehicle collisions with arctic foxes may occur. Mortality events for fox may include these as well as disease (e.g., rabies) and defense of life and property (DLP). Vehicle collisions with caribou during winter may occur, particularly during reduced visibility in winter when the hard surfaces of ice roads are attractive to caribou for travel (Corps 2012, § 5.10.3.1, p. 5-286). Caribou, moose, muskoxen and bears on roads are uncommon; however higher traffic during construction and dark driving conditions in the winter could lead to vehicle strikes (BLM 2004, § 4A.3.4, p. 575). Speed limits on oil field roads are enforced and the Applicant (CPAI) has instituted wildlife avoidance policies and training at APF, which would be applied to the GMT1 project as well (comment provided by CPAI).

Caribou may attempt to use the airstrip to escape parasitic insects. Planes would have a potential to collide with caribou during landings or takeoff; however, for pilot and passenger safety, caribou would not be allowed to remain on the airstrip and collisions would be unlikely to occur.

Predators, particularly bears and foxes, may be killed to defend human life. Bears may charge humans in a predatory manner or become conditioned to humans and overly aggressive towards humans. Foxes may become conditioned to humans and bite or threaten to bite a human. These animals would be considered nuisance animals and would likely be destroyed. Grizzly bears and foxes may have increased occurrence of DLP kills, but those are generally uncommon occurrences in the oil fields. Increased access to hunting from local residents (Nuiqsut Village) may increase mortality of caribou, moose, musk oxen and grizzly bears. Bears within 600 feet of construction activities may abandon dens, which would result in negative impacts to individuals and newborn cubs, including mortality (BLM 2004, § 4A.3.4.1, p. 575). The Applicant has proposed to implement design measures that would minimize the potential for wildlife to become attracted to humans and human development, thus minimizing the potential need to destroy nuisance animals.

Altered Survival or Productivity

Terrestrial mammal displacement from preferred habitats could result in reduced survival and productivity. Caribou displaced from habitats with more nutritious forage, and caribou that expend energy responding to disturbances may not be able to compensate for these energetic losses, which would potentially reduce the individual's survival and reproduction; recent studies of calf growth and survival for caribou displaced by or exposed to oil and gas infrastructure disturbance during calving, however, did not conclude significant survival or growth effects (Corps 2012, § 5.10.3.1, p. 5-291).

Food waste and the availability of infrastructure for thermal protection, escape cover, or den sites can benefit arctic foxes, bears, and weasels, potentially increasing their survival and productivity (Corps 2012, § 5.10.3.1, p. 5-291). Staging of construction materials and equipment would create additional crevices and voids that may provide cover for terrestrial mammals. Studies of foxes and grizzly bears in the Prudhoe Bay oil fields generally conclude that these

benefits have been responsible for increased densities and productivity of arctic foxes and bears (Corps 2012, § 5.10.3.1, p. 5-291). Operational procedures and controls established to protect terrestrial mammals, as described in the Applicant's proposed mitigation, would minimize factors that commonly attract arctic foxes and bears to oil field infrastructure; e.g., maintaining a clear space under modules and buildings to prevent creation of artificial den sites for foxes and managing food materials and food wastes such that they are unavailable to wildlife.

Spills could involve crude oil, refined products, produced water, or seawater. The extent of environmental impacts would depend upon the type, location and amount of materials spilled or released, and the effectiveness of the response. The majority of small spills would be contained on the gravel pad and would have no impact on terrestrial mammals or their habitat. Caribou and other terrestrial mammals could be coated with oil (in the case of a blow-out, or from lying on oiled tundra) or ingest contaminated vegetation. The extent of the disturbance to the animals would depend upon a variety of factors, including spill/release size and location, response actions, and season.

Drilling and Operation

The drilling and operation phase of the action alternatives would affect terrestrial mammals and their habitats through medium-term habitat alteration and disturbance, medium-term potential for vehicle collision and human safety mortality, and medium-term altered survival or productivity.

Habitat Loss and Alteration

Storage areas for drilling equipment would require no additional habitat loss/alteration beyond what is described for construction (Section 5.3.4.1). Dust fallout from gravel infrastructure would result in impact over the life of the project. Habitat alteration of tundra foraging areas may result from delayed melt of ice roads and pads, which would be a long-term impact under Alternative D as it requires ice roads throughout the life of the project.

Disturbance

Disturbance from additional traffic on gravel and ice roads, as well as from additional air traffic would occur during drilling and operation. Maximum traffic levels would likely occur when construction and drilling activities occur simultaneously. Activities in support of drilling would occur primarily during February through August. Noise from the drill rig, rig camp, and people walking on or around the production pads may cause some additional disturbance, especially during summer; but most disturbances to terrestrial mammals, primarily caribou, muskoxen, and grizzly bears, would result from vehicle traffic on the roads as described under construction (Section 5.3.4.1).

Winter mobilization and resupply of the drilling rig over the ice roads under Alternative D would contribute to additional traffic with associated winter disturbance primarily for arctic foxes. Once drilling is completed, summer demobilization of the drilling rig would contribute additional disturbance to caribou.

Habitat Fragmentation

No additional habitat fragmentation or blockage of movements would be expected during drilling, although traffic levels on infield roads would be increased when the rig is active on the GMT1 pad.

Mortality

Additional vehicle collision, aircraft, and human safety mortality may occur as numbers of personnel, rig camps, and more vehicles are active during drilling. The causes and effects of such collisions and mortality are described under construction (Section 5.3.4.1).

Vehicle collisions would likely be reduced during operations because of reduced personnel and transportation requirements. Occasional animal mortality would still be likely. In addition to collision mortality, other types of wildlife mortality, such as exposure to flares, entanglement, and trapping and destruction of nuisance animals, could occur during operations, as exemplified in the Prudhoe Bay oil field (Corps 2012, § 5.10.3.1, p. 5-293).

Altered Survival or Productivity

Survival and productivity alterations during operations would be similar to those described in the construction phase (Section 5.3.4.1).

Comparison of Alternatives

The direct impacts of gravel placement on all habitats and potential caribou use habitats are summarized in Table 4.3-15. Each alternative would have a total gravel fill footprint representing less than 1 percent of the total area of habitat in the approximately 100,000 acre project study area, and would impact less than 1 percent of specific habitats identified as potential caribou use habitats. Indirect impacts based on a 300-foot zone surrounding gravel infrastructure would also impact less than 1 percent of the total project study area with Alternatives A, B, and D (Table 4.3-16).

Alternative C would impact slightly more than 1 percent of the total area of the project study area with gravel fill (but less than 5 percent), and it would impact more than 3 percent each of the moist sedge-shrub tundra, riverine complex, and tussock tundra habitats that are found within the project study area; the other action alternatives would impact lower percentages of these habitats.

Gravel mining at the Clover site would also impact potential habitat for terrestrial mammals; the footprint of impact would vary according to the Alternative and the gravel demand, including: Alternative A (18.7 acre), Alternative B (19.8 acre), Alternative C (25.0 acre), and Alternative D (24.5 acre).

Alternatives A, B, and C would have similar impacts to terrestrial mammals, with impacts due to habitat loss and alteration expected to be of low intensity, long-term duration, and local extent (Table 4.3-17). The affected resources, which in this case include important subsistence food resources for the local community, are rated important because caribou fill a distinctive ecosystem and ecological service role within the locality and region.

As the project study area is not within the reported caribou calving area of NPR-A (BLM 2012, Map 3.3.6-5, Teshekpuk Lake Caribou Herd - Calving Areas), potential impacts are rated low intensity to reflect the low likelihood of calving or impacts to calving. Effects would be long term and local extent, but unlikely to occur. Although non-calving caribou could be disturbed at moderate levels of intensity for the long term duration from drilling and vehicle disturbances, the impact would be limited in extent to the local area (within the project study area).

Overall, Alternatives A, B, and C are expected to result in minor impacts to terrestrial mammals.

The use of aircraft to access the site during the non- ice road season (approximately eight months per year) under Alternative D would differentiate this alternative from the others with respect to potential impacts to caribou. The high number of flights required for transport of personnel and for special studies for Alternative D (see Table 2.4-3) is expected to result in moderate impacts to caribou in the project study area, and could extend into adjacent areas beyond the project study area, causing a regional-level extent of impact.

The air traffic under Alternative D would be additional to the existing activity in the APF and Nuiqsut airspaces, and would continue for long term. Under Alternatives A, B, and C, an estimated 162 to 223 additional new flights each month would be required during construction and would reduce to no new flights after construction is completed; under Alternative D these would increase during drilling and operation to 540 new flights per month during May and June, and 282 new flights added for July and August for the life of the project. The air traffic specific to this alternative would likely follow the general route of the proposed access road to GMT1. Annual ice roads would require construction activity and potentially disturb caribou throughout the project life. Re-use of annual ice road routes and ice pad locations could damage tundra, a potential long term impact. (Table 4.3-18). The affected resource is rated important for impacts under this alternative.

Alternative D is expected to result in overall moderate impacts to terrestrial mammals.

Alternative E would result in no impacts to terrestrial mammals.

Table 4.3-15. Estimated Direct Impacts to Potential Caribou Use Habitats

Potential Caribou Use Habitat1	Project Study Area Mapped2		Impacts by Alternative (acre and % of total project study area)								
			A		B		C		D		E
	acre	(%)	acre	(%)	acre	(%)	acre	(%)	acre	(%)	acre
Moist Sedge–Shrub Tundra	15,187	17%	19.2	0.1%	26.5	0.2%	26.1	0.2%	24.8	0.2%	0
Riverine Complex	162	0.2%	0.2	0.1%	<0.1	<0.1%	0.3	0.2%	<0.1	<0.1%	0
Tussock Tundra	15,973	18%	41.1	0.3%	29.5	0.2%	56.0	0.4%	50.2	0.3%	0
Wet Sedge Meadow Tundra	23,814	26%	5.2	<0.1%	11.6	<0.1%	6.8	<0.1%	9.6	<0.1%	0
Barren	3,019	3%	0	--	0	--	1.2	<0.1	0	--	0
Total Potential Caribou Use Habitats			**65.7**	**--**	**67.6**	**--**	**89.2**	**--**	**84.6**	**--**	**0**
Total of All Habitats (acre and % of project study area)			**72.5**	**0.1%**	**79.3**	**0.1%**	**97.5**	**0.1%**	**87.3**	**0.1%**	**0**

Table 4.3-16. Estimated Indirect (300 Feet) Impacts to Potential Caribou Use Habitats

Potential Caribou Use Habitat1	Project Study Area Mapped2		Impacts by Alternative (acre and % of total project study area)								
			A		B		C		D		E
	acre	(%)	acre	(%)	acre	(%)	acre	(%)	acre	(%)	acre
Moist Sedge–Shrub Tundra	15,187.1	17%	181.4	1.2%	211.2	1.4%	477.4	3.1%	75.1	0.5%	0
Riverine Complex	162.5	0.2%	2.8	1.7%	0	--	5.9	3.6%	0	--	0
Tussock Tundra	15,973.3	18%	253.1	1.6%	154.7	1.0%	508.3	3.2%	155.4	1.0%	0
Wet Sedge Meadow Tundra	23,813.8	26%	55.8	0.2%	89.1	0.4%	184.1	0.8%	11.5	<0.1%	0
Barren	3,019.0	3%	0	--	0	--	26.4	0.9%	0	--	0
Total Potential Caribou Use Habitats			**493.1**	**--**	**455.0**	**--**	**1,175.7**	**--**	**242.0**	**--**	**0**
Total of All Habitats (acre and % of project study area)			**595.3**	**0.6%**	**613.7**	**0.6%**	**1,368.7**	**1.3%**	**275.9**	**0.3%**	**0**

[1] Includes potential forage and insect relief areas as discussed in Methodology, above.

[2] Percent of vegetation type acreage within the mapped vegetation portion of the project study area. Note that 12,428 acre (12%) of the project study area extends outside of the vegetation map coverage. All the project facilities under all the alternatives are within areas of mapped vegetation. This area also represents the 2.5-mile buffer for indirect impacts.

Table 4.3-17. Impact Criteria Summary for Terrestrial Mammals – Alternatives A, B, and C

Alternatives A , B, and C					
Impact Type and Affected Population		**Intensity**	**Duration**	**Context**	**Geographic Extent**
Habitat Loss and Alteration	Small Mammals	Low	Long term	Common	Local
	Caribou Potential Use Habitats (within 300 ft)	Low	Long term	Common	Local
Disturbance	Arctic Fox Dens/Den Habitat	Low	Long term	Common	Local
	Grizzly Bear Dens/Den Habitat (within 2.5 miles)	Low	Long term	Common	Local
	Caribou (non-calving; within 2.5 miles)	Low	Long term	Important	Local
	Calving Caribou[1] (within 2.5 miles)	Low	Long term	Important	Local
	Muskoxen and Grizzly Bear (within 2.5 miles)	Low	Long term	Common	Local

[1] The project study area is not within the reported caribou calving use areas in NPR-A (BLM 2012, Map 3.3.6-5, Teshekpuk Lake Caribou Herd - Calving Areas).

Impact criteria definitions are presented in Table 4.3-1.

Table 4.3-18. Impact Criteria Summary for Terrestrial Mammals – Alternative D

Alternative D					
Impact Type and Affected Population		**Intensity**	**Duration**	**Context**	**Geographic Extent**
Habitat Loss and Alteration	Small Mammals	Low	Long term	Common	Local
	Caribou Potential Use Habitats (within 300 ft)	Low	Long-term	Common	Local
Disturbance	Arctic Fox Dens/Den Habitat	Low	Long term	Common	Local
	Grizzly Bear Dens/Den Habitat (within 2.5 miles)	Low	Long term	Common	Local
	Caribou (non-calving; within 2.5 miles)	Medium	Long term	Important	Regional
	Calving Caribou[1] (within 2.5 miles)	Low	Long term	Important	Local
	Muskoxen and Grizzly Bear (within 2.5 miles)	Low	Long term	Common	Local

[1] The project study area is not within the reported caribou calving use areas in NPR-A (BLM 2012, Map 3.3.6-5, Teshekpuk Lake Caribou Herd - Calving Areas).

Impact criteria definitions are presented in Table 4.3-1.

Mitigation

Avoidance or reduction of potential impacts to terrestrial mammals and their habitat would be accomplished by implementing siting and design features and other mitigative measures described in Section 4.7. In particular, design requirements for elevating pipelines 7 feet above ground surface, aligning the placement of VSMs from CD4 to APF to avoid a picket-fence effect, road and pipeline separation, and speed limits that allow for passage of caribou and other terrestrial mammals.

Mitigation is provided through the following protective measures in BLM (2013: A-1 through A-8, A-11, A-12, C-1, E-7, E-8, E-12, E-19, F-1, I-1, L-1, M-1, and M-4).

The existing Alpine Project, operated by the Applicant, uses a Wildlife Avoidance and Interaction Plan and Predator Management Plan that includes methods to discourage scavenging. A similar plan should be developed for the GMT1 Project to further mitigate wildlife interaction impacts.

Conclusions

Terrestrial mammals may be impacted during the construction, drilling and operation of the action alternatives through habitat loss and alteration, disturbance, habitat fragmentation, mortality, and altered survival or productivity.

The magnitude of the overall impacts vary among the alternatives, with Alternatives A, B, and C having a lower level of overall impact (minor), compared to Alternative D (moderate).

4.3.4.2 Marine Mammals

In general, marine mammals are not expected to occur either within the project study area, or north of the project study area along the coastline of Harrison Bay. The water along the coast is either out of geographical range, or too shallow for most species to utilize during limited migrations through the area. The exceptions are polar bear, which are covered under Section 4.3.5, *Threatened and Endangered Species*, spotted seal, and the beluga whale.

Spotted Seal

Spotted seal are known to utilize haul outs as far as Ocean Point along the Colville River during summer and late fall (discussed in detail in Section 3.3.4.2, *Marine Mammals*). The greatest concern for spotted seals in respect to the GMT1 development, is disturbance of terrestrial haul-out locations and the potential for oil spills (BLM 2012, § 4.3.10.2). The number of animals affected by spilled oil would depend upon the number of animals present, spill size, location, and timing of such an event. If spilled oil were to reach a haul-out location, large numbers of spotted seal could be negatively impacted (BLM 2012, § 4.3.10.2, p. 230). The potential for an onshore spill of any size to reach marine or marine-connected waters is minimized by stipulations K-1 and K-6, as stated and provided in BLM (2012, § 4.3.10.2 p. 225).

Disturbance from noise impacts are not expected to reach the marine environment, outside of increased air traffic (BLM 2012, § 4.3.10.2, p. 221). Aircraft, under the Marine Mammal Protection Act (MMPA), are expected to maintain an elevation greater than 1,000 feet over water, except take-off and landing. At 1,000 feet, the potential for disturbance to seals is greatly reduced (BLM 2004, § 4A.3.4.2, p. 593).

Beluga Whale

Beluga whales are known to be seasonally present (in small aggregations) off the coastline north of the project study area (discussed in detail in Section 3.3.4.2, *Affected Environment-Marine Mammals*). Belugas could be impacted in the unlikely case of a spill to land reaching a river that carries spilled oil to the marine environment. The number of animals affected by spilled oil would depend upon the number of animals present, spill size, location, and timing of such an event. An oil spill is unlikely, but if it did occur, there could be some mortality and longer-term impact to reproduction or survival of some individuals, but not the population. On-shore spills during winter would not have any effect on beluga whales if they are cleaned up prior to spring break-up, as belugas winter in the Bering Sea (BLM 2012, § 4.3.10.2, p. 221).

Disturbance impacts from noise associated with construction or operations are not expected to reach the marine environment (BLM 2012, § 4.3.10.2 p 221). Air traffic elevation restrictions

under MMPA are the same as discussed for spotted seals and are not expected to disturb beluga whales.

Conclusions

There would be no difference in impacts to marine mammals under each of the action alternatives, since the drill rill location is the same under either action alternative. Activities associated with construction or operations for the proposed GMT1 Project are not expected to impact spotted seals, beluga whales, or other marine mammals rarely occurring off the coastline of Harrison Bay. In the unlikely event of a large oil spill reaching open water during summer or fall, small populations of beluga whales and larger groups of spotted seals could be negatively impacted. Details of the resultant impacts from contact or ingestion of hydrocarbons for both species are discussed in BLM (2012, § 4.3.10.2, p. 226). Assuming that no large oil spills occur, or reach the open water environment, impacts to marine mammals are expected to be negligible.

4.3.5 Threatened and Endangered Species

Impacts on threatened and endangered species are described in BLM (2004, § 4F.3.5) and BLM (2012, § 4.5.11). The threatened and endangered species that have been reported as occurring in or near the project study area include spectacled eider, Steller's eider, and polar bear. The yellow-billed loon, a candidate species under the ESA, also occurs in the area and is described in BLM (2004, § 4F.3.3.1) and BLM (2012, § 4.5.11.2).

The impact evaluation criteria for threatened and endangered species are presented below in Table 4.3-19, which are based on the general impact criteria described in Section 4.1.1, *Impact Criteria*. The definition of impact criteria for threatened and endangered species differs from other resources evaluated in terms of population. The assignment of an intensity magnitude for threatened and endangered species considers an impact to any individual of the population a major loss, whereas, other evaluated resources deem a population-level impact as major.

Table 4.3-19. Impact Criteria—Threatened and Endangered Species

Impact Category	Magnitude	Definition
Intensity	High	Potentially affecting 25 percent or more of a high value habitat.
	Medium	Potentially affecting more than 5 percent but less than 25 percent of a high value habitat.
	Low	Potentially affecting 5 percent or less of a single high value habitat.
Duration	Long term	Lasting longer than 10 breeding seasons.
	Interim	Lasting longer than 2 breeding seasons but less than 10 breeding seasons.
	Temporary	Lasting less than 2 breeding seasons.
Context	Unique	The affected resource is rare or is depleted either within the locality or the region, and is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Important	The affected resource is protected by legislation or the portion affected fills a distinctive ecosystem role within the locality or the region.
	Common	The affected resource is considered usual or ordinary in the locality or region; it is not depleted in the locality or region and is not protected by legislation.
Geographic Extent	Statewide	Extends beyond project study area.
	Regional	Extends beyond 300 ft from project components but within project study area.
	Local	Within the footprint and extending 300 ft from project components.

Bearded seal and ringed seal that may occur seasonally along the coast of Harrison Bay could potentially be affected by a catastrophic spill from the pipeline. However, this is considered a

highly unlikely event that would require very specific environmental conditions, including the presence of open water, as described in BLM (2012, § 4F.3.4.2) and BLM (2012, § 4.5.11.4). Bowhead whales migrate through the Beaufort Sea, but generally do not occur in the nearshore waters north of the project study area. However, potential impacts are considered because of the ecological and cultural importance of the bowhead.

As described in BLM (2012, § 3.3.7) the fin whale and humpback whale (both listed as endangered) do not occur in the project study area. The Pacific walrus (candidate) is also extralimital in the Southern Beaufort Sea (76 FR 47040, August 3, 2011), and there is very low probability of adverse impacts from the GMT1 Project. Potential impacts to these three species were described in the BLM (2012, § 4.5.11.4), but due to the proposed GMT1 location within the NPR-A, impacts are not further considered in this SEIS. However, it is noted that the fin whale, humpback whale, and Pacific walrus are subject to the same protective measures as other ESA or MMPA-listed species.

The types of potential impacts to threatened and endangered species is similar to that of other birds and mammals, and includes habitat loss and alteration, disturbance and displacement, mortality, obstruction of movement, and predation. Refer to the respective section on these topics within Section 4.3.3, *Birds* and 4.3.4, *Terrestrial Mammals* for information about these potential impacts.

Avoidance or reduction of potential impacts to threatened and endangered species are provided through facility design features and mitigation described in Section 4.7, including mitigation provided by the following protective measures in BLM (2013: BMPs A-1 through A-8, A-11, A-12, C-1, E-4, E-8, E-10, E-11, E-18, F-1, I-1, and J).

Overall, the potential impacts to the threatened and endangered species that could potentially be affected by the action alternatives are expected to be of low intensity, local in extent, and long term in duration. There would be negligible impacts to the populations of threatened and endangered species as a result of the GMT1 Project (see Table 4.1-2). A discussion of impacts follows.

4.3.5.1 Spectacled Eiders

Impacts to spectacled eiders from construction and drilling and operation within the project study area are discussed in BLM (2004, § 4A3.5.2) and in BLM (2012, § 4.3.11.2). Results from these previous analyses are summarized in this section.

Potential habitats for spectacled eiders and yellow-billed loon are outlined in Table 4.3-19.

Table 4.3-20. Potential Habitats of Spectacled Eider and Yellow-Billed Loon

Species	Reported Use	Habitats[1]
Spectacled Eider (Threatened) 2	Pre-nesting Brood-rearing	Brackish Water Shallow Open Water without Islands Shallow Open Water with Islands or Polygonized Margins Grass Marsh Salt-killed Tundra Salt Marsh Deep Polygon Complex Deep Open Water without Islands Deep Open Water with Islands or Polygonized Margins Shallow Open Water without Islands Shallow Open Water with Islands or Polygonized Margins
Yellow-Billed Loon (Candidate) [2]	Pre-nesting Brood-rearing	Tapped Lake with High-water Connection Deep Open Water with Islands or Polygonized Margins Deep Open Water without Islands Grass marsh Patterned Wet Meadow Sedge Marsh Deep Polygon Complex Tapped lake with High-water Connection

[1] Potential Habitats listed in Table 4.3-19 only include habitats occurring within the potential impact zone from proposed action alternatives

[2] Johnson et al. 2013, Tables 5, 8, 11 and 16

There is no designated critical habitat for the spectacled eider on the North Slope. Multi-year surveys show the spectacled eider is present in the project study area; with the species occurring in high concentrations on the Colville River delta and north of Nuiqsut. The closest spectacled eider nest was found about 0.8 mile from an existing or proposed facility. Habitats utilized by the spectacled eider adjoin the conceptual location of the road, production pad, and pipeline system for GMT1. The spectacled eider could be impacted by the proposed project under all action alternatives as a result of habitat loss and alteration, disturbance and displacement, obstruction of movement, spills, and mortality.

Densities of pre-nesting and nesting spectacled eiders decrease with distance from the coast (Johnson et al. 2004, 2013). The USFWS annual ACP surveys (Larned et al., 2011) measured spectacled eider densities between 0 to 0.236 birds per km^2 in the project study area. Densities of pre-nesting spectacled eiders based on site specific surveys in the GMT1 area are low (0.04 birds per km^2) (Johnson et al, 2013). Average densities within the 200-meter zone around GMT1 (using Alternative A) was slightly higher (0.08 birds per km^2), but in eight of the nine years of survey no eiders were recorded in the area.

Habitat Loss and Alteration

Spectacled eiders utilize islands, peninsulas, shorelines, hummocks in wet meadows, and polygon rims as nesting habitat. Wet, aquatic, and halophytic habitats are utilized during breeding. Alternative A impacts a small amounts of wet, aquatic, and halophytic habitat types. An oil spill could impact birds using terrestrial or aquatic habitats, and could have an effect on congregations of shorebirds and waterfowl. Potential impacts to birds would depend on the location and size of the spill and on the time of year.

The potential loss and alteration of potential spectacled eider habitat resulting from Alternatives A and B would be similar and less than Alternative C. Alternative D would have the least amount of potential spectacled eider habitat loss and alteration among the action alternatives. There would be no habitat impacts under Alternative E, No Action.

Disturbance and Displacement

Spectacled eider density is low in the GMT1 Project study area (Johnson, 2013) and it is unlikely that spectacled eiders would be affected by any of the GMT1 Project alternatives. Project related activities during the summer when spectacled eiders are present could disturb or displace birds near gravel roads, pads, and airstrips.

USFWS Incidental Take Statements estimate a 200-meter buffer around a gravel footprint when estimating take (USFWS 2004, BO for the ASDP, 2011 BO for CD5). Other documents have utilized a 50-meter buffer (BLM 2004, § 4A.3.3, p. 544). In this analysis a 91-meter (300 feet) buffer is used in calculating indirect habitat impacts.

Alternatives A, B, and C are expected to have overall low intensity of disturbance and displacement impacts to spectacled eiders, although Alternative C would involve a greater distance of roadway that vehicles would travel and potentially result in incremental greater disturbance and displacement impact to spectacled eiders. Alternative D would have a greater intensity of potential disturbance and displacement impacts to spectacled eiders compared to Alternatives A or B due to aircraft noise as described in 4.3.3.3, *Birds – Comparison of Alternatives*. There would be no disturbance or displacement impacts under Alternative E.

Mortality

Spectacled eider mortality could result from collisions with vehicles, aircraft, or structures, increased predation, and increased subsistence hunting, as described in Section 4.3.3, *Birds*. Due to the low density of spectacled eiders in the project study area, impacts are unlikely to occur. Overall, the potential mortality impact to spectacled eiders is considered minor for all the action alternatives. There would be no mortality impacts under Alternative E.

Predation

The GMT1 project could increase the numbers of predators in the area, which could result in increased predation of spectacled eiders and their nests, similar to that described in Section 4.3.3.1, *Birds-Construction*. Spectacled eider densities are low in the project study area and predation impacts from the GMT1 Project are unlikely to occur. Overall, the potential mortality impact to spectacled eiders is considered minor for all the action alternatives. There would be no mortality impacts under Alternative E.

Conclusion

Overall, the potential impacts of the action alternatives to spectacled eiders are expected to be minor. There would be no impacts to spectacled eiders under Alternative E.

4.3.5.2 Steller's Eiders

Steller's eiders have not been found in the project study area and have a low probability of occurring there in the future. There is no designated critical habitat for this species on the North Slope. No impacts to Steller's eiders are expected to occur as a result of action alternatives. There would be no impacts under Alternative E.

4.3.5.3 Yellow-Billed Loons

There is no designated critical habitat for this candidate species on the North Slope. BLM (2012, Map 3.3.8-4) indicates there is a concentration of yellow-billed loons associated with the lake area upstream from the confluence of the Tiŋmiaqsiġvik (Ublutuoch) River with Judy Creek. Deep water lakes containing fish are preferred yellow-billed loon habitat. Several deep water

lakes with fish are located within the general project study area and within the larger cumulative effects evaluation area; none of these lakes are in close proximity (e.g., within 0.5 mile) to proposed facilities for GMT1 under the action alternatives. In all of the action alternatives, deep water lakes in the project study area could be used for winter water withdrawals. Water withdrawal from lakes during ice road construction could lower the level of lakes and affect yellow-billed loons that use these habitats, particularly small islands and shoreline areas that are used for nesting. Changes in the surface levels of lakes due to water withdrawal would be dependent on the amount of water withdrawn, the volume of the lake, and the recharge rate. There is also potential for impacts to birds due to potential impacts to invertebrate and fish food resources from varying winter water levels if recharge does not fully recharge pumped lakes (BLM 2012 § 4.3.8.2, p. 171). Lake surveys conducted prior to water withdrawal, limits on the amount of water that may be withdrawn from lakes due to Lease Stipulations, and the ability of lakes to naturally recharge, would likely negate any potential negative impacts related to water withdrawal.

Overall impacts are expected to be minor to yellow-billed loons under all of the action alternatives. There would be no impacts under Alternative E.

4.3.5.4 Polar Bears

As shown in Figure 3.3-12, there have been no polar bear dens documented within a mile of the proposed infrastructure for the GMT1 project alternatives and the project study area is outside the area where den concentration is expected to be highest. However, den locations are not static, and polar bears have been known to den as far south as the project study area. Female polar bears have fidelity to denning habitat, but not specific denning sites (USFWS, 2011b).

The potential impacts to polar bears are described in BLM (2004, § 4A3.4.2) and BLM (2012, § 4.3.11). Impacts to polar bear could occur as a result of habitat loss or alteration, disturbance to, or displacement of, denning females and cubs, incidental harassment of polar bears transiting the project study area, intentional hazing near occupied work sites, or mortality due to collisions or defense of life kills.

The original designation of polar bear critical habitat (from December 7, 2010) included all land within the NPR-A located within 5 miles of the coast. This area is known to contain potential terrestrial denning habitat. While at this time there is no critical habitat designated for the polar bear (on January 10, 2013, the U.S. District Court for the District of Alaska issued an order vacating and remanding to the Service the December 7, 2010, Final Rule designating critical habitat for the polar bear), the Beaufort Sea coastline, creek and river drainages, and bluffs along lakes throughout the coastal area of NPRA-A provide important areas for polar bear resting, feeding, denning, and seasonal movements.

Incidental Take Regulations (ITRs), promulgated in August 2011 under the Marine Mammal Protection Act, authorized nonlethal, incidental, unintentional take of small numbers or polar bears for oil and gas related activities in the Beaufort Sea and adjacent northern coast of Alaska (76 FR 47010). Under the ITRs, Letters of Authorization can be requested from industry to authorize the take of small numbers of polar bears and Pacific walrus incidental to the exploration, development and production operations associated with this project. Project stipulations require that no activities occur within 1 mile of known or suspected polar bear dens.

Habitat Loss and Alteration

Polar bears den in areas of topographic relief greater than 4.3 feet (1.3 meters; e.g., along river and lake banks, coastal areas, and abandoned human-made gravel pads) where drifting snow accumulates early in the winter and provides adequate cover of snow throughout the denning season. Bears will generally select the leeward side of prevailing winds, and generally avoid human activity.

The proposed GMT1 pad location and most of the road between CD5 and GMT1 is located more than 5 miles (9 km) from the coast, and so out of the area where polar bear sightings are more common.

Figure 3.3-12 shows one area of *potential* denning habitat occurring along the banks of the Tiŋmiaqsiġvik (Ublutuoch) River. This map depicts an estimate of where topographic conditions might create an environment where snow depth is adequate for a polar bear to create a den.

Under all the action alternatives, habitat loss and alteration impacts to polar bears are expected to be minor. There would be no impacts under Alternative E, No Action.

Disturbance and Displacement

Denning female polar bears could potentially be disturbed by project related activities as described for other terrestrial mammals (see Section 4.3.4, *Terrestrial Mammals*). Denning polar bear females are sensitive to disturbance, and if disturbance occurs after establishing a den, abandonment of the den could occur and result in mortality of young, if present.

Annual ice road construction could impact potential polar bear denning habitat; however, polar bear den detection methods, e.g., FLIR surveys, prior to road construction could identify den sites along the proposed route prior to construction and dens would be avoided.

The presence of human activity or camps may attract polar bears to the project study area and could result in incidental or intentional harassment for the protection of the bears and human health and safety. BMP A-8 and USFWS LOA requirements on personnel training and harassment protocols should minimize this impact.

Potential disturbance and displacement impacts to polar bears would be minor for all the action alternatives. There would be no impacts under Alternative E.

Mortality

Polar bears could be killed by project related activities as described for other terrestrial mammals (see Section 4.3.4, *Terrestrial Mammals*), or in the event a large oil spill reached marine waters. Polar bear deaths resulting from vehicle collisions, ingestion of hazardous chemicals and defense of life kills, or other impacts are unlikely to occur. Waste management protocols at the work site, personnel training, and permit/lease stipulations are designed to minimize such occurrences.

Subsistence hunters may utilize the project study area; however, it is not expected this would result in an increased level of mortality to polar bears as the GMT1 Project does not increase access to areas where there are higher concentrations of polar bears (along the coastline). Subsistence take quotas are established under the Inuvialuit-Inupiat Polar Bear Management Agreement (76 FR 47021), and harvests are generally lower than the quota.

The potential mortality impacts to polar bears resulting from all the action alternatives are expected to be minor. There would be no impacts under Alternative E.

Conclusions

The potential impacts to polar bears resulting from all the action alternatives are expected to be minor, with negligible effects on the population. There would be no impacts to polar bears under Alternative E.

4.3.5.5 Bowhead Whale

Bowhead whales generally do not occur in the nearshore Beaufort Sea (located to the north of the project study area) and impacts to population, habitat, migration, foraging, breeding, survival and mortality are not expected (BLM 2004, § 4.F.3.5.1).

There would be no marine transportation related impacts (e.g., barging) to bowhead whales associated with the GMT1 project, as there is no marine activity involved.

Conclusions

There are no potential impacts to bowhead whales expected to occur resulting from the GMT1 Project.

4.3.5.6 Bearded and Ringed Seals

Ringed seals prefer nearshore stable landfast ice or drifting pack ice and neither species is expected to occur in the Tiŋmiaqsiġvik (Ublutuoch) River or Fish Creek Delta. Although conceptually it is possible that individual ringed or bearded seals could be present in locations where noise from construction activity could be perceived, the likelihood of their presence is remote, and the potential for disturbance is negligible.

Construction of the Tiŋmiaqsiġvik (Ublutuoch) River bridge will occur in winter, when no seals are expected to be present. Additionally, no bridge piers will be located within the main channel. Because the piers are not located in water, noise from installation would not carry to the same extent (distance) as if there was in-water construction activity.

No facilities or pipelines are proposed on or immediately adjacent to the marine coastal zone. Neither species is likely to be in areas affected by the GMT1 Project. The sources of potential spills are generally small enough and far enough from marine waters that there would be no or very little impact to marine water quality or resources. As noted in Section 4.5, *Impacts of Oil, Saltwater, and Hazardous Material Spills*, the probability of a large spill to marine waters is very low. Manual and automated valves on both sides of the Tiŋmiaqsiġvik (Ublutuoch) River will be in place to control flow in the oil pipeline, and would substantially reduce the potential risk of an oil release to the river. The Tiŋmiaqsiġvik (Ublutuoch) River is a tributary of Fish Creek that flows north approximately 7 river miles, connecting to Fish Creek approximately 10 river miles upstream from Harrison Bay. The Tiŋmiaqsiġvik (Ublutuoch) River is a slow moving, meandering, river, with many oxbows, allowing for opportunities to intersect the majority of oil before it could travel to Fish Creek, or farther to the Fish Creek delta.

Conclusions

Overall, the potential impacts to bearded and ringed seals as a result of the GMT1 Project are expected to be negligible. There would be no impacts to bearded and ringed seals under Alternative E.

4.4 Social Systems

The following discussion of environmental consequences on or by the social and cultural systems is generally categorized and organized as it is in BLM (2004).

4.4.1 Socio-Cultural Systems

Socio-cultural systems on the North Slope, as described in Section 3.4.1, are based in large part on the family structure and cultural values of the community, with a particular emphasis on the relationship of the Iñupiat with the land and its resources. Factors likely to affect socio-cultural systems are:

- Availability of new technologies.
- Increased or variable income.
- Disruptions to subsistence activities and uses.
- Influx of non-Native residents not associated with existing community.
- Influx of non-resident temporary workers (e.g., oil industry workers).
- Increased interaction between residents and non-resident workers.

Potential impacts on socio-cultural characteristics are described in BLM (2004, § 4F.4.1.1) and BLM (2012, §§ 4.5.14.2 and 4.5.21.1), with mitigation provided by the following protective measures of BLM (2013: A-1, A-2, A-4, A-10, A-11, A-12, and I-1).

Construction and operation of the proposed project is not expected to result in any appreciable influx of new, non-Native residents or visitors to the community of Nuiqsut. Oil industry construction and operations personnel will be housed in temporary camps or at the APF. However, interactions between Nuiqsut residents and oil industry workers will likely increase if residents use the project-associated roads or if the project results in increased use of community facilities, such as the Kuukpik Hotel currently located in Nuiqsut. Because industry will provide housing, food, health, and other services for oil industry workers, Alternative A is not expected to result in an appreciable increase in demand on community resources.

Increased revenue for Kuukpik Corporation resulting from development of GMT1 could provide economic benefits to those Nuiqsut residents who are Kuukpik shareholders. While this increased income from dividends may be positive for the community if residents use the income to support familial and socially beneficial purposes, including subsistence harvesting activities, a negative social impact may occur if it creates income disparities between households that include shareholders or employable individuals versus those that do not. Disproportionate household incomes have the potential to affect social relations and leadership roles within the community. Similarly, if the proposed project results in increased employment opportunities for Nuiqsut residents, the community could experience both positive and negative effects. Positively, for example, increased income for subsistence users may allow them to purchase equipment and fuel with which to conduct subsistence activities. Negatively, employment may reduce the time available for Nuiqsut residents to participate in subsistence activities. Current employment of Nuiqsut residents by the oil industry is relatively low (see Section 3.4.1.6). However, employment rates may increase if the community has road access to the GMT1 drill pad.

In addition to the potential for increased tensions within the community due to income disparities, development of GMT1 also has the potential to increase social and political tensions

between different population sectors and community institutions that either support or oppose aspects of development. New development projects increase the likelihood for such disagreements within the community to occur, thus resulting in impacts on social cohesion.

Comparison of Alternatives

Impacts of Alternative A on the population of Nuiqsut are expected to be minimal. The net population of Nuiqsut has remained stable since the last NSB census in 2003, and therefore there does not seem to be a direct relationship between oil and gas development near the community and total population levels. However, the magnitude and nature of in- and out-migration are unknown.

Section 4.4.3 discusses potential impacts of Alternative A on subsistence uses. Subsistence hunting and harvesting activities are central to the cultural identity and social cohesion of the community of Nuiqsut. Disruption of subsistence activities may affect social and kinship ties, many of which are based upon the harvesting, processing, distribution, and consumption of subsistence resources. If subsistence harvesting opportunities are reduced, then opportunities to engage in cooperative harvesting activities will also decline. Reduced participation in subsistence activities could also negatively impact the community's ability to pass on traditional knowledge about subsistence harvesting patterns and cultural values to younger generations. Furthermore, as discussed in Section 4.4.3, the GMT1 development will introduce permanent oil and gas infrastructure into traditional hunting areas to the west of the community, thus contributing to the community's perception that they are surrounded by development. Disruptions to subsistence harvesting patterns or perceptions of exclusion from traditional lands may result in social stresses on residents and on the community as a whole.

Impacts to socio-cultural systems under Alternative B are similar to those described above under Alternative A. The potential for impacts on subsistence harvesting patterns may be higher because of the slightly closer proximity of the road and pipeline to the community.

Impacts to socio-cultural systems under Alternative C are similar to those described above under Alternative A. However, the potential for interactions between Nuiqsut residents and non-local workers will likely be much higher due to the use of the community as a hub for industrial activity and resulting traffic along the upgraded Nuiqsut Spur Road. Alternative C may also lead to increased economic benefits for the Native Village of Nuiqsut due to additional income from use of its airport and hotel.

The impacts to socio-cultural systems under this alternative would be similar to those for Alternative A, except for greater subsistence impacts related to increases in air traffic and the lessening of impacts related to road traffic (see discussion of subsistence impacts under Section 4.4.3). Because the development would not be connected to the road system, the potential for interactions between Nuiqsut residents and non-resident workers would be less than under Alternatives A, B, and C.

No changes from baseline conditions would be expected under Alternative E, because no action would take place under this alternative.

Public Health

The following discussion of potential impact to public health is generally categorized and organized as presented in BLM (2012). Impacts to public health were not discussed in BLM (2004).

The BLM (2012, § 4.3.21) contains an extensive discussion of analysis of potential impacts on public health in the NSB based on potential future oil and gas development in the NPR-A. The following discussion of potential impacts to human health and community welfare associated with the proposed development is tiered to BLM (2012, § 4.3.21). The BLM (2012) considered all eight villages of the NSB as well as other villages of the Northwest Arctic Borough. Therefore, the focus was broader than for the proposed GMT1 Project SEIS, which focuses on the community of Nuiqsut, the closest community to the proposed project.

The BLM (2012) categorizes potential impacts into two types: impacts related to oil and gas exploration and development, and impacts that are not. This SEIS focuses on direct and indirect impacts related to oil and gas development, consistent with the proposed project.

For oil and gas exploration and development, BLM (2012, p. 343) identifies that impacts to public health could result through changes in diet and nutrition, environmental exposures, infectious disease, safety, acculturative stress, economic impacts, and capacity of local health care services. A new influx of workers may increase potential exposures to communicable disease, alcohol and drug use for the local community, as well as increasing stress and mental health issues associated with these activities.

New data and information have not changed the discussion of impacts as presented in 2012, so the discussion in BLM (2012) is still considered relevant to this proposed GMT1 Project SEIS.

As outlined in the BLM (2012, § 4.3.21.5) several potential mitigation measures have been identified and would be implemented to minimize potential adverse health impacts associated with the considered alternatives. Mitigation measures include, but are not limited to: developing new operating procedures focusing on prevention of infectious diseases, conducting air monitoring to ensure airborne components are within regulatory limits, and how the community should respond to oil spills and medical emergencies.

The BLM (2012) concluded that activities associated with oil and gas development would be localized and temporary, and that there would be no measurable impact on public health at a population level. The localized and temporary impacts were related to displacement of animals due to aircraft noise and/or the presence of camps that could result in avoidance of the area by animals or hunters. Influx of workers can add to impacts with regard to availability of medical care and other emergency services in a rural community like Nuiqsut. Mitigation measures discussed above are planned to handle such impacts.

A summary of impacts from oil and gas activities to public health, from the BLM (2012), is below. These impacts would be common to all action alternatives.

- Localized activity will create transient impacts on subsistence by diverting hunters and animals.
- Noise from air traffic and other sources will create a nuisance around individuals' camps and cabins.
- Development may increase the perception that traditional foods are contaminated, exacerbating the shift away from a subsistence diet.
- Fixed production sites, particularly those near villages or in areas of heavy subsistence use (e.g., near rivers) will lead to avoidance by hunters. In turn, this will increase travel times and costs for subsistence activities, and could potentially decrease harvests and increase risk of injury and accidents.

- Episodes of poor air quality associated with dust or emissions can pose a health hazard for at-risk populations such as those suffering from chronic obstructive pulmonary disease (COPD) or asthma.
- It is unlikely that new employment for the Inupiat in the oil and gas sector will be significant enough to cause public health impacts.

Comparison of Alternatives

The impacts discussed above would be relevant for Alternatives A and B. It is possible that avoidance of activities near Fish Creek could reduce impacts associated with the "fixed production sites" impact discussed for Alternative A.

If the Fish Creek setback is avoided, this could reduce the impact on subsistence hunting areas identified as potentially leading to adverse impacts. For example, travel time and cost may not be as elevated as assumed under Alternative A because a more heavily used subsistence area would be preserved. In turn, this would likely reduce the risk of injury and accidents on the road because less time will be spent on the land. Harvests may be closer to normal since a more typical subsistence hunting range would be utilized.

The same impacts discussed above for Alternative A are also relevant for Alternative C. It is likely that this Alternative, which includes an airstrip extension at the Nuiqsut airport and other infrastructure in and near the village, could cause impact to public health on the Nuiqsut community associated with both noise from air traffic and other sources and episodes of poor air quality relative to Alternative A.

The same impacts discussed above for Alternative A are also relevant for Alternative D. However, the absence of gravel roads would likely reduce potential impacts associated with perception of food contamination, noise from road traffic, and avoidance of fixed sites in subsistence hunting. Increased air emissions anticipated under Alternative D (Section 4.2.3.2) could potentially lead to increased impacts to public health.

No changes from baseline conditions would be expected under Alternative E, because no action would take place under this alternative.

4.4.2 Economy

This section addresses the projected potential economic effects associated with the construction, operations, and abandonment of the various GMT1 development alternatives on the state, the North Slope Borough, and the community of Nuiqsut.

The primary economic effects of the action alternatives are expected to be moderate and would include the following:

- Increased economic activity in the state, in the NSB, and in the community of Nuiqsut, resulting from direct industry spending on goods and services during the construction phase, operations phase, and until the abandonment of facilities.
- Increased revenues to the State, the NSB, and the City of Nuiqsut, resulting from shared royalties, state corporate income taxes, property taxes, bed taxes, and other fees.
- Increased job opportunities for Alaskans, including residents of Nuiqsut and other communities in the NSB.

- Additional indirect (or spin-off) effects resulting from spending of income earned by workers, as well as government spending of revenues for capital and operating programs.
- Increased oil production in the Alaska North Slope that will result in additional secondary economic effects such as increasing TAPS throughput (and State revenues).

These economic effects associated with the GMT1 development action alternatives are within the range of effects analyzed in BLM (2004) and BLM (2012). The impacts to the state, regional, and local economy are described in BLM (2004, § 4F.4.2) and BLM (2012, § 4).

However, both BLM (2004; 2012) considered broader development scenarios than the GMT1 development. BLM (2004) evaluated development of five satellites (including GMT1) — two in the Colville River Delta (CD3 and CD4) and three in the NPR-A (CD5, GMT1 [formerly CD6], and GMT2 [formerly CD7]). On the other hand, BLM (2012) addressed development scenarios encompassing the entire NPR-A. The development scenarios included oil production in the Moose's Tooth and Bear Tooth units, as well as at Umiat. The analysis also considered production of yet to be discovered oil and gas resources in other parts of the NPR-A.

The economic effects presented in the following sub-sections are specific to the proposed GMT1 development and the other alternatives as described in a previous section of this document.

The proposed GMT1 development as described in a previous section of this document includes construction of drilling and processing facilities, pipelines, roads, and power and fiber optic lines. Following the construction of these facilities, expected annual average production at GMT1 is expected to peak at 20,000 barrels per day in 2018, declining to about 5,000 barrels per day in 2031, then goes to a steady decline of about 15 percent per year through 2041. This projection is the same assumption used in BLM (2004, § 4A.4.2.1, p. 620), which still provides BLM a reasonable estimate, although may overestimate the amount of recoverable oil from the reservoir.

Table 4.4-1 shows the Alaska Department of Revenue's (ADOR) projections of crude oil production at Alpine and the total for the Alaska North Slope through 2022. Note that the ADOR production volumes at Alpine include production at Alpine, Fiord, Nanuq, Qannik, and Mustang (after 2016).

As shown in Table 4.4-1, oil production in the North Slope is expected to continue its declining trend in the future. With development of GMT1, the annual production volumes at Alpine would increase by approximately 50 percent at GMT1's peak production during the years 2018 through 2022. In these same years, oil production at GMT1 would add about 5 percent to the total North Slope oil production.

Any additional oil production in the North Slope extends the life of the TAPS and benefits the State. As noted in Section 3.4.2.1, the State of Alaska relies heavily on oil revenues. Oil revenues are dependent on the oil production levels and the price of oil at the wellhead. The State of Alaska would receive revenues from oil production in the NPR-A. However, revenues from the NPR-A are treated differently than those from state lands and the outer-continental shelf (Federal OCS). As noted in 3.4.2.1, Federal law designating the NPR-A established a requirement that 50 percent of lease sale revenues, royalties, and other revenues be paid to the State of Alaska, and the other half be paid to the General Fund of the U.S. Treasury. As stated in BLM (2012), the State of Alaska General Fund receives shared revenues from federal leases two times a year and the State makes these available as grants to eligible municipalities in the

following fiscal year. Communities in the NSB have historically benefited from these grants. Additional grants for planning, construction, maintenance of essential public facilities, or for provision of essential public services can be expected by municipalities in the North Slope region, with revenues associated with production at GMT1.

As described in Section 1.1, the GMT Unit has mixed land status with federal land, native interim conveyed and native selected lands. CPAI's plan incorporates horizontal drilling which may involve drilling into ASRC minerals. While the actual production area from these wells has yet to be delineated, ASRC will receive 100 percent of the royalties for any production from ASRC-owned leases. Production from Federal leases would result in royalties paid to BLM, and the state will receive 48 percent of these royalties. Allocations will be made at the time adequate information exists. Participating area boundaries will be established, pursuant to the GMT Unit Agreement between ASRC, CPAI and BLM, and royalties will be paid according to that agreement.

An assumed royalty rate is assessed based upon the federal royalty rate of 16.67 percent of wellhead value for high oil potential areas (BLM 2012). Given expected production volumes at GMT1 and the ADOR projected ANS wellhead values through 2022 (as reported in the 2013 Spring Revenue Forecast), averaging $95.16 per barrel of oil (2013 real $), it is estimated that royalties from GMT1 would amount to over $2.9 million over the entire production period; approximately $1.5 million would be paid to the State of Alaska, and shared with North Slope communities.

In addition to the royalties, the State of Alaska and the NSB would receive property tax payments associated with the taxable oil infrastructure that will be developed at GMT1. The property tax payments would be based on the assessed valuation of the facilities developed onsite. The annual levy is based on the full and true property value of property taxable under AS 43.56. For production property, the full and true value is based on the replacement cost of a new facility, less depreciation. The depreciation rate is based on the economic life of the proven reserves. Pipeline property on the other hand is treated differently from production facilities in that it is valued on the economic value of the property over the life of the proven reserves. The state property tax rate is 20 mills. A local tax is levied on the state's assessed value for oil and gas property within a city or borough and is subject to local property tax limitations. The NSB property tax rate is 18.5 mills, hence, the state portion of the property tax is 1.5 mills.

Table 4.4-1: Projected Crude Oil Production: Alpine, Total Alaska North Slope, GMT1

Year	Alpine	Total Alaska North Slope	GMT1*
	Barrels Per Day		
2013	66,700	538,300	
2014	64,300	526,600	
2015	60,300	512,800	
2016	60,500	499,700	
2017	55,500	476,900	2,500
2018	47,200	443,300	20,000
2019	40,100	422,400	20,000
2020	34,400	399,400	20,000
2021	29,800	372,300	17,000
2022	26,000	344,500	14,450
2023			12,283
2024			10,563
2025			9,190
2026			8,087
2027			7,197
2028			6,478
2029			5,830
2030			5,247
2031			4,722
2032			4,014
2033			3,412
2034			2,900
2035			2,465
2036			2,095
2037			1,781
2038			1,514
2039			1,287
2040			1,094
2041			930

Source: 2013 Spring Revenue Forecast, Alaska Department of Revenue, Tax Division (Alpine and Total ANS crude production); *2004 ASDP Final EIS (GMT1 Annual Production estimates).

The project proponent provided an aggregated estimate of the cost of the proposed development at GMT1, approximately $400 million for the action alternatives. Given limited information on the value of each the potentially taxable facilities at GMT1, it is not possible to estimate the property tax payments given the methodology noted above. An approximation of property tax payments however can be provided using a simplified approach that is based on a unit factor estimate of $0.50 per barrel. This same approach was used in BLM (2004 § 4A, p. 624). Given this point estimate of $0.50 per barrel and the production figures presented in Table 4.4-1, it is estimated that annual property tax payments to the State of Alaska and the NSB could amount to approximately $100,000. This rough estimate would be revised once more detailed information on the cost of each of the facilities become available.

In addition to the above revenue streams, the State of Alaska would receive additional corporate income tax on petroleum activity. The tax is calculated as 9.4 percent of the Alaska share of

worldwide income for each corporation. The Alaska income is calculated using a "modified apportionment formula," which averages the Alaska share of corporate worldwide property, sales, and extraction and applies that formula to calculate the Alaska share of worldwide income. The state apportions the tax base for all other types of corporations using a formula that substitutes payroll for extraction. Consequently, the Alaska tax base for the special corporate income tax on petroleum depends not only on activity and profits within Alaska, but also on activity and profits in other locations, making it difficult to forecast. This is reflected in the historical variability of tax revenues which have averaged 2.6 percent of the value of production at the wellhead, but ranged from a low of 0.3 percent to a high of 5.1 percent. Annual revenues have ranged from $18 million to $860 million, or from $.03 to $2.32 per barrel of oil (Northern Economics and Institute of Social and Economic Research, 2009).

The City of Nuiqsut is also projected to benefit from bed taxes resulting from higher hotel occupancy during construction and even through the operations phase of the project. The City of Nuiqsut has a 7 percent bed tax. It is however difficult at the point to estimate bed taxes associated with the proposed project.

Project-related employment would include temporary jobs during the construction season, permanent operations and maintenance jobs, and then again temporary jobs during the abandonment phase. The peak construction workforce is estimated at 300 which includes specialized tradesmen (at particular short periods during construction).

Operations manpower requirements for GMT1 production pad was presented in BLM (2004), (see Table 4.4-2). Each 12-hour position represents two people and is equivalent to 4,380 man-hours per year. The manpower forecast is an estimate of the number of 12-hour positions (that is, two people per position) that would work onsite at the production pad location.

Table 4.4-2. Operations Manpower Requirements for GMT1 Production Pad

Field Personnel	Number of Positions
CPAI Operator	1.00
CPAI Maintenance	1.00
Contract Operator	0.00
Contract Maintenance	0.00
Heavy Equipment Operator	2.50
Heavy Equipment/Vehicle Repair	1.00
Incremental Number of 12-hour positions at production pad	5.50
Cumulative Number of 12-hour positions at production pad	9.20

Source: 2004 ASDP EIS, Volume 1, page 59.

Periodic work-overs of the wells, as well as removing facilities and rehabilitating the land will also generate additional employment for several years.

As noted in BLM (2004), many of the construction workers hired would need skills and experience in drilling and pipeline construction. Hence, local hire of Nuiqsut and other NSB residents are expected to be minimal. Non-Alaska residents represent 30 percent of the total oil and gas industry workforce in the state (ADOLWD 2011).

Indirect economic effects would also result from project capital expenditures. As noted above, it is estimated that total cost for the proposed development (Alternative A), would cost approximately $400 million. There is no estimate at this point of the annual operating costs of the GMT1 facilities. Like other development projects in the North Slope, it is expected that most

of the materials and equipment would be purchased outside of Alaska and would be shipped to the job site. A portion of the spending however would be made within Alaska. It can be expected that some of the contracts for construction and operations and maintenance of the facilities would be awarded to Alaska private corporations, including the North Slope regional and village corporations.

Finally, spin-off effects or multiplier effects of spending by workers and government spending in the local, regional, and state economies are expected to be generated during construction, operations, and abandonment phases.

Comparison of Alternatives

The impacts to the economy under the action alternative would be similar; however, there may be slight differences in employment, income and revenues due to differences in capital spending. It is estimated that the total capital cost of Alternative B would be 12 percent higher than the cost of Alternative A.

The impacts to the economy under this alternative would be similar to those for Alternative A; however, there may be slight differences in employment, income and revenues due to differences in capital spending. It is estimated that the total capital cost of Alternative C would be 14 percent higher than the cost of Alternative A. Alternative C may also lead to increased economic benefits for the Native Village of Nuiqsut due to additional income from use of the airport and hotel.

The impacts to the economy under this alternative would be similar to those for Alternative A; however, there may be slight differences in employment, income and revenues due to differences in capital spending. It is estimated that the total capital cost of Alternative D would be 80 percent higher than the cost of Alternative A, due to additional facilities that will have to be built given limited road access to the site. The cost also includes cost for building a bridge to extend the airstrip.

There will be no impacts to the state and local economy under this alternative. The range of economic benefits associated with construction and operations as described under Alternative A would not be realized under this alternative.

4.4.3 Subsistence

Impacts to subsistence are discussed and analyzed in BLM (2004 § 4A.4.3) and BLM (2012, §§ 4.3.13, 4.4.13, 4.5.13, 4.6.13, and 4.7.13). The primary impacts to subsistence identified in these EISs were reduced availability of subsistence resources, reduced access to subsistence use areas, and hunter avoidance of industrial areas. These impacts could result in increased investments in time, money, fuel, and equipment and potentially change hunting success. The impacts would last for multiple generations and affect key subsistence use areas and overall Nuiqsut subsistence activities. Overall the **types** of impacts are expected to be similar to those identified in BLM (2004) and BLM (2012); new information since these EISs provide additional context and information that indicate the **intensity** of these impacts and overall degree of impacts are higher than previously anticipated.

New information since BLM (2004) and BLM (2012), including SRB&A's (2010b, 2011, 2012, and 2013) caribou use area and harvest data from the Nuiqsut Caribou Subsistence Monitoring Project and resource-specific use area analysis from SRB&A (2010a) provide additional insight into the potential effects of the GMT1 development. This information includes geographically

specific data that document the types of resources, percent of harvest (for caribou), percent of harvesters, timing of activities, and method of transportation within the project study area. Furthermore, this new information includes recent traditional knowledge and documentation of impacts to caribou hunting that have occurred since the development of Alpine Satellites.

As discussed in BLM (2012, § 4.3.13.2), effects to subsistence species could also occur as a result of an oil spill although the effects would depend upon the size and location of the spill. A history of spills and potential impacts are discussed in Section 4.5 of this SEIS. Specifially spills contained on a road or pad would likely have a limited impact to subsistence species as State regulations require spill reporting and cleanup. Spills to tundra could affect a small number of terrestrial mammals or birds in the immediate vicinity of the spill, if they were unable to avoid the spill. Population-level effects are not anticipated. Spills to water resources or that reach water resources, such as fish-bearing streams could spread and thus have a wider potential impact area; in the case of a large spill, areas that could be impacted includ nearshore or marine waters. Spills of this nature could have a regional impact, which could vary in duration based on migration of the spill and ease of cleanup. Subsistence users would be unlikely to harvest subsistence resources in the vicinity of a spill or an area perceived to have been impacted, which could result in additional travel time or energy expenditures for subsistence harversters. The potential for oil spills is present under all of the action alternatives.

Impacts under Alternative A

Subsistence Use Areas

The proposed project study area overlaps with areas that have been documented for multiple types of subsistence activities as described below. This overlap results in loss of traditional use areas for resources in those areas. New data show that 44 percent of all Nuiqsut use areas and 31 percent of overland Nuiqsut use areas are overlapped by the project study area for the 1995-2006 time period (Table 3.4-8). In addition, the project overlaps with 86 percent of all 2008-2011 caribou use areas and 22 percent of overland 2008-2011 caribou use areas. In general, overland subsistence activities that would be particularly impacted by project activities include caribou, geese, and wolf and wolverine hunting in addition to some overland travel to Arctic cisco and burbot fishing use areas along the Colville River (Figure 4.4-1 through Figure 4.4-6). A high number of overlapping caribou use areas was documented throughout the project study area during the 1995-2006 study (Figure 4.4-1). More recent documented caribou use areas (Figure 4.4-2) show the highest numbers of overlapping use areas within the project study area more focused along the Nigliq Channel, Fish Creek and in overland areas west of the community toward Tiŋmiaqsiġvik (Ublutuoch) River and Fish Creek. Geese hunting areas (Figure 4.4-3) show the highest numbers of overlaps in lands surrounding Nigliq Channel, Fish Creek, and the Colville River south of the community. Wolf and wolverine use areas (Figure 4.4-4) show the highest numbers of overlaps in the southern and western portions of the project study area. Arctic cisco and burbot use areas in the project study area occur primarily along the Nigliq Channel north of the community (Figures 4.4- 5 and 4.4-6). Resources such as caribou and Arctic cisco contribute highly to the community's overall per capita harvest and although other resources such as geese and burbot do not contribute as much in terms of edible pounds, a high percentage of households participate in these activities and use and share these resources (Figure 3.4-11, Figure 3.4-12, and Figure 3.4-13). The majority of direct impacts to subsistence users in the project study area would occur during the late fall caribou hunt, winter caribou and wolf/wolverine hunting, and spring geese hunting. Direct impacts to existing summer subsistence use areas, which are focused more along river channels, would be more limited in nature. The project study area may also see increased subsistence activity in the summer,

however, because Nuiqsut residents will be able to drive vehicles or four-wheelers along the constructed roads.

User Access

In general, impacts on access to and through the project study area will be lessened due to the seven foot pipeline height and permission to use and cross gravel roads associated with the project. Several Nuiqsut individuals have reported that the seven foot pipelines still produce barriers to access in areas of high snow drifts (SRB&A 2009a, 2013). Use of the GMT1 access road under Alternatives A, B, and C could have countervailing impacts to subsistence by enabling hunters to access more areas year-round via gravel road. If BLM requires the road to be removed upon project abandonment, travel benefits to Nuiqsut residents related to the road would cease. Road removal may provide a benefit to the extent that rehabilitation is successful in restoring some degree of natural conditions; however data is inconclusive on whether such rehabilitation is achievable. Direct impacts to access (i.e., by introducing physical barriers or obstructions to travel) would be most likely for subsistence activities near Fish Creek that would require traveling through the proposed project area by snowmachine. Specifically, these impacts may occur during winter wolf and wolverine hunting and spring geese hunting, both of which occur in the Fish Creek area. In addition, these impacts could occur for residents traveling by snowmachine in the winter to hunt caribou. The road may provide a possible benefit to access for residents who do not have snowmachine or four-wheeler transportation. While the actual footprint of the proposed project overlaps with only a small portion of Nuiqsut residents' subsistence use areas, avoidance of the area will be at a greater distance than the footprint and therefore the loss of subsistence use areas will be larger than the direct overlap of the project with documented use areas (Minerals Management Service 2007, BLM 2004, National Research Council [NRC] 2003). The shifting of subsistence use areas away from areas of development at a distance greater than the development footprint has already been documented for the community of Nuiqsut (Pedersen et al. 2000, Minerals Management Service 2007, Research Foundation of State University of New York 1984, IAI 1990a, SRB&A 2013). User avoidance will be most acute near the proposed drill pad and pipeline to CD5. Concerns about shooting near or toward pipelines also could cause residents to avoid hunting near the project, even if resources are present in those areas.

Avoidance of the project study area or portions of the project study area could cause hunters to hunt elsewhere and travel farther at greater cost and effort (Pedersen et al. 2000; BLM 2012, §4.3.13.2; Corps 2012). Currently, harvest locations are based on local knowledge of resources and their abundance at traditional harvest areas during specific times of the year. Moving to another area to avoid project components and activities means harvesters would more heavily use areas with potentially fewer and less densely distributed subsistence resources. These changes to subsistence activities would require increased investments in time, money, fuel, and equipment. It is possible that Nuiqsut hunters would not have the same rate of harvest success if access to these traditionally used areas is altered.

Resource Availability

Impacts on resource availability related to noise, traffic, and infrastructure is an impact that has been frequently observed and reported by North Slope harvesters (SRB&A 2009a). Noise, traffic, and infrastructure associated with the project could affect the availability of key resources such as caribou, waterfowl, and furbearers including wolf and wolverine. Overall project activity levels would be highest during the construction period and could heighten the impact to resource availability during the construction period. Similar to user avoidance, impacts to resource availability could also lead to increased costs, time, and effort as harvesters would have to look elsewhere or spend more time and/or money in search of resources.

According to Section 4.3.4, project components (e.g., road, pipeline, air traffic) may cause local displacement of caribou in and near the project. Even localized or "limited" changes in caribou distribution resulting from displacement can affect the availability of caribou to harvesters because of residents' limited means to access caribou at different times of the year and the fact that caribou are not always available near Nuiqsut. In particular, harvesters have observed that helicopter and plane traffic tends to divert caribou or cause skittish behavior, resulting in reduced harvest opportunities (SRB&A 2009a). During interviews with Nuiqsut caribou hunters for the 2008-2011 study years, helicopter traffic was the most commonly cited impact on caribou hunting related to CD4 and other Alpine Satellite Developments, followed by plane traffic, and human-made structures (i.e., pipelines blocking caribou movement; SRB&A 2010b, 2011, 2012, 2013). During operations, helicopter traffic will be limited to summer months in support of scientific studies. Residents of Nuiqsut have reported observing caribou unable to cross under pipelines at seven feet due to heavy snowdrifts. Impacts from ground traffic on the road could also affect caribou distribution. Caribou, especially cows with calves, tend to avoid areas of human activity and have been found to shift calving areas farther from developed areas (NRC 2003). Research indicates their avoidance zone may extend to 1.2 miles from the activity (NRC 2003). Drilling activities during construction may also result in reduced caribou availability. Studies show that caribou, especially females with calves, generally avoid drilling sites, and those caribou that do approach drilling sites spend less time feeding and lying down (NRC 2003). Section 3.3.4 notes that the project study area is in the peripheral eastern range of the TH and notes that, generally, caribou utilization of the area is low. However, as noted in SRB&A (2013), because the Colville River delta is in the peripheral range of both the Teshekpuk and Central Arctic herds, Nuiqsut harvesters are particularly vulnerable to changes in the distribution and/or behavior of caribou in these herds. Resource displacement will also likely occur for other resources such as waterfowl and furbearers and will affect residents' success and effort in these areas (Section 4.3.4 and 4.3.3).

Contamination or perceived contamination associated with the proposed project could result in reduced resource availability to subsistence users. The availability of subsistence resources not only depends on their abundance in traditional use areas, but on their health or quality (either actual or perceived). A major concern to North Slope subsistence users is the potential effects of contamination and air pollution on subsistence resources related to development (SRB&A 2009a). Contamination or perceived contamination of subsistence resources could result in reduced availability of subsistence resources considered healthy enough for consumption. If contamination of subsistence resources occurs, consumption of these resources by Nuiqsut subsistence users could potentially affect human health.

Community Participation

Effects on subsistence related to the proposed project could result in reduced harvests of resources, particularly caribou, geese, and furbearers and reduced opportunities to participate in subsistence harvesting and associated activities. While some hunters respond to changes in resource availability by taking more trips and increasing costs in order to harvest what they need, others may choose to take fewer trips because of lack of funds or reduced success. As discussed above, in 2011, nine percent of households in Nuiqsut said they avoided the Alpine area altogether because they believe they may experience impacts in the area (SRB&A 2012: 79, Table 41). These responses were volunteered and not cued by researchers, and therefore the percentage of households or harvesters avoiding Alpine facilities may be higher because the study team did not systematically ask each respondent if they had avoided the Alpine area.

When subsistence users' opportunities to engage in subsistence activities are limited, their opportunities to transmit knowledge about those activities, which are learned through

participation, are also limited. If residents stop using the project study area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about that traditional use area would be diminished and eventually lost. The loss of that knowledge could result in a permanent reduction in Nuiqsut's subsistence use area. If harvests of subsistence resources (particularly caribou, geese, and furbearers) decline because of the effects of infrastructure, noise/traffic, contamination, or changes in resource availability, then there would be fewer opportunities to teach younger generations the skills necessary to hunt, harvest, and process subsistence resources. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of the community. Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to eat subsistence foods could have long-term or permanent effects on culture by diminishing social ties within the community that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

Impacts under Alternative B

The impacts to subsistence under this alternative would be similar to those for Alternative A; the potential for user avoidance near Fish Creek will be lower due to the closer location of the pipeline and road under Alternative B to the community of Nuiqsut.

Impacts under Alternative C

The impacts to subsistence under this alternative would be similar to those for Alternative A except for impacts related to increased road and air traffic near the community. Nuiqsut residents would already have the benefit of increased access from the Nuiqsut Spur Road that is being developed independently of this proposed project. The increased amount of traffic along the upgraded Nuiqsut Spur Road, however, would create additional impacts to resource availability beyond those anticipated under Alternative A. This increased traffic could create additional local displacement of caribou and would create the greatest impact for caribou hunters waiting for caribou along the Nigliq channel.

Alternative C would increase air traffic near Nuiqsut. Air traffic near Nuiqsut would potentially benefit summer caribou hunters along the Nigliq channel as there would be fewer flights into the existing Alpine Central Facilities. Although potentially benefiting caribou hunters along the Nigliq channel, increased air traffic near Nuiqsut could impact nearby subsistence activities, particularly fall caribou and waterfowl hunting west of the community.

Impacts under Alternative D

The impacts to subsistence under this alternative would be similar to those for Alternative A except for greater impacts related to increases in air traffic and the lessening of impacts related to road traffic. Air traffic is the most frequently cited impact of development by Nuiqsut caribou hunters (SRB&A 2010b, 2011, 2012, and 2013). Alternative D would create increased impacts to caribou, waterfowl, and furbearer hunting due to increased air traffic as well as new project components (e.g., new airstrip, occupied structure pad) and a larger drill pad. While there may be less of a physical barrier to caribou movement due to less road traffic and fewer roads in general, it is unclear whether these impacts would be offset by increased air traffic and the continued presence of the pipeline. Hunter avoidance may increase due to larger and new project components west of the community and the continued presence of industry activity associated with air traffic.

Impacts under Alternative E

No additional impacts to subsistence would be expected under Alternative E.

Summary and Comparison of Alternatives

In summary, under Alternatives A, B, C, and D, Nuiqsut residents would experience direct impacts to subsistence use areas, particularly those for caribou, geese, and furbearers such as wolf and wolverine. Some winter fishing activities such as Arctic cisco and burbot fishing may also be impacted. Direct impacts on subsistence use areas would be lowest during the summer months as many of the subsistence activities that occur in the project study area take place during late fall through early spring. Except for areas of high snow drifting, user access will not be restricted for residents who wish to conduct subsistence activities in the project study area as the pipeline will be elevated to seven feet and the roads will be open to local use. User avoidance is expected to be the primary impact related to user access, as Nuiqsut residents will likely avoid the project study area drill pad and pipeline corridor. Subsistence harvesters often avoid areas of development due to concerns about contamination and because of residents' discomfort with hunting near human or industrial activity. The occurrence of an oil spill could also impact subsistence resources or subsistence harvesters as it relates to actual or perceived concerns about contamination. The potential for spills is present under all the action alternatives and would vary depending on type, location, and size of spill.

Impacts related to resource availability will occur year-round and may extend outside the project footprint to use areas along the Colville River (including Nigliq Channel), Fish Creek, and in an area west of the community. Resource availability impacts will be greatest for caribou that migrate through the project study area, and these impacts would be most likely to occur during the peak caribou hunting season, between June and September; other resources such as waterfowl and furbearers may also experience local displacement that will affect Nuiqsut subsistence activities. Finally, for all alternatives (except for Alternative E), overall community participation and transmission of knowledge may be affected if residents take fewer trips due to user avoidance or reduced harvest success. Increased costs, time, and effort would also likely occur as indirect effects related to changes in use areas, resource availability, user access, and community participation. Nuiqsut residents harvest key resources within the project study area multiple times a year and these areas have been used for multiple generations. Effects of the proposed project would occur in key geographic areas relative to other areas of subsistence availability and would pertain to individual subsistence users, hunting groups, and the overall pattern of Nuiqsut subsistence uses. In particular, Nuiqsut residents with limited means of transportation and limited funds would be the most impacted among subsistence users as they typically conduct subsistence activities closer to Nuiqsut and will be less able to adapt to the impacts by traveling further and/or more frequently.

In terms of overall subsistence impacts, Alternatives A and B would likely have the fewest impacts to subsistence because they require less air traffic close to the community and because development related ground traffic would be limited to the road between CD5 and GMT1. Alternative C would likely have more impacts than Alternatives A and B, because it would move development related ground traffic closer to the community, along the road between Nuiqsut and CD5, and because the community would experience more air traffic if used as a hub, which could result in deflection of subsistence resources near the community. Alternative D would likely have the greatest impact to subsistence uses and activities of all the alternatives, as it would result in increased air traffic in hunting areas west of the community and would create a new source of air traffic that did not exist before. As noted above, air traffic is the most frequently reported caribou hunting impact associated with development.

Overall the types of impacts (e.g., subsistence use areas, user access, resource availability, community participation, oil spills) identified above are similar to those identified in BLM (2004) and BLM (2012). New information since these EISs including the results of CPAI's Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2010b, 2011, 2012, and 2013) and the Mineral Management Service's subsistence mapping project in Nuiqsut for the 1995-2006 time period (SRB&A 2010a) provide additional context and information that indicate the intensity of these impacts and overall degree of impact are higher than previously anticipated.

Although there are differences between the alternatives in terms of air and ground traffic and associated effects on subsistence, the nature and overall degree of impacts on subsistence do not vary substantially by alternative. In contrast to the BLM (2004), the current analysis identifies that the intensity of potential impacts to subsistence would be high because the impacts to subsistence use areas and user avoidance would be consistently measurable or observable. This is supported by data gathered during the Mineral Management Service's subsistence mapping project (SRB&A 2012a) in addition to local hunter observations and data collected during CPAI's Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2010b, 2011, 2012, 2013), which has documented shifts in subsistence activity away from Alpine related development activities. Results from the ongoing caribou monitoring program will provide further information regarding the magnitude of expected impacts to Nuiqsut residents' caribou subsistence uses. Furthermore, Nuiqsut residents currently have two remaining directions (west and south) in which they can conduct subsistence activities without the presence of permanent oil and gas infrastructure. This project, along with the already approved CD5 project, introduces oil and gas infrastructure into subsistence use areas west of the community, further reducing the areas in which residents can subsist without the presence of nearby oil and gas infrastructure to only the southern direction.

This high intensity impact to subsistence would be of interim duration for construction and long-term duration during operation and it would affect multiple generations of subsistence users. While the spatial extent of impacts during construction and certain operational impacts (e.g., direct loss of subsistence use areas) would be localized, the indirect effects of operation (e.g., increased cost, time, effort) could extend beyond the local area and affect the whole of Nuiqsut's subsistence activities (i.e., regional) in addition to introducing disruptions to caribou availability and other resources that could extend outside of the project study area and to a broader area-wide level. Lastly, the context of subsistence is an important resource that fills a unique role in the regional sociocultural environment. Thus, the overall degree of impact to subsistence is expected to be major because it is a high intensity impact, will have effects of long-term duration, extend to regional extents, and is an important resource.

4.4.4 Environmental Justice

Executive Order No. 12898 (Feb. 1994), discussed in Section 3.4.4, directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of proposed federal actions, such as authorizing development at GMT1, on minority and low-income populations. Federal agencies also are required to give affected communities opportunities to provide input into the environmental review process, including identification of mitigation measures.

The community of Nuiqsut, as discussed in Section 3.3.2.4, meets the demographic characteristics to be qualified as a minority population, and requires evaluation for disproportionate impacts under environmental justice.

Environmental justice effects are described by BLM (2004 § 4F.4.4) for the proposed GMT1 project and generally for oil and gas development within NPR-A (BLM 2012 § 4.5.15.2). This analysis of impacts related to environmental justice considers if implementation of one of the proposed GMT1 alternatives would result in disproportionately high and adverse environmental effects to the community of Nuiqsut. Environmental justice analyses weigh the benefits of a proposed project (oftentimes increased economic activity or access to improved infrastructure) on the environmental justice community, which may offset the adverse environmental effects from construction or operation.

The issues to be addressed in the Environmental Justice section include:

- Potential reduced access to traditional subsistence use areas
- Potential destruction or disruption of subsistence resources
- Employment effects from the creation or loss of jobs

Construction

The primary impact of the GMT1 project would be the loss or significant reduction in value of an important subsistence use area close to town. This area northwest of town has become more valuable as other areas to the north and east have been developed and are thus avoided by many hunters. As discussed in detail in Section 4.4.3, Subsistence, the residents of Nuiqsut currently use the project study area for subsistence caribou hunting and to access marine and freshwater aquatic resources. Locating the GMT1 facilities in the project study area has the potential to disrupt subsistence activities through the loss of subsistence use areas, reduced resource availability, and reduced user access resulting from project infrastructure, noise, traffic, avoidance, contamination concerns, and hunting regulations. The impacts to subsistence are characterized as major in intensity, long-term, and regional in geographic extent (see Section 4.4.3, *Subsistence*). Nuiqsut depends heavily on subsistence, therefore this impact, if it occurs, falls disproportionately on the Native community.

Construction crews would be housed at the APF, at commercial housing in Nuiqsut, or at a temporary camp at the drill site or on an ice pad. This would minimize disturbance related to environmental justice. Construction at the site would not bisect any communities and is unlikely to adversely impact access between communities. Because the project alternatives would potentially increase the transportation options available to Nuiqsut residents, there could be a positive effect on reducing community isolation. Because of the predominance of Alaska Natives in the NSB, minority individuals form “the broader community” of the area.

Construction of the proposed project would not isolate minority or low-income individuals from the broader community.

Construction of the GMT1 Project is expected to increase employment opportunities as residents take advantage of the local hire program sponsored by the Applicant and its contractors. Local residents who work at the GMT1 facility would benefit from jobs and increased income. Although the number of jobs the GMT1 Project generates for local residents would not be known until after contracts are awarded and construction begins, it likely that positions for local residents would be available. However, based on the history of past development projects on the North Slope, the construction of the GMT1 Project would likely have a minor impact on overall NSB resident employment. The majority of positions for the project would likely be filled by nonresident workers who would leave the area in between shifts.

An increase in employment and in cash income from both employment and dividends would help local residents, especially those of working age, to stay in the area and maintain their culture and community characteristics. Residents may also experience economic benefits through increased income from native corporation dividends, and through indirect effects of increased tax income for the NSB government. Section 4.4.2, Economy provides additional discussion of impacts to employment, income, and the NSB tax base.

Health impacts related to GMT1 construction were predominantly rated low (Section 4.4.1.5), and there would be limited interaction between workers at the site and the local community, thereby having minor impacts to food, nutrition, subsistence, and social determinants of health. Exposure to hazardous materials was rated as medium; however, emissions would be regulated for protection of human and environmental health.

Drilling and Operation

The effects of drilling and operation of the GMT1 Project on the minority community of Nuiqsut would be similar to those described above for construction, except that fewer workers would be employed to drill the wells than to construct the facility.

The 2012 NSB Baseline Community Health Analysis Report notes that a recent study examining air quality in Nuiqsut has not found evidence of [air] pollution at levels expected to have significant health effects (NSB 2012, p. 98 and 184). That NSB Report also notes that 24 percent of Iñupiat heads of household in Nuiqsut reported a shortage of subsistence food at some point during the year. This finding could be exacerbated if there was an adverse impact on the availability of subsistence resources due to GMT1 Project drilling and operation.

Comparison of Alternatives

Under all action alternatives, residents of the minority community of Nuiqsut could experience disproportionally high and adverse impacts as the result of disrupted access to traditional subsistence use areas. Resource availability could also be impacted in the immediate vicinity of the project.

The gravel access road constructed under Alternatives A, B, and C could provide increased access for Nuiqsut residents to subsistence use areas, depending upon the construction of a proposed Nuiqsut Spur Road, which would link Nuiqsut to the existing Alpine Satellite road system. However, the ease of road access to the area will likely decrease the quality of the area, increase hunting competition in the area, and decrease the success rate of those who hunted there in the past. Alternative C would include improvements at the Nuiqsut Airport and upgrade of the proposed Nuiqsut Spur Road (if constructed). This alternative may provide minor

economic benefits to the community but would negatively impact subsistence hunters who depend on harvesting near town. The action alternatives would not change existing restrictions on public use of industry roads. Residents of Nuiqsut would continue to have access to oilfield roads and facilities on winter ice roads.

Alternative D would likely have the largest impact to subsistence and thus environmental justice for Nuiqsut. It would result in increased air traffic and associated noise directly over the residents' subsistence hunting areas and would include a larger footprint for the project components, including a permanent camp at GMT1. There would not be a road linking GMT1 to the other Alpine Satellite facilities and Nuiqsut (depending on construction of the Nuiqsut Spur Road) that would facilitate residents' access to subsistence use areas with the positive and negative impacts the road would entail. However, there would still be a pipeline connecting GMT1 to CD5. Aircraft would be used approximately 9 months of the year (May through January) to access GMT1 from APF or Nuiqsut; ice roads would provide access approximately 3 months of the year (February through April). Noise impacts from aircraft operations between APF and GMT1 would disturb caribou and subsistence hunting activity, resulting in potentially significant effects to environmental justice because Nuiqsut residents are nutritionally, economically, and culturally dependent upon subsistence resources.

Mitigation

Prior planning documents covering the proposed project study area, described in BLM (2004), BLM (2008b), BLM (2012) and BLM (2013), have provided opportunities for public involvement for low-income and minority populations. BLM has carefully considered community views when developing and implementing mitigation strategies to reflect the needs and preferences of these populations, to the extent practicable. These planning documents have made some lands unavailable for oil and gas leasing, including a large portion of the eastern coastal plain within the NPR-A that is used by Nuiqsut subsistence users. See Section 5 for consultation activities associated with this SEIS.

These efforts also include ways to adapt management of these lands to better meet resource and use objectives, including adopting measures to protect subsistence resources, protect access to those resources, protect public health, and monitoring lessees'/permittees' activities to ensure compliance with requirements. The NPR-A Subsistence Advisory Panel provides a forum for tribal representatives to propose mitigations to BLM, and the BLM conducts regular government-to-government consultation with the Native Village of Nuiqsut council. In addition, the 2013 NPR-A ROD required BLM to establish the NPR-A Working Group, made up of representatives of the North Slope local government, Native corporations, and tribal entities, in order to facilitate and provide for meaningful and regular input by local communities.

In the ANILCA § 810 analysis documented in BLM (2004a) and BLM (2013), BLM concluded that the authorized developments (Alternative F and B-2, respectively, both of which include the GMT1 Project) *"includes reasonable steps to minimize adverse impacts on subsistence uses and resources."*

Potential impacts to subsistence activities and resources are mitigated by design and operational features included in Section 4.6 and the following protective measures of BLM (2013: A-4, A-5, A-6, A-7, A-11, A-12, B-1, B-2, C-3, C-4, C-5, E-1, E-2, E-6, E-7, E-19, F-1, H-1, H-3, I-I, K-1, K-2, and M-1).

Conclusions

The analysis of impacts related to environmental justice considers if implementation of one of the proposed alternatives would result in disproportionately high and adverse environmental effects to the minority community of Nuiqsut. Environmental justice analyses weigh the benefits of a proposed project (e.g., increased economic activity or access to improved infrastructure) on the minority community, which may offset the adverse environmental effects from construction, drilling, or operation. The potentially affected resource in the environmental justice analysis is the community of Nuiqsut, which is characterized as unique in context. The duration of effects under all the action alternatives would be long-term and of regional extent.

The ANILCA § 810 analysis for this project concludes that, for all action alternatives, the effects fall above the level of significantly restricting subsistence use for the community of Nuiqsut. The potential impacts to subsistence resources by displacement and impacts to access by subsistence users must, in the case of Nuiqsut, be considered as significant Environmental Justice issues.

Overall, impacts to the minority community resulting from Alternatives A, B, and C are expected to be long term and of high intensity. In A, B, and C, the improved permanent access to subsistence use areas is expected to have a long-term, beneficial effect for many residents of Nuiqsut while diminishing the value of the area for others. Alternative D would result in increased aircraft noise in the project study area and would not include the mixed effects of the road, therefore resulting in long-term, high intensity, and significant effects to the community.

There would be negligible overall effects on environmental justice under Alternative E, no action.

In the reasonably foreseeable future, development of oil and gas facilities is unlikely to change the population in the project study area.

4.4.5 Cultural Resources

The following is a discussion of potential environmental effects for cultural resources from the GMT1 project alternatives. For a discussion of cultural resources in the GMT1 Project study area see Chapter 3, section 3.4.5.

Direct effects include any impact to a cultural resource that is caused by an action and occurs at the time of activity in the vicinity of the project. Indirect effects to cultural resources include those impacts that are reasonably foreseeable, result from the action, and/or are later in time or further removed from the resource by distance (40 CFR 1508.8). In addition to an area of direct and indirect effects, this analysis includes an additional area of effect for visual and noise impacts to cultural resources. Visual and noise impacts could be direct or indirect effects, could occur over a larger area than other effects, and could be temporary or cause lasting effects to a resource.

For the analysis of effects on cultural resources, three impact analysis areas are defined for the GMT1 Project:

- Direct impact analysis area is limited to the GMT1 Project footprint;
- Indirect impact analysis area consists of a 2.5 mile buffer surrounding the GMT1 Project footprint (also the project study area); and

- Visual and noise impact analysis area consists of a 5 mile buffer of the GMT1 Project footprint alternatives.

General discussion regarding direct and indirect effects to cultural resources in the NPR-A are discussed by BLM (2012, §§ 4.3.12, 4.4.12, 4.5.12, 4.6.12, and 4.7.12). Impacts to cultural resources are also addressed in BLM (2004, § 4A.4.5). This analysis of potential impacts is tiered off of those documents but also considers any new or additional information. New and updated data relevant to analysis of effects of GMT1 on cultural resources include:

- Updated AHRS and TLUI data.
- The Nuiqsut Cultural Landscape

The analysis of impacts on cultural resources includes counts of AHRS and TLUI sites by alternative. In addition, the analysis of impacts addresses cultural resources from additional sources that contribute to the cultural landscape. Limitations of these data are that they may include duplicate features documented within or by other similar studies. Due to time constraints, differences in data collection methods, and location discrepancies, efforts were not made to reconcile duplicate features within and between data sources and counts of these features are not included in the environmental effects analysis. However, these sources provide additional details and context regarding cultural resource sites in the project study area that are not available in the AHRS and TLUI databases, and the cultural landscape as a whole is addressed in the environmental consequences analysis.

For the GMT1 Project, direct effects could occur in the project footprint during the construction and/or operation phase of the action. Examples of direct effects to cultural resources could include physical destruction of or damage to all or part of a cultural resource, removal of the resource from its original location, change in the character of the resource's use or change of the physical features within the resource's setting that contribute to the importance of the resource, change in access to traditional use sites by traditional users, or loss of cultural identity with a resource. Examples of ground disturbing activities that could cause direct effects during the GMT1 Project include excavation of gravel; construction and maintenance of gravel roads, pads, airstrips, bridges and culverts; construction of ice roads and pads; construction of VSMs for power lines and pipelines; and any other disturbance of the ground surface in the proximity of project components. Other activities and events that could cause direct effects to cultural resources include damage caused by equipment during the construction, drilling, and operation phases of the project, and unanticipated accidents such as blowouts, spills, or fires and subsequent cleanup activities. BLM (2012, §4.3.12.2) provides additional discussion of potential direct effects to cultural resources associated with oil and gas exploration and development.

Indirect effects to cultural resources for the GMT1 Project could occur in the 2.5-mile project study area around project footprints. Indirect effects to cultural resources could occur throughout the construction and operation phases of the project and during project closure and reclamation. Examples of indirect effects to cultural resources in the analysis area could include removal, trampling, or dislocation of cultural resources and culturally sensitive areas by personnel and visitors, complete or partial destruction of a site from erosion, melting permafrost, vibrations, or other landscape changes caused by GMT1 project components; the loss of traditional meaning or importance of a resource or loss of cultural association with a resource; neglect of a resource that causes deterioration; and transfer, lease or sale out of federal ownership without proper restrictions.

The noise and visual impact analysis area for cultural resources extends 5 miles from proposed GMT1 Project components. This analysis area is based on descriptions of noise and visibility

discussed in BLM (2004, §§ 3.2.3, 4A.2.3.3, 3.4.8, 4.4.8) and BLM (2012, § 3.4.9). Examples of visual impacts to sites may include interrupted views such as direct views of project components from cultural resource sites; disruption of the natural landscape due to mining of gravel for project components; atmospheric pollution visible from cultural resource sites; and loss or degradation of viewshed features such as large caribou herds, clean snow, and clear lakes, streams, and ponds that could add meaning and importance to cultural sites. Noise impacts on cultural resource sites could include changes in ambient sounds near culturally sensitive areas during construction and operations.

Potential cumulative effects from the GMT1 development are discussed in Section 4.6.

Impacts under Alternative A

Construction and operation of the Alternative A would occur in the vicinity of known cultural resource sites. Table 4.4-3 summarizes the number of AHRS and TLUI cultural sites within each of the direct, indirect, and visual and noise impact analysis areas. No cultural resources listed in the AHRS or TLUI databases are located within the direct analysis area of Alternative A. Three cultural resource sites listed in the AHRS and TLUI databases are located within the indirect effects analysis area for Alternative A; a site called Nanuq and two TLUI sites, Apqugaaluk and Tiŋmiaqsiġvik (Ublutuoch) River, which lack site descriptions. The Nanuq site was occupied during the 1920s; it consists of two sod houses, several storage pits, and a scattering of habitation debris. Twelve cultural resource sites listed in the AHRS and TLUI databases are within the 5-mile visual and noise impact analysis area for Alternative A. Cultural resource sites in this analysis area include the three sites described in the indirect buffer as well as Uyagagvit, a rocky beach on the Colville River where people have gathered stones for net sinkers and camped for multiple generations, and the Niglivik 2 settlement with at least one sod house, sod quarry, and cache pit. Additional cultural sites include four sites with the remains of sod houses and other habitation debris, at least two graves, and one site with a scatter of animal bones. In addition to previously documented cultural resources, unidentified cultural resources may also occur within unsurveyed areas of the proposed project. Unidentified cultural resources may be buried in areas that have been previously surveyed.

All project components associated with Alternative A overlap the Nuiqsut Cultural Landscape. As shown on Figure 3.4-16, cultural activity occurs throughout the project study area with a heavy occurrence of travel routes, trails, and cultural sites overland area north and west of the community to Fish Creek and along the Nigliq Channel. Subsistence use areas encompass the entire project study area. Therefore, Alternative A will have both direct and indirect effects on the Nuiqsut Cultural Landscape. Direct effects to the Nuiqsut Cultural Landscape could include physical destruction or damage to the landscape through ground disturbing activity; restricted access to multi-generational camps, hunting areas, and travel routes used by Nuiqsut residents due to physical barriers and user avoidance of industrial areas; and the destruction or degradation of any, including unknown or unrecorded, cultural sites or areas through construction activities or incidents associated with project activities.

Indirect effects of Alternative A to the Nuiqsut Cultural Landscape may include altering the way subsistence hunters access hunting and fishing areas away from the community (e.g., a shift from overland travel by snowmachine or four-wheeler to the use of roads); altering routes used to access hunting areas and to travel between villages, cabins, and camps; decreased use of the landscape in the vicinity of project components due to decreased availability of subsistence resources, and accompanying loss of cultural association with those areas; and gradual shifting of cultural activities away from areas within the cultural landscape due to avoidance of project components. Visual and noise impacts to the cultural landscape include disruptions to ambient

noise levels caused by construction, operation, and reclamation of project components; changes to the viewshed due to project components; and the introduction of new landmarks associated with industrial infrastructure in culturally sensitive areas.

Table 4.4-3. Number of AHRS and TLUI Sites in GMT1 Analysis Areas by Alternative

Alternative	Direct Impact Analysis Area	Indirect Impact Analysis Area	Visual and Noise Impact Analysis Area	Total Number of Cultural Sites in Analysis Areas
Alternative A	0	3	12	12
Alternative B	0	3	12	12
Alternative C	0	4	17	17
Alternative D	0	5	16	16

All Alternatives overlap the Nuiqsut Cultural Landscape.

Impacts under Alternative B

Construction and operation of Alternative B would occur in the vicinity of known cultural resources. Direct, indirect, and visual and noise effects to cultural resources, including the Nuiqsut Cultural Landscape are similar to those identified for Alternative A. Table 4.4-3 summarizes the number of AHRS and TLUI sites within each of the direct, indirect and visual and noise impact analysis areas.

No cultural resources listed in the AHRS or TLUI databases are located within the direct analysis area of Alternative B. Three cultural resource sites listed in the AHRS or TLUI databases are located within the indirect effects analysis area for Alternative B; these are the same three sites that are within the Alternative A indirect effect area discussed above. Twelve cultural resource sites listed in the AHRS and TLUI databases are within the 5 mile visual and noise impact analysis area for Alternative B; these are the same 12 sites within the Alternative A visual and noise impact analysis area discussed above. Impacts of Alternative B on the Nuiqsut Cultural Landscape are the same as those discussed under Alternative A.

Impacts under Alternative C

Construction and operation of Alternative C would occur in the vicinity of known cultural resources. Direct, indirect and visual and noise effects to cultural resources are similar to those identified for Alternative A. Table 4.4-3 summarizes the number of cultural sites (AHRS and TLUI) within each of the direct, indirect and visual and noise impact analysis areas.

No cultural resources listed in the AHRS or TLUI databases are located within the direct analysis area of Alternative C. Four cultural resource sites are located within the indirect effects analysis area for Alternative C. The four sites within the indirect effect area of this alternative include *Uyagagvit*, *Nanuq*, and *Niglivik* 2 that are described under Alternative A and *Napasalgun* which is described as a hunting and camping area. Seventeen cultural resource sites listed in the AHRS and TLUI databases are within the 5-mile visual and noise impact analysis area for Alternative C. In addition to 10 sites identified within the visual and noise analysis areas for Alternative A, the visual and noise analysis area for Alternative C also includes the ancestral Iñupiaq sites of *Putu, Tirrabruaq*, and *Itkillikpaa,* traditional subsistence sites of *Nappaun, Ixaanibruaq*, and *Napasalgun,* and the undescribed *Tuibauraq* site. The site of *Putu* consists of two sod houses, a scattering of historic artifacts, and a portion of a whaling boat. *Tirrabruaq* consists of the remains of a well-documented 1920s settlement. *Itkillikpaa* is much larger than the other sites discussed and consists of at least 23 sod houses, a cemetery, storage pits, prehistoric artifacts, and modern subsistence debris. The sites of *Nappaun, Ixaanibruaq,* and *Napasalgun* are described as fishing, hunting and camping areas with the

remains of one sod house reported at *Nappaun.* Impacts of Alternative C on the Nuiqsut Cultural Landscape are the same as those discussed under Alternative A.

Impacts under Alternative D

Construction and operation of Alternative D would occur in the vicinity of known cultural resources. Direct, indirect, and visual and noise effects to cultural resources, including the Nuiqsut Cultural Landscape are similar to those identified for Alternative A. Table 4.4-3 summarizes the number of cultural sites (AHRS and TLUI) within each of the direct, indirect and visual and noise impact analysis areas. In addition to the effects discussed above, additional effects from increased air traffic associated with this alternative would occur. Potential effects include indirect effect to culturally important hunting areas and sites through the deflection of subsistence resources, and additional visual and noise effects to culturally sensitive areas important for their remoteness or silence.

No cultural resources listed in the AHRS or TLUI databases are located within the direct analysis area of Alternative D. Five cultural resource sites listed in the AHRS and TLUI databases are located within the indirect effects analysis area for Alternative D; these five cultural sites are also within the indirect effect analysis area of Alternative C and are described above. Sixteen cultural resource sites listed in the AHRS and TLUI databases are within the 5-mile visual and noise impact analysis area for Alternative D;.these 16 cultural sites are also within the visual and noise impact analysis area of Alternative C and are described above. Potential visual and noise impacts are similar to those discussed under Alternative A; however, noise impacts may be higher under Alternative D due to the increased air traffic associated with this alternative in an area where air traffic was previously low.

Impacts on the Nuiqsut Cultural Landscape under Alternative D are similar to those discussed under Alternative A. However, because of the increased air traffic under this alternative, impacts related to noise may be higher, negatively affecting residents' experiences while conducting cultural activities within the landscape.

Impacts under Alternative E

No additional impacts to cultural resources would be expected under the No Action Alternative.

Mitigation

Design and operational features could help mitigate potential impacts to cultural resources. In addition to the protective measures of BLM (2013: E-13, I-1, K-1, K-2, L-1), and CPAI's built in design mitigation measures, the following measures are recommended for consideration in adopting mitigation to reduce impacts to cultural resources:

1. Conduct consultation or interviews with Nuiqsut residents regarding locations of previously unidentified cultural resources to help ensure that no unidentified cultural resources are adversely impacted by construction and operation activities and potentially assist in identifying the significance of sites and mitigating impacts.

2. For future cultural resource surveys, include knowledgeable Nuiqsut residents as cultural resources advisors during surveys prior to ground disturbing activity.

3. Conduct additional research with the community of Nuiqsut for further documentation and analysis of the Nuiqsut Cultural Landscape.

Summary and Comparison of Alternatives

Impacts on cultural resources are similar across all alternatives. When compared to Alternatives A and B, Alternatives C and D include five (Alternative C) and four (Alternative D) additional AHRS and TLUI sites within the indirect and visual and noise effects analysis areas. One of these additional sites is a large settlement containing numerous sod houses, a cemetery, storage pits, prehistoric artifacts, and modern subsistence debris. Alternative D would have greater impacts related to noise due to the increased air traffic under that alternative.

Although there are differences between the alternatives in terms of the number of cultural resources affected and the level of potential noise impacts, the nature and overall degree of impacts on cultural resources do not vary substantially by alternative. In contrast to the BLM (2004), the current analysis identifies that the intensity of potential impacts to cultural resources would be medium, because the impacts to the cultural landscape would result in a detectable alteration. This is supported by the documentation and recent update of the Nuiqsut Cultural Landscape (SRB&A 2013a) and consideration of the impacts of the project on this cultural landscape, which had previously not been assessed in either BLM (2004; 2012).

4.4.6 Land Use and Ownership

The proposed action (Alternative A) and Alternatives B, C, and D would result in impacts to land use during construction, operation, and drilling. These impacts are described in detail by BLM (2004, § 4B.4.6). The following discussion summarizes the impacts and is supplemented with information from BLM (2012) and the Point Thomson FEIS related to potential impacts to land use and ownership (Corps 2012, §§ 3.13.4 and 5.13).

Impact analysis criteria used in this assessment for land use and ownership are presented below in Table 4.4-4. These impact criteria were developed based on a range of possible outcomes and to provide a frame of reference for impacts. The potential impacts to land use and ownership would be the response needed by the landowners or managers based on the proposed project.

Land use in the project study area largely reflects ownership of the surface and subsurface resources. Land ownership is complex and has evolved since 2004 with additional surface land now owned by the Kuukpik Corporation (Village Corporation of Nuiqsut) and additional subsurface conveyed to ASRC. When the surface and subsurface have both been transferred out of federal ownership, the BLM waives management of the federal oil and gas leases. The State also owns both the surface and subsurface resources east of the NPR-A, as well as the beds of navigable waters such as the Colville River. Kuukpik also has selected surface acreage and ASRC subsurface acreage in the vicinity of the conceptual GMT2 facilities. BLM remains the manager of selected land until ownership has been conveyed. There is one Native Allotment in the project study area (AKFF 011723), approximately 1.5 miles east of Nuiqsut (see Figure 1.1-1).

As explained in BLM (2004), BLM continues to manage selections and land ownership options made under the provisions of ANCSA and ANILCA. The end result of the selection process is a transfer of ownership and management of the surface estate and subsurface estate to the village and regional corporations, respectively, which were established by ANCSA.

Table 4.4-4. Impact Criteria—Land Use and Ownership

Impact Category*	Magnitude	Definition
Intensity	High	Land owner must respond in substantial ways to the action—change in ownership (condemnation) or substantial change in management–major inconsistency with land plan that forces amendment of plan. Complete change in land use not anticipated in plans.
	Medium	Land owner must respond to the action, but response is minor, routine. Action is neither wholly consistent nor wholly inconsistent with existing plans. Substantial change in land use but anticipated in plans.
	Low	Land owner need not respond to action in any substantive way; action is substantially consistent with existing management plans. Substantially similar land uses.
Duration	Long term	Land use, ownership, or management changes are expected to last the length of the project and beyond (effectively permanent).
	Interim	Land use, ownership, or management changes may reasonably be expected to convert (or revert) to another use within less than the life of the project.
	Temporary	Land use, ownership, or management changes are expected to last through construction or some equally clearly limited time that is substantially less than the life of the project.
Context	Unique	The supply of land or water for an affected use or management category is constrained and is identified as having special, rare, protected, or unique characteristics in an adopted management plan.
	Important	The supply of land or water for an affected use or management category is moderately available, serves a specialized function but is not identified as having special, rare, protected, or unique characteristics in an adopted management plan.
	Common	The supply of land or water for an affected use or management category is extensively available, serves no specialized function and is not identified as having special, rare, protected or unique characteristics in an adopted management plan.
Geographic Extent	Statewide	Affects land use, ownership, and management over a large area—beyond the project study area.
	Regional	Affects land use in the project study area only.
	Local	Affects land use, ownership, and management in the immediate vicinity of the project footprint.

* See Section 4.1.1 Impact Criteria for term definitions

4.4.6.1 Construction

Human uses of the project study area fall into four main categories: subsistence and traditional uses by local residents, research, outdoor recreation, and industrial land uses associated principally with oil and gas construction and operations. Human use during construction would be low by comparison to urban and most rural areas.

During construction, land use in developed portions of the project study area would change. Human presence is most intense during construction. Common among the four action alternatives on land use include construction of gravel pads, pipelines, roads, and airstrips, from excavation of gravel mine sites, and installation of VSMs. Ice roads and ice pads will be constructed to assist in development of the project site infrastructure. All of this construction requires a labor force to complete the work.

Land within the western portion of the project study area (Figure 2.4-2) is generally natural in character, undeveloped, and roadless. The Alpine facilities are in the eastern portion of the study area, along with the village of Nuiqsut. The study area can be broadly characterized as the arctic lowlands on the ACP. Nuiqsut is the only community in the study area. Inupiat Natives use the study area for subsistence hunting, fishing, and gathering, as described in Section 3.4.3.

If there were a typical municipal or borough land use map for the North Slope, actual land use in the immediate vicinity of the project study area prior to the Alpine development would likely be classified as "vacant" or "open public lands." With the proposed project construction, the actual land use would change from primarily undeveloped land used principally for wildlife habitat, subsistence, research, and some recreation, to further oil and gas development (industrial use), which is consistent with the state's oil and gas management intent, including the state's certification order and the intent of the oil and gas and gas-only lease program. With the project construction, industrial land uses would dominate in the immediate vicinity of the project footprint.

4.4.6.2 Drilling and Operation

After the construction phase, drilling will occur at the drill site for up to approximately four years. After that, human presence will be determined by operation, maintenance, and inspection needs. These activities are within the range of development activities evaluated in the BLM (2004; 2012). Excluding mine site development, the Alternatives (A, B, C, and D) would directly impact varying amounts of land as described in Section 4.4.6.3, *Comparison of Alternatives*.

The BLM has determined the subsurface resources should be offered for oil and gas leasing with requirements for environmental protection and for due diligence to explore for oil and gas to maintain ownership of the lease. When a federal oil and gas lease is renewed, previous conditions are reviewed to see if they comply with current land use plans. For GMT1, federal oil and gas lease AA-87852 (Unit Case File Number) reflects stipulations in BLM (2008e). Surface uses on BLM land must meet the land use plan currently in effect, e.g. those best management practices in BLM (2013).

4.4.6.3 Comparison of Alternatives

Alternatives A through D include drill site development on federal land. The pipelines (from GMT1 to CD5) of Alternatives A, B, C, and D would cross both federal and private lands. The gravel access road in Alternative A, B, and C also would cross both federal and private lands; Alternative D has no gravel road access. The approximate distribution of federal and private land crossed by each of the alternatives is shown in Table 4.4-5. There would be no change in current land use west of CD5 and the Nuiqsut Spur Road associated with Alternative E because development of GMT1 would not occur.

Table 4.4-5. Land Ownership

Linear Component	Land Owner	Land Ownership (Approximate Percentage [%])			
		Alternative A	Alternative B	Alternative C	Alternative D
Pipeline Length GMT1 to CD5	Federal BLM	65%	62%	65%	65%
	Native Patent or IC	35%	38%	35%	35%
Gravel Access Road (GMT1 to CD5)	Federal BLM	66%	62%	29%	100%
	Native Patent or IC	34%	38%	71% a	0

IC = Interim Conveyed

[a] The 7 miles of gravel road to Nuiqsut comprising 5.8 miles of upgraded Nuiqsut Spur Road and 1.2 miles of new road to the Nuiqsut Airport is not included in the 71%. This Nuiqsut access road is all on Native land.

The various alternatives with different route and design elements make small changes in the amount of land use modification, from the current state of near natural to small areas of intense development for the purpose of hydrocarbon production. Development of GMT1 is consistent

with the IAP adopted by BLM in 2013 (BLM 2013). Impacts related to subsistence use of the area are described in Section 4.4.3.

Excluding mine site development, the action Alternatives (A, B, C, and D) would directly impact varying amounts of land: Alternative A impacts 72.5 acres, Alternative B impacts 79.3 acres, Alternative C impacts 97.5 acres, and Alternative D impacts 87.3 acres. The Clover site is currently natural in character, which will change if this source is mined. This site would be reclaimed under terms of the approved Mining and Reclamation Plan (Appendix I). The ASRC Mine Site is a commercial operation that has been mined for more than 15 years, and will continue to be mined as long as marketable gravel resources are available at the site. After mining, the ASRC Mine Site will be reclaimed under the terms of the approved Reclamation Plan.

4.4.6.4 Mitigation

The Applicant has included the following design measures as part of the project design to avoid or minimize impacts on land ownership, use and management:

- consulting with land owners or managers within or adjacent to the project area,
- ensuring project activities do not encroach upon Native allotment or Traditional Land Use sites through survey and demarcation, and
- avoiding any trespass or impact to any allotment.

Potential impacts to land use are also mitigated by design, and operational features described in Section 4.7. Adherence to lease stipulations and BMPs of BLM (2013) will reduce the impacts and total area of disturbance; these include: A-1, A-3, A-4, A-5, A-10, C-2, C-3, E-1, E-5, E-8, F-1, I-1, K-1(e) and K-1(g).

4.4.6.5 Conclusions

The direct effects of the four action alternatives on land use include construction of gravel pads, roads, and airstrips, from excavation of gravel mine sites, and installation of VSMs. The overall effects to land ownership, land management, and land use among the four action alternatives would be similar. Based on Table 4.4-5, and under all action alternatives, the intensity of land ownership, land management, and land use changes would be expected to be low to moderate, primarily because of the need for the Applicant to request exceptions to current BMPs. All changes would be of temporary to long-term duration. The geographic extent of changes would be local to the project area. The context of the land is common for all alternatives. While the context of the land is common, the land uses by the Applicant is dependent on their federal oil and gas leases. Overall, construction and operation of all the action alternatives would result in moderate effects to land use and ownership.

4.4.7 Recreation

The proposed action (Alternative A) and Alternatives B, C, and D would result in minimal impacts to recreation during the construction and operation. These impacts are described by BLM (2004, § 4F.4.7) and generally for the Northeast NPR-A (BLM 2008b, §§ 4.3.16, 4.4.16, 4.5.16, and 4.6.16) and the entire NPR-A (BLM 2012, § 4.3.16). The following discussion summarizes the impacts, and uses impact criteria from the Point Thomson FEIS related to recreation (Corps 2012a, § 5.18).

There are no public recreational facilities in the project study area. Existing recreational opportunities in the project study area are a function of the natural setting. Public recreational use in the project study area is low intensity and primarily represented by non-local visitors that float the Colville River between Umiat and Nuiqsut. The project study area offers opportunity, but limited access, for primitive unconfined recreation to backpack, sightsee, and hunt.

Limited access and the remote nature of the area inherently restrict the ability of the public and local residents to access outdoor recreational opportunities in the project study area. Under existing conditions, a person who does not live on the North Slope has limited access, with most recreational access currently originating by air on a chartered aircraft landing at or near their specific destination. From the landing spot, land access would continue by chartered aircraft during the summer or by snowmachine/dog sled during the winter. The proposed gravel road (Nuiqsut Spur Road) extending northward from Nuiqsut would provide pickup/car/ORV travel to the Alpine gravel road system (which can be used by the local population, but not outside recreational users) for subsistence activities and to the GMT1 vicinity in all but Alternative D. Except for winter ice roads, there is no road access between Nuiqsut and the Dalton Highway or any other airport. Construction in the project study area would have negligible effect on the limited recreation potential.

Impact analysis criteria used in this assessment for recreation are presented below in Table 4.4-6. These impact criteria were developed based on a range of possible outcomes and to provide a frame of reference for impacts.

Table 4.4-6. Impact Criteria—Recreation

Impact Category*	Magnitude	Definition
Intensity	High	Change in recreational environment, recreational opportunity, or the quality of the experience that would likely be felt by most recreationists in the area or contemplating use of the area; change that is likely to be controversial for users and/or land managers.
	Medium	Change in the recreational environment, recreational opportunity, or the quality of the experience that would likely be felt by some recreationists in the area; likely to generate little controversy for users or land managers.
	Low	Little or no evident change in the recreational environment, recreational opportunity, or quality of the experience.
Duration	Long term	Impact would be irreversible or so long term that no end would be known; there would be no plan for elimination of impact at end of project.
	Interim	Impact would last for several years but less than life of project, or known elimination of impact as part of the project's end.
	Temporary	Impact would last through project construction or similar clearly limited time frame that would be substantially less than the life of the project.
Context	Unique	Impacts to unique recreation opportunities and constraints.
	Important	Impacts to recreation opportunities and constraints within the locality or region protected by legislation.
	Common	Impacts to usual or ordinary recreation opportunities and constraints.
Geographic Extent	Statewide	Likely to be felt by recreationists beyond the local geographic extent (i.e., outside the Northeast NPR-A) e.g., by 'the idea' of loss of recreation opportunity; impact perceptible in the project study area in such a way as to change the recreation experience that is currently available.
	Regional	Extending beyond the project study area but within the northeastern part of the NPR-A
	Local	Within the project study area

* See Section 4.1.1 Impact Criteria for term definitions

4.4.7.1 Construction

Most construction features such as roads, pipeline construction, and gravel pad construction, would occur during the winter months to minimize effects on the tundra environment. Very little organized recreation occurs during these harsh winter months, and only limited recreation occurs in the area during the summer months.

During construction of any of the action alternatives, the extra activity and noise of mobilizing equipment to the site and the outdoor activity associated with gravel mining and construction of road, runway, and drilling pad embankments would make the site somewhat more conspicuous to recreationists than during drilling and operations.

4.4.7.2 Drilling and Operation

Similar to construction, drilling and operation would cause minimum effect on the limited recreation potential in the project study area. The drilling and operations phases for any of the action alternatives are expected to result in the same kinds of recreational impacts at the same intensity and geographic extent.

4.4.7.3 Comparison of Alternatives

Under all of the alternatives, residents of Nuiqsut will continue to have access to existing Alpine Field transportation facilities including limited access on winter ice roads.

BLM has determined that adverse effects to primitive recreational uses associated with a community generally are indistinguishable to users that are at least 5 miles distant from a community, and by inference, at least 5 miles from a permanent oil and gas facility (BLM 2012, § 4.8.7.19, pp 279 and 122). Impacts to primitive, unconfined recreation would have low intensity beyond 5 miles, a long-term duration, and localized spatial extent.

Alternatives A, B, C, D, and E would not provide year-around surface transportation to the Dalton Highway. Public access via road between the Dalton Highway and Umiat does not exist, but a road to Umiat that could provide public recreation access to the Colville River has been considered by the State. Alternatives A, B, C, and D would not affect a future decision on whether a road to Umiat is, or is not, constructed. Conversely, Alternative E would deny development of GMT1. This decision has the potential to adversely impact public access to Umiat for recreational use of the Colville River. The state road to Umiat could be delayed or abandoned due to the potential implication that remote oil and gas resources will not be approved by the responsible federal entities.

4.4.7.4 Mitigation

In the reasonably foreseeable future, development of oil and gas facilities is unlikely to change the overall number of visitors that would participate in outdoor recreation in the project study area.

BMPs and design features that would reduce the visual effect and noise could also reduce the area of effect on recreation, including: A-1, A-5, C-2, C-3, C-4, E-5, E-6, E-7, E-17, F-1, H-3, I-1, and M-2. Impacts are expected to be minor and within the range described in BLM (2004, § 4F.4.7).

4.4.7.5 Conclusions

Impacts to recreation are expected to be negligible as a result of all the alternatives. Recreation use in the project area could be negatively impacted under all of the action alternatives due to the presence of permanent facilities and associated noise. However these impacts would be common and only local in nature. The duration of impacts would be temporary to long term depending on the activity taking place. The impact intensity of the proposed project would be moderate as the change would be recognizable to a local subsistence user, but not necessarily an outside recreational visitor.

4.4.7.6 Wild and Scenic Rivers

The Colville River has been determined to be not suitable for inclusion in the National System; primarily because federal ownership stops at mean high water of the west bank of the Colville River and there is a general lack of support by the State and Native land owners of the river bed and the east river bank.

Alternatives A, B, C, and D would have no effect on existing or future potential of the Colville River to be added to the National Wild and Scenic Rivers System. Given the general priority for oil and gas resource exploration and development on the North Slope in this area, it is unlikely that Alternative E would increase the future potential that the Tiŋmiaqsiġvik (Ublutuoch) River or Fish Creek be added to the National Wild and Scenic Rivers System at some future date.

4.4.7.7 Wilderness

The project study area is not within a Federal designated Wilderness area, adjacent to an existing Wilderness Area, and does not include lands recommended for Wilderness designation. The Secretary of the Interior recommended that an area of NPR-A adjoining Gates of the Arctic National Park and Preserve Wilderness not be opened to oil and gas leasing that would otherwise forego potential Wilderness designation at some future date (BLM 2013d). At the same time, the BLM (2012 and 2013d) did not recommend existing CPAI oil and gas leases or other oil and gas ownerships be cancelled so the federal lands surrounding GMT1 could be added to the National Wilderness Preservation System. Adherence to lease stipulations and BMPs of BLM (2013) will reduce the impacts to wilderness characteristics; these include: A-1, A-4, A-5, A-6, C-2, C-3, E-5, F-1, I-1-, and M-2.

4.4.8 Visual Resources

This section discusses potential impacts to visual resources that could result from the proposed project. The level of impacts on visual resources will be based on levels of intensity, duration, extent and context as shown in Table 4.4-7.

These impact criteria were developed based on a range of possible outcomes and to provide a frame of reference for impacts.

Table 4.4-7. Impact Criteria—Visual Resources

Impact Category[1]	Magnitude	Definition
Intensity	High	Acute or obvious disturbance to visual resources.
	Medium	Noticeable disturbances to visual resources
	Low	Disturbances in visual resources may not be measurable or noticeable.
Duration	Long term	Impact would be irreversible or of such long duration that it appeared permanent; no plan for elimination of impact at end of project.
	Interim	Impact lasts for several years but less than the life of the project or known elimination of impact as part of the project's end.
	Temporary	Impact lasts through project construction or similar clearly limited time frame that would be substantially less than the life of the project.
Context	Unique	Impacts to unique visual resources or resources protected by legislation.
	Important	Impacts to visual resources within the locality or region or resources protected by legislation.
	Common	Impacts to usual or ordinary visual resources; not protected by legislation.
Extent	Statewide	Likely to be seen beyond 2.5 miles from project developments and across much of the project study area or farther.
	Regional	Likely to be seen within 2.5 miles.
	Local	Likely to be seen at close range within one-half mile.

[1] See Section 4.1.1, Impact Criteria for term definitions.

Based upon BLM (2013), approximately 8.4 million acres of federal land in the NPR-A including the GMTU are classified as VRM IV (see BLM 2013, Map 3). VRM IV is the least restrictive visual classification, allowing high relative change to the existing visual character of the area. Developments in VRM IV may attract attention and dominate the view, but are still mitigated. The buffer around the proposed project also crosses into an area classified as VRM III; the area of land located in the area classified as VRM III varies by alternative. VRM III is more restrictive than VRM IV, with the objective of retaining the existing character of the landscape while allowing moderate changes. VRM considerations do not apply to land owned by the Kuukpik Corporation within NRP-A. Until transferred from BLM ownership, pending valid selections by the Kuukpik Corporation continue to be managed by BLM (i.e., VRM considerations will apply).

Oil and gas activities, including the action alternatives would change the existing undeveloped visual character of federal land in the project study area, but still be consistent with VRM IV. The BLM (2004a) approved the authorization of the proposed GMT1 Project, and BLM (2013) assumes that GMTU, and specifically GMT1, would be developed under the lease stipulations, and BMPs described in Section 4.7. There has been little change in the existing or prospective use of the project study area for oil and gas or other uses that could impact visual resources of federal land in the project study area that were not considered in BLM (2004; 2004a) and the subsequent authorizations for construction and operation of production facilities in the Alpine Field that were contemplated in 2004. The BLM (2012; 2013) considered the visual resources associated with: the development facilities constructed since 2004, and assumed the GMTU would be developed by both the GMT1 Project and the conceptual GMT2 Project. The proposed GMT1 Project has only been slightly modified from the project authorized for permitting in BLM (2004a).

4.4.8.1 Construction

Under the action alternatives the presence of drill rigs would be the most noticeable and direct effect of construction. During the summer season, when drilling is operational, the drill rig would create a moderate contrast when viewing from a distance of 5 miles or less, resulting in an interim adverse impact. During the summer season when there is adequate daylight, drill rigs would introduce vertical lines and dominate the landscape. Other activities such as pad construction and road construction would have a minor impact as construction activities would occur in winter when snow and darkness make viewing activities difficult.

4.4.8.2 Drilling and Operation

Production pad facilities would introduce a strong contrast with the natural landscape. Most buildings associated with the action alternatives are less than three stories high. However, communication towers can be as much as 200 feet high, in contrast to the predominant horizontal line of the surrounding landform. These facilities would also contrast in color with natural vegetation. Bridges across water bodies and pipelines would repeat the horizontal line of the landform but would contrast with the colors in the surrounding landscape. Emergency response containers strategically placed along channels would also contrast with the colors of the surrounding landscape.

Lighting on tall structures could have a negative impact unless design criteria were included, such as directing artificial light inward and downward, rather than upward and outward. BMP E-10 requires artificial exterior lighting to be directed inward and downward from August 1 through October 31.

4.4.8.3 Comparison of Alternatives

Alternative B essentially would have the same impact on visual resources as the proposed GMT1 project (Alternative A). Alternative B includes more gravel road and pipeline system. Alternative C also would be similar, but would increase the footprint of the Nuiqsut Spur Road and Nuiqsut Airport. Both the Spur Road and the Nuiqsut Airport are on non-federal land and not subject to VRM IV development considerations. Alternative D would eliminate the visual impact of a gravel road to the GMT1 pad but would include an elevated pipeline. This would be counterbalanced by the establishment of a 5,000-foot gravel airstrip and instrumentation for all-weather aircraft use. Alternative E would have no effect on the existing VRM IV classification.

4.4.8.4 Mitigation

The BLM (2004) recommends mitigation that would blend structures and permanent facilities into their surroundings and reduce impacts from lighting on facilities over 20 feet high. Potential mitigation measure for visual resource impacts, as described in BLM (2004), including:

> *"All structures would be painted to blend with the natural environment. All colors would be pre-approved including emergency spill containers along river channels. BLM will use computer-generated colors to determine the color for structures that blend in best with the background colors of the natural landscape and may do a color test onsite. Self-weathering steel, or best management practice, will be used on all metal structures not otherwise painted, including but not limited to pipelines, communications towers and drill rigs, thus providing a more natural color of brown."*

Adherence to lease stipulations and BMPs of BLM (2013) will reduce the impacts and total area of disturbance; these include: A-1, A-3, A-4, A-5, A-6, C-2, C-3, E-5, E-17, F-1, I-1, and M-2. BMP E-17 requires the Applicant to submit a plan to the BLM to describe how they will minimize visual impacts consistent with the VRM class for the lands on which facilities would be located.

4.4.8.5 Conclusions

Overall, construction and operation of all the action alternatives would result in moderate effects to visual resources. Pad and road construction activities would have a minor impact as these activities would occur in the winter when snow and darkness make viewing more difficult. Summer introduces more daylight and increases the opportunities for viewing operational activities. Facilities and structures would introduce a moderate contrast with the natural landscape when viewed from the foreground-middle-ground zone. For Alternatives A through D, the effects would be of medium intensity, common in context, with temporary to long-term duration, and ranging in extent from local to regional. There would be no impacts to visual resources under Alternative E.

4.4.9 Local Transportation

Impact analysis criteria used in this assessment for transportation systems are presented below in Table 4.4-8. These impact criteria were developed based on a range of possible outcomes and to provide a frame of reference for impacts.

Table 4.4-8. Impact Criteria—Local Transportation

Impact Category[1]	Magnitude	Definition
Intensity	High	Acute or obvious change in air or land transportation volume.
	Medium	Noticeable change in air or land transportation volume.
	Low	Change in air or land transportation volume may not be measureable or noticeable.
Duration	Long term	Impacts would continue for the life of the project.
	Interim	Impacts would last more than one phase of project development.
	Temporary	Impacts would last for a single phase of project development.
Context	Unique	Impacts to unique transportation opportunities and constraints.
	Important	Impacts to transportation opportunities and constraints within the locality or region protected by legislation.
	Common	Impacts to usual or ordinary transportation opportunities and constraints.
Extent	Statewide	Affects transportation volume beyond a regional scale.
	Regional	Affects transportation volume on a regional scale, outside of the project study area.
	Local	Within project study area

[1] See Section 4.1.1, Impact Criteria for term definitions.

4.4.9.1 Construction

Under Alternatives A, B, and C, the construction activities would vary by season, but most construction traffic would occur on industry-constructed ice roads with no public access. Minor impacts to local transportation are anticipated from these alternatives. Most construction in the vicinity of rivers would occur during winter until gravel roads and bridges have been installed. Construction activities may interfere with some winter travel on frozen channels, but this impact would be interim, lasting only during the construction phase. Travel needs of local residents could be allowed through construction areas.

Alternative D would not have road access to the drill site and would rely solely on ice roads and aircraft transportation. The estimated number of flights during construction is summarized in Table 2.4-3.

4.4.9.2 Drilling and Operation

Operation of the facilities under the action alternatives would result in lower levels of traffic than is anticipated during construction. Road traffic would be limited to the transportation of personnel and supplies between GMT1 and APF. The regional and statewide transportation systems have adequate capacity to accommodate the level of activity anticipated during construction and operation of the GMT1 Project.

4.4.9.3 Comparison of Alternatives

In general, all the action alternatives would impact common transportation opportunities and constraints within the region, which include both air and land transportation modes.

Transportation components are similar under Alternatives A, B, and C, linking GMT1 to existing infrastructure by a gravel access road. There would be impacts of low intensity, interim duration (limited to the construction phase), and regional extent. The proposed Nuiqsut Spur Road would link Nuiqsut by gravel road to the proposed CD5 road and GMT1 access road. If constructed, residents of Nuiqsut would have an additional local transportation option available, particularly during times outside of the ice road season (approximately February through May).

Under Alternative C transportation infrastructure would be enhanced at the Nuiqsut Airport including a runway extension, a logistics pad and apron, and a new airport access road to direct project-related traffic around the community. The proposed Nuiqsut Spur Road would be widened to accommodate project-related traffic. Air traffic at Nuiqsut would increase as workers and supplies are flown in for delivery to the project construction sites and facilities. Commercial flights at Nuiqsut may increase as a result of greater demand, depending on the volume and the decisions of private aviation companies.

Under Alternative D, there would be no road connection with the GMT1 drill site and all access would be by ice road and aircraft. The number of flights required to service the limited access drill site during construction and drilling are summarized in Table 2.4-3, which indicates a large increase in air traffic would occur in the APF airstrip and in the regional airspace between APF and GMT1. The increased air traffic to service the GMT1 drill site under Alternative D would be mostly small, fixed-wing aircraft. Helicopter flights would more than double under Alternative D, mostly to transport special studies personnel that would otherwise travel by road under Alternatives A, B, or C; these include flights to perform work required by permits; most are necessary during the summer season when fish, wildlife, and other resources can be monitored. Overall, impacts to local transportation under Alternative D are expected to be medium intensity, long-term duration, and of regional extent.

Under Alternative E, no new transportation components would be added and there would be no impact to local transportation. Opportunities for gaining road transportation to access subsistence use areas would not be realized.

4.4.9.4 Mitigation

The transportation components of GMT1 are designed and located to tie into existing transportation infrastructure without additional modification. The road will extend only to the

production facilities at Alpine, but not to an existing network. The GMT1 access road will also connect with the Nuiqsut spur road allowing local residents to travel an additional 7.8 miles into the NPR-A for subsistence hunting and fishing.

Potential impacts to transportation are also mitigated by design, and operational features described in Section 4.7. Adherence to lease stipulations and BMPs of BLM (2013) will reduce the impacts and total area of disturbance; these include E-1, E-5, and F-1. The Applicant's Draft Aircraft Transportation Plan is provided in Appendix J.

4.4.9.5 Conclusions

Overall, impacts to local transportation, including hydrocarbon transportation, are expected to be minor under Alternatives A, B, and C. Impacts would be moderate overall for Alternative D, due to the increased demand for air transportation service to transport personnel and equipment to a GMT1 drill site that is not accessible by gravel road. Alternative E would have no impacts to local transportation. For Alternatives A through D, the effects would be of medium intensity, common in context, with temporary to long-term duration, and regional in extent. This determination is based primarily on transportation of produced hydrocarbon from GMT1, which will have a beneficial effect by assuring continued operations of existing facilities (APF). These impacts are within the range of impacts analyzed by BLM (2004; 2012).

4.5 Impacts of Oil, Saltwater, and Hazardous Material Spills

This analysis tiers to information presented in BLM (2004) and updates that information with an analysis of the most current spill information obtained from the ADEC spills database of all spills to the Alpine Field, along with an analysis performed for the CPAI Alpine Participating Area Development Oil Discharge Prevention and Contingency Plan (ODPCP) document that addressed potential spills of more than 55 gallons, as required per ADEC regulations. BLM (2004, §§ 3.1.2 and 4.3) and BLM (2012, § 3.2.11) provide resource-specific spill-related impact assessments for the proposed GMT1 Project. Each document also provides detail on the factors affecting the fate and behavior of spilled oil.

4.5.1 Background

A complete spills analysis was conducted for BLM (2004, § 4.3). A description of the rate, behavior, and potential impacts of spills in a variety of spill scenarios was provided, along with a review of the 30-year spill history of the North Slope occurring in environments similar to the proposed GMT1 Project. The type of material or product likely to be spilled and the primary causes and sources of spills were identified. As stated in BLM (2004), many prior documents have described the rate, risk, probability, and impacts of oil and hazardous material spills on the North Slope, and although each spill scenario is different and each document provides different details, the basic data and conclusions were found to be similar.

Basic assumptions were used in the impact assessment in both the BLM (2004) analysis and the BLM (2012) analysis, including spill size classification. The size classifications are similar to those used by ADEC when they respond to and evaluate spills of oil and hazardous materials. To describe the impacts of spills, BLM (2004) used the following spill size categories:

- Very small spills – less than 10 gallons (0.24 bbl)
- Small spills – 10 to 99.5 gallons (0.24 to 2.4 bbl)

- Medium spills – 100 to 999.5 gallons (2.4 to 23.8 bbl)
- Large spills – 1,000 to 100,000 gallons (23.8 to 2,380 bbl)
- Very large spills – greater than 100,000 gallons (greater than 2,380 bbl)

The BLM (2012) updated the data provided in the BLM (2004) analysis, including the spill size classifications that were used. The BLM (2012) analysis provides three spill-size categories:

- Small spills – less than 500 bbl
- Large spills – 500 to 120,000 bbl
- Very large spills – 120,000 bbl or more

Based on the 34 years of North Slope experience, both the 2004 and 2012 analyses found that the vast majority of spills have been less than 10 gallons or between 10 and 100 gallons, and were contained within secondary containment or on gravel pads and roads. Impacts caused by spills to natural resources of the North Slope have been limited in area, duration, and size. Large spills were determined to have low probability.

One key conclusion discussed in the BLM (2004) analysis describes a generally decreasing trend in the volume of oil and saltwater spills occurring on the North Slope over the more than 30-year oilfield operating history. The BLM (2012) updated this information, which includes a 2006 spill from a crude oil transit line at GC-2 at Prudhoe Bay. The GC-2 spill resulted in the release of over 200,000 gallons of crude oil spilled to tundra and frozen lake surface (ADEC 2008). The spill volume was large, because it was a small leak from a low-pressure line that went undetected for some time. According to BLM (2012), the same conditions that allowed it to continue undetected (snow cover and low temperatures) limited the spread of oil and environmental impact to approximately two acres. To date, this is the largest spill to occur on the North Slope, other than saltwater spills.

The BLM (2004) analysis determined that most spills, except those from pipelines, would occur and be contained on or immediately adjacent to the ice or gravel pads, roads, and airstrips, and would generally be cleaned up before reaching the tundra or water bodies. There is greater potential for pipeline spills to reach open water if a leak or pipeline break were to occur at a river crossing, especially during ice-free seasons.

4.5.2 Construction

Spills related to construction activities are relatively small volume and primarily result from vehicle and construction equipment fueling and maintenance. A tanker truck accident or a fuel storage tank failure would be the most likely source of the largest construction spills, while spills from blowouts, pipelines, uncontrolled releases, or facility accidents would not occur during construction (BLM 2004).

4.5.3 Drilling and Operation

Spills that could occur during drilling and operation phases could potentially result in larger-volume spills, but these types of spills are not likely to occur.

The Alpine ODPCP, which received renewed approval in February 2013, provides results of analyses of spills greater than 55 gallons at Alpine between facility startup in 1998 and June 2012. This information only covers spills 55 gallons and greater as required by ADEC 18 AAC 75. Results of the analysis indicated that equipment difficulties accounted for most spills at

Alpine. Most spills were small events that were contained on gravel pads and rarely reached the tundra or water environment. Sources with the highest percentage of spill incidents were tanks (36 percent) and heavy equipment/mobile equipment/vehicles (23 percent), followed by pipelines (9.1 percent). The largest percentage of spill volume was from tanks (40 percent) and from heavy equipment/mobile equipment/vehicles (19 percent). Spills from pipelines made up a smaller percentage of spill volume at 5.9 percent.

4.5.3.1 Spill Scenario Modeling

CPAI will amend its Alpine ODPCP to include the GMT1 Project if development proceeds as proposed. A hypothetical spill of an uncontrolled well blowout is described in the current Alpine ODPCP. The Response Planning Standard (RPS) for the spill scenario is 30,000 bbl, or 2,000 bopd for a duration of 15 days.

ADEC regulations governing the ODPCP (18 AAC 75) require modeling to show where dispersed oil would be most likely to fall within the environment (trajectory analysis). This involves consideration of prevailing wind direction (wind direction is taken from the nearest available wind monitoring station). For the proposed GMT1 project the nearest wind monitoring station is in Nuiqsut. The RPS scenario in the Alpine ODPCP describes a hypothetical well blowout at CPAI's CD2 Pad. The plume dispersion model is from SL Ross, which projects that the oil takes the form of an aerial plume extending from the well in the direction of predominant winds. Using wind data derived from the Nuiqsut Air Quality Monitoring Program, the predominant winds are from the NE, ENE, and E. Therefore; the hypothetical blowout would discharge 30,000 bbl to the W, WSW, and SW of the CD2 Pad. The model predicts the following plume dimensions:

- Approximately 80 percent of the discharged oil falls within 600 feet downwind of the well. At that distance, each fallout plume is about 119 feet wide.
- Approximately 90 percent of the discharged oil falls within 4,175 feet (0.8 mile) downwind of the well. At that distance, each fallout plume is about 684 feet wide.
- According to the SL Ross model, 10 percent of discharged oil is in the form of droplets so small (50 micrometers or less) that they do not fall to the ground. As a conservative measure for response planning purposes, the volume of oil that is predicted to stay aloft is proportionately distributed between the two modeled fallout zones. Consequently, the conservative scenario addresses the full RPS volume of 30,000 bbl.

For this scenario, approximately 80 percent (23,333 bbl) of the discharged oil falls on the pad, while approximately 6,667 bbl of oil falls beyond the pad. The average thickness of the oil deposited off pad is 0.7 inch. This would be considered a very large spill (under size classification of the BLM (2004); however this type of release is considered to be highly unlikely.

Between 1998 and 2013, the largest reportable spills from Alpine Field were a seawater spill in 2002 of 4,998 gallons, and a produced water spill in 2013 of 1,560 gallons. The largest oil spill reported by CPAI was 840 gallons of diesel at CD1 Pad in 2008. The cause was a tank overflow resulting from a fitting connection not being fully closed. Most of this spill occurred to secondary containment, with only 0.5 gallon reaching outside of containment.

4.5.4 Comparison of Alternatives

For the proposed GMT1 Project (Alternative A), the largest pipeline river crossing would occur at the Tiŋmiaqsiġvik (Ublutuoch) River, where a 350-foot-long bridge is proposed. The Tiŋmiaqsiġvik (Ublutuoch) River is the only perennial stream that would be crossed by the

GMT1 access road and is a tributary to Fish Creek. A potential spill to the river would have to reach the Fish Creek delta at Harrison Bay to impact marine mammals. The Tiŋmiaqsiġvik (Ublutuoch) River is a slow moving, meandering river, with many oxbows, allowing for opportunities to intersect the majority of oil before it could travel to Fish Creek, or farther to the Fish Creek delta. Seals do not occupy the Tiŋmiaqsiġvik (Ublutuoch) River, but spotted seals may occur in the Fish Creek delta (see Section 3.3.4).

If a large spill reached Harrison Bay, it would not likely affect bearded seals, walruses, beluga or gray whales because these species mostly occur offshore in Harrison Bay (BLM 2004). An oil spill resulting from development would be unlikely to occur in the marine environment, or to reach typical bowhead whale migration habitat from onshore locations (BLM 2012). Any large spill would be expected to disperse before it reached migration routes and offshore habitats of these species. Polar bears would be most vulnerable to an oil spill that reached coastal habitats of Harrison Bay, but the potential for this occurrence from the GMT1 Project is extremely low.

In terms of pipeline access for the purposes of surveillance monitoring and repair, most of the pipeline under Alternative A follows the proposed GMT1 access road, allowing easy year-round access. Over the more than 30-year history of oil industry operations on the North Slope, operators have been more likely to inspect pipelines more frequently if they are easily accessible (Corps 2010). The small portion (less than a mile) of pipeline that does not closely follow the proposed road system would not be easily accessed. Surveillance for this portion of the pipeline could be done with snowmachine or ATV, if mobilization of a helicopter was not feasible.

To be as effective as possible, elevated pipelines should be separated at or beyond the recommended minimum distances of 500 feet from roads (Cronin et.al., 1994). Likewise, if the pipeline is greater than 1,000 feet from the road, the benefits of co-locating the pipeline with the road are reduced. Approximately 1.5 miles of pipeline is more than 1,000 feet from the road.

A resource-specific impact assessment on oil spills is discussed in BLM (2004 § 4.3.3).

Alternative B

This alternative is similar to Alternative A, except that the road and pipeline would be located to the south, avoiding the Fish Creek setback. It increases the footprint by increasing the distance of the access road in order to remain outside the setbacks established for Fish Creek, and waterbodies on federal land in the NPR-A. Under this alternative, the pipeline closely follows the access road from GMT1, south of lakes L9820 and L9819, to the western valve pad at the Tiŋmiaqsiġvik (Ublutuoch) River crossing, then follows the preferred alternative route, keeping the route entirely out of the Fish Creek buffer zone. Similar to Alternative A, this option places the road next to the pipeline allowing for easier access by operators for pipeline surveillance, monitoring, repair, and emergency response, and thereby potentially increasing the frequency of inspections by operators.

Alternative C

Similar to Alternative A, this option places the road next to the pipeline allowing for easier access by operators for pipeline surveillance, monitoring, repair, and emergency response, and thereby potentially increasing the frequency of inspections by operators.

Additional road access and connection to facilities by gravel road under the Nuiqsut Alternative Access would increase the options to move resources from APF or Nuiqsut in the event of a spill response.

Alternative D

Under Alternative D, transportation to GMT1 from the existing APF would be via aircraft approximately nine months of the year (May through January, and via ice road approximately three months of the year: February through April). The ice road would roughly parallel the pipeline for easy access. The pipeline route would run from GMT1 to CD5, with a portion of the pipeline crossing into the Fish Creek setback. A portion of the pipeline would also cross through the Tiŋmiaqsiġvik (Ublutuoch) River setback.

Ice roads would be required annually to access GMT1 during winter. Additionally, a 5,000-foot airstrip with apron and access road to the drill pad would be constructed at GMT1.

This alternative would require a larger footprint in part because of additional storage, including fuel storage at the GMT1 pad and possibly the new airstrip, and to accommodate additional infrastructure. This alternative would also require the addition of a 2-inch diesel pipeline added to the production pipelines along the same route to GMT1. The additional pipeline could increase the opportunity for spills to occur by adding another product line as more volume of oil passes through the cable trays.

There are two types of pipeline access needed by an operator; one for daily operations (for activities such as inspection, monitoring, repairs and modifications, testing, pigging, and construction), the other for emergency response (for response to a spill, security, leak mitigation, emergency repairs, emergency access to equipment or valves, and fire fighting). Quick access can mitigate environmental impact from all of these (Corps 2010, POA-2005-1576).

The limited access provided under Alternative D would complicate spill response. Tundra travel can be difficult during winter and more difficult during summer, and must be done by low ground pressure vehicles. Without a road to follow the pipeline for easy access, aircraft would be required for pipeline monitoring and surveillance.

Spill response equipment would be stored at the GMT1 pad and at the proposed airstrip to be used in the event of an emergency response. An approved Class 1 disposal well and injection pump module would be located at the GMT1 drill site.

Waste Disposal

Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil and natural gas are solid wastes that are not hazardous waste in accordance with 40 CFR §261.4(b)(5). Any other hazardous waste generated at the facility is subject to the hazardous waste regulations under Sections 3001 through 3019 of the Resource Conservation and Recovery Act (RCRA) (42 USC 3251 et seq.).

In the event of an oil spill there may be a need for temporary storage of oil, oily waste, and debris recovered during a spill cleanup. The spill location or other logistical concerns, in the event of a roadless alternative, may require the use of small, portable containers that can be mobilized via truck or aircraft to the nearest disposal facility.

Numerous options are available at North Slope facilities for the recycling of recovered hydrocarbons. Injection well disposal of Class I fluids is available at the Alpine Development and at Pad 3 in the Prudhoe Bay Unit, and would be included in the limited access alternative infrastructure. Injection well disposal of Class II solids is available at the Grind and Inject Facility in Prudhoe Bay Unit, and Class II wells for liquids disposal in Alpine and Kuparuk. If materials need to be transported off the North Slope, truck, and/or air transportation would be arranged.

4.5.5 Mitigation

The likelihood of an onshore spill reaching marine waters is greatly reduced through several mitigation measures included in Stipulations K-1 through K-6, which require contingency planning, include set-back requirements, and deal with the handling of fuel and other pollutants (BLM 2012).

Several BMPs were developed to minimize impacts of the proposed project from contaminants. The BLM (2013) provides BMP A-3, which has the objective of minimizing pollution through effective hazardous-materials contingency planning prior to transportation, storage, or use of fuel or hazardous substances. BLM (2013) also provides BMP A-4, which has the objective to minimize the impact of contaminants on fish, wildlife, and the environment, including wetlands, marshes and marine waters, as a result of fuel, crude oil, and other liquid chemical spills. This requirement includes the development of a comprehensive spill prevention and response contingency plan, which shall include items such as on-site clean up materials, storage containers with secondary containment, container identification and labeling, liner materials, fueling stations, and reporting spills. BMP A-5 has the objective to minimize the impact of contaminants from refueling operations on fish, wildlife and the environment. This requirement includes setbacks for refueling of equipment and fuel storage near water bodies (BLM 2013).

Facilities that must have an ADEC-approved ODPCP must also meet oil discharge prevention requirements. Required prevention measures include training programs, operating procedures, monitoring, inspections, and equipment/facility specifications such as leak detection systems. Design specifications are also required under these state approved plans. For example, pipelines are designed to ASME Codes B31.4 (oil and water) and B31.8 (gas).

CPAI North Slope operations employ several measures to minimize and mitigate the occurrence of spills. A “Root Cause Failure Analysis” investigation process occurs for significant spills and corrective actions are taken based on the analysis by the review team. Lessons learned are then shared with supervisors and workgroups. CPAI promotes spill prevention by encouraging proactive involvement and knowledge sharing though spill prevention programs and awareness training or communications.

CPAI provides new-employee orientation on health, safety, and environmental issues, annual environmental training seminars, and appropriate certification classes for specific activities, including spill prevention and response, as noted above. All North Slope employees and contractors are required to complete an 8-hour unescorted training program. All trainees in that program receive a Field Environmental Handbook and an Alaska Safety Handbook. Project specific training is provided for all personnel working in the NPR-A. A key objective of this program is to increase awareness of the environmental, social, and cultural issues that relate to the NPR-A. This training emphasizes protection of archaeological and biological resources, avoiding conflicts with subsistence activities, relevant health and safety measures, and project mitigation commitments.

In the event of a pipeline failure, CPAI Operations personnel isolate the damaged section by closing the necessary valves to prevent further discharge from production or backflow potential. Manual isolation valves, to be located on each side of the Tiŋmiaqsiġvik (Ublutuoch) River, will minimize potential spill impacts in the event of a leak or break by isolating the production pipeline across the bridge. Another manual valve will be located on a gravel pad adjacent to the gravel road, approximately 1,700 feet west of the Tiŋmiaqsiġvik (Ublutuoch) River bridge. A similar valve will be located approximately 700 feet east of the Tiŋmiaqsiġvik (Ublutuoch) River bridge. These valves comply with mitigation adopted in BLM (2004, p. 23).

Reaction time to isolate pipeline sections varies and is a factor in predicting spill volume potential. Continuous production from drill sites is stopped when low pressure is sensed as a result of the failure. It is unlikely an entire pipeline volume would be drained, due to the frequent elevation changes associated with routing of pipelines, as well as the planned installation of automatic valves at GMT1 and the CD5 tie-in, and manual valves on either side of the Tiŋmiaqsiġvik (Ublutuoch) River.

The general spill prevention and response for the Alpine area includes several sites for boom pre-deployment. CPAI's primary response action contractor, ACS, has pre-staged equipment in containers by the Nigliq Channel crossing. ACS would deploy diversionary and exclusion boom immediately downstream of pipeline crossings over rivers. This line of defense could also be implemented for the proposed GMT1 Project, along with the BLM stipulations and BMPs for spill prevention.

Due to seasonal changes of the river channels and weather conditions causing fluctuating river currents, specific boom configurations and exact lengths of boom pre-deployed at each site may vary. At each pre-deployment site, sufficient boom sections and anchors are utilized to traverse the water body in a manner that optimizes its intended use for containment, diversion, exclusion, and/or recovery.

Oil spill responders would be able to reach production pads by several means. Primary spill responders would come from CD1 and from ACS, with additional resources available from Kuparuk Oilfield, the Nuiqsut Village Response Team, and mutual aid providers.

Additional information on spill response resources is provided in BLM (2004, § 2.3.4.2).

BLM received new potential mitigation measures from the public during scoping, which would be considered in addition to the mitigation, prevention and response measures described above. BLM will determine whether to adopt new potential mitigation measures in the Record of Decision. These new Potential Mitigation Measures would update BMP's A-4 and A-3, and include:

New Potential Mitigation Measure 1 – Fuel Storage (new subparagraph to BMP A-4)

Objective: Minimize the impact of contaminants on fish, wildlife, and the environment, including wetlands, marshes and marine waters, as a result of fuel, crude oil, and other liquid chemical spills. Protect subsistence resources and subsistence activities. Protect public health and safety.

Requirement/Standard: Fuel and hazardous material storage containers with a capacity greater than 660 gallons must use impermeable lining and diking capable of containing 110 percent of the containers' capacity. Vinyl liners, with foam dikes and a capacity of 25 gallons, must be placed under all valves or connections to fuel tanks when located outside of secondary containment. Fuel and hazardous material tanks and containers on ice or gravel pads must be 100 feet away from the edge of the pad, or if the pad is less than 200 feet long or wide, tanks must be centered.

Potential Benefits and Residual/Unavoidable Impacts: Potential benefits of these added measures above current protections include additional protection for vegetation, wetlands, and other surface resources by locating potential spill sources away from the edges of the pad, and using liners for protection outside of secondary containment.

New Potential Mitigation Measure 2 – Oil Spill Response Equipment (new subparagraph to BMP A-3)

Objective: Minimize pollution through effective hazardous-materials contingency planning.

Requirement/Standard: Oil spill response equipment must meet the following standards:

- Equipment must be designed in accordance with standard arctic engineering practices for use in arctic conditions;
- Mechanisms must be available to prevent the freezing of response equipment (including the equipment used for storing, transferring, and treating recovered fluids) and/or to de-ice it;
- Equipment must be capable of tracking and recovering oil spills in dark conditions, on snow surfaces, and under solid ice.

Potential Benefits and Residual/Unavoidable Impacts: Potential benefits of these added measures above current protections include additional protection for vegetation, wetlands, and other surface resources by ensuring response equipment is operational under extreme weather conditions and other limiting factors such as low light and ice and snow conditions.

New Potential Mitigation Measure 3 – Facility Equipment and Design Criteria (new subparagraph to BMP A-3)

Objective: Minimize pollution by ensuring adequate facility design criteria and system integrity.

Requirement/Standard: Equipment used to develop hydrocarbons must meet the following standards:

- Equipment must be designed in accordance with standard arctic engineering practices for use in arctic conditions;
- Design criteria must be based on actual measurements of the worst-case data in recorded history for the exploration or development site, or based on conservative estimates (as determined by the authorizing officer).

Potential Benefits and Residual/Unavoidable Impacts: System integrity is essential for spill prevention, but not all integrity requirements are within the scope of Oil Spill Contingency Planning. Potential benefits of these added measures above current protections include additional protection for vegetation, wetlands, and other surface resources by ensuring facility design and system integrity are suitable to harsh arctic environmental conditions.

New Potential Mitigation Measure 4 – Spill Prevention and Response Plan (new subparagraph to BMP A-3)

Objective: Minimize pollution by ensuring effective hazardous-materials contingency planning.

Requirement/Standard: The spill prevention and response plan must include the following:

- The spill prevention section must contain: design criteria to prevent and detect slow leaks; all spill prevention programs in place to inspect, maintain and repair all equipment; a description of the age and condition of equipment; spill prevention methods and operating restrictions for periods when response is not possible; and policies protecting whistleblowers.

- The spill response section must contain: specific response measures which must be immediately taken when a spill is reported or detected; a detailed, probabilistic risk assessment of a very large volume spill and a most likely trajectory for various environmental conditions related to a catastrophic spill; a list of response equipment proven in the arctic; training programs for responders and contractors; and proof of contract(s) with well control experts, personnel and equipment.
- An emergency countermeasure plan must include well capping if technically feasible, and a Blowout Prevention (BOP) System capable of handling 150 percent of the maximum anticipated surface pressure. All wells must be secured with at least two independent pressure tested flow barriers prior to removing the BOP. The BOP must have two sets of blind shear rams to prevent failure, and must be tested weekly to ensure proper functioning.

Potential Benefits and Residual/Unavoidable Impacts: Many of the requirements are within the scope of Oil Spill Contingency Planning, but not specifically required under current regulations. System integrity will help prevent spills from occurring, while planning for organized and adequate response equipment and personnel will help ensure fast and proper cleanup. Potential benefits of these added measures above current protections include additional protection for vegetation, wetlands, and other surface resources by ensuring effective prevention of a spill, as well as planning for proper controls in the event of a spill or blowout.

4.5.6 Conclusions

The direct effects of oil spills under each of the potential action alternatives are similar, with the greatest impacts resulting from spills to water. The spill history for the Alpine Unit shows the primary type of spill was from equipment failure. Most of these spills have occurred to a pad area or containment and resulted in minor impacts with low intensity, short duration, and limited extent. A spill that reached water could have major impacts if subsistence resources were affected. However, the likelihood of this is very low with the many prevention measures that would be in place.

Alternative D would have the greatest potential risk of a spill or leak reaching fish bearing or marine waters before detection or before response teams could be mobilized to the spill site, given its limited access.

Localized impact may occur from oil or hazardous material spills. The potential impacts may be greater if oil is sprayed under high pressure into the air creating plumes to land and/or water.

The BLM (2004) analysis determined that large spills that directly or indirectly enter flowing water of the rivers or creeks that discharge to Harrison Bay, the Colville River delta (including the Nigliq Channel), and Kogru River mouth could have limited impacts on some marine mammals. Likewise, the BLM 2012 analysis found that chances were higher for oil to reach the marine environment if a spill occurred near a major river drainage or near coastal areas.

Oil spilled on land could also enter lakes or ponds and could be contained by the banks of those water bodies. Because cold water increases the viscosity of oil in water, this could restrict oil spreading on the water surface. If a spill were to enter moving water such as rivers and streams, spreading of oil would be dependent on the velocity or surface currents of the moving water (BLM 2012).

Fate and behavior of spills, and how spills would act during different seasonal conditions is described in BLM (2004, § 4.3.2.3). Potential Pipeline Spill Volumes are detailed in BLM (2004, Table 4.3.3-1).

The greatest defense against larger impacts from oil spills is prevention and countermeasures. As discussed under mitigation measures, CPAI places a high priority on spill prevention, which is integrated into their existing programs. From initial design to regular inspections, preventative maintenance, training and root cause analysis, and pre-staging of equipment, CPAI is continually evaluating their programs to optimize their defenses against oil spills and minimize the impacts should an oil spill occur.

4.6 Cumulative Effects

As defined by Council on Environmental Quality (CEQ) regulations (40 CFR 1508.7 and 1508.25[a][2]), a cumulative impact is:

> *"…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."*

4.6.1 Background

The ASDP Final EIS (BLM 2004a) evaluated a proposal by CPAI to develop 5 satellite oil accumulations in the northeast corner of the NPR-A and the Colville Delta. The EIS considered direct, indirect, and cumulative impacts that could occur with implementation of the ASDP. The BLM (2004a) determined the ASDP was an environmentally responsible development of the oil resources discovered on federal lease tracts and that gravel drilling/production pads described as CD6 and CD7, roads, and pipelines were compatible with BLM's management plans for the NPR-A. The BLM (2004a)

> *"...documents the Department of the Interior's decision to approve rights-of-way and permits to drill on public lands in response to an application by ConocoPhilips Alaska, Inc...The authorizations will allow development of federal oil leases on BLM-managed land in the National Petroleum Reserve-Alaska. These authorizations will adopt the Preferred Alternative, with minor modifications... in the...ASDP FEIS"* (BLM 2004a, p. 1)

Pursuant to BLM (2004a), CPAI developed CD3 and CD4, and is currently constructing CD5. The other two satellites, GMT1 and GMT2, were considered Reasonably Foreseeable Future (RFF) actions by BLM (2008b, § 4.7; 2012, § 4.8), and also by the Corps (2012, § 4.2). It is noted that a GMT2 Project is <u>not</u> currently pending authorization, modification, or rejection as part of this SEIS, and that CPAI has not indicated when, or if, an application for the GMT2 development, as conceptually depicted, may be filed. BLM has determined that the conceptual GMT2 Development Project should be treated as a connected action (40 CFR 1508.25(a)(1)), not ripe for decision, but appropriate for analysis in the cumulative effects because it is reasonably foreseeable (BLM 2008c, H-1790-1, p.45).

The cumulative effects analyses described in BLM (2004, § 4.G, pp 1233-1333), BLM (2008b, § 4.7, pp 4-631 - 4-929), BLM (2012, § 4.8, pp 1- 296), and Point Thomson EIS (Corps 2012, § 4.2 p. 4-2) provide an overarching picture of existing and potential oil and gas related activities on the North Slope, to which the SEIS analysis is tiered and which are incorporated by reference.

4.6.1.1 Assumptions

Key assumptions used for the cumulative effects analysis in this SEIS are:

- Development of the oil and gas resources of the GMTU is consistent with the Secretary of the Interior's most recent decisions to offer federal oil and gas leases in the NPR-A (BLM 2013).

- As a stand-alone production facility in the GMTU, cumulative effects from GMT1, including abandonment and final reclamation, would extend 30-50 years. Production at the conceptual GMT2, which requires GMT1 to be operational, would extend the period of some cumulative effects at GMT1 for an additional period to coincide with abandonment and final reclamation at the conceptual GMT2.

- BLM has approved a substantial number of winter exploration wells in the area now known as the GMTU, with CPAI planning to drill two wells (Rendezvous No. 3 and Flat Top No. 1) in the GMTU during the 2013-14 winter season. Newly-identified and economically recoverable oil resources resulting from these or other future drilling projects in the GMTU may further extend the cumulative effects of GMT1 and/or the conceptual GMT2 based on BLM policy to minimize the number of permanent facilities such as gravel roads and elevated pipeline systems to the maximum extent practicable.

- The conceptual GMT2 Project is directly linked to development of GMT1. However, GMT1 is not dependent upon production of oil from conceptual GMT2 facilities.

- Production of oil at the conceptual GMT2 would likely result in the transfer of federal land and management of federal oil and gas leases in existing valid selections to Kuukpik and ASRC, respectively.

- Alternatives A, B, C, or D would meet the purpose and need identified in Section 1.3.

- Alternative E would not meet the purposes and need identified in Section 1.3.

- Alternative E would deny the production of economically viable oil resources in the GMTU that are 8 to 16 miles from existing oil production and transportation facilities connected to the TAPS in the Prudhoe Bay area. Prohibiting a project in the GMTU that otherwise appears to meet the requirements contained in federal oil and gas leases, as amended in 2008, and the requirements of BLM (2013), may result in industry uncertainty and concern that proposed developments meeting the requirements of the lease and land use plans would be denied. This uncertainty could reduce industry interest in development on federal lands in the NPR-A.

- The Deepwater Horizon spill in the Gulf of Mexico has caused re-examination of the technology and environmental protections for offshore drilling in the Beaufort and Chukchi Seas OCS. This technical review is not expected to cause abandonment of existing federal leases in either of these two areas of the Alaska North Slope.

4.6.1.2 Methodology

The cumulative effects analyses for this SEIS begins by reviewing the cumulative effects summary and conclusions in BLM (2004) and BLM (2012), followed by an identification and evaluation of changes (e.g., new actions, new data) relevant to analysis of cumulative effects of developing the proposed GMT1 and the conceptual GMT2 projects. Table 4.6-1 summarizes the parameters bounding the cumulative effects analyses performed by BLM (2004; 2012).

This SEIS cumulative effect analysis tiers to these two previous analyses. It uses procedures developed from the CEQ (1997). This analysis involves the following steps:

- Define the time frame and geographic scope for each resource/issue analyzed in this SEIS.
- Identify past present and future actions within the geographic area.
- Characterize response to changes and evaluate cause and effect relationships.
- Determine the magnitude of cumulative effects from current conditions and if any thresholds of significance would be exceeded.
- Potentially modify alternatives or mitigation to minimize cumulative effects.
- Develop plans for long term monitoring and adaptive management.
- Time Frame and Geographic Area

Table 4.6-1. Parameters of Cumulative Effects Analyses in the 2004 ASDP EIS and the 2012 NPR-A IAP/EIS

Parameter	2004 ASDP EIS	2012 NPR-A IAP/EIS
Period of Analysis	20 years in the future (2024)	Through the year 2100
Total Past, Present, and Reasonably Foreseeable Direct Disturbance in NPR-A between NPR-A and the Colville River and Canning River, and in Near Shore Estuarine/Marine Waters	21,402 acres. Gravel mines = 7,435 acres with 5,202 acres of gravel mining in rivers used primarily for construction of the Dalton Hwy and TAPS. Natural gas production was considered speculative due to lack of commercial gas pipeline system before 2024.	55,895 acres (non oil and gas = 4,300 acres). Gravel mines = 10,950 acres including 3,050 acres in NPR-A). Includes a commercial gas pipeline and deletes road connection to Umiat and Nuiqsut. Commercial gas pipeline and production in the Beaufort Sea OCS and Chukchi Sea OCS with onshore support and pipelines included.
Plan Area for Reasonably Foreseeable Future (RFF) Actions	NPR-A, land between Colville and Canning Rivers, near shore estuarine and marine waters (all federal, state, and Alaska Native ownerships on the 57 million acre North Slope not closed to oil and gas activity and adjoining near shore estuarine and marine shallow waters).	NPR-A, land between Colville and Canning Rivers, near shore estuarine and marine waters, Beaufort Sea OCS and Chukchi Sea OCS (all federal, state, and Alaska Native ownerships on the 57 million acre North Slope not closed to oil and gas activity and adjoining near shore estuarine and marine waters extending northward into deeper OCS marine waters).
102 mile-long gravel road with an estimated footprint of 505 acres, to provide access to Umiat and to Nuiqsut	Yes	Road only between Umiat and Dalton Highway (includes potential pipeline system between Umiat and TAPS).
Number of Discovered Oil Resources	33 producing with an additional 14 discoveries producing in the next 20 years.	38 past and current producing in 2010 with production from the Beaufort Sea OCS = 1.1 BBO/5.75 TCF Gas and Chukchi Sea OCS = 6.23 BBO/24.75 TCF Gas and continued onshore production of 3.91 BBO/50.69 TCF Gas for the period 2012 - 2100.
Tiŋmiaqsiġvik (Ublutuoch) River Setback Designated	No.	Yes.
Enforceable Land Use Controls	1998 Northeast NPR-A IAP/EIS ROD, NSB Land Use Plan, ACMP, and agreements between Kuukpik/ASRC and CPAI.	2013 NPR-A IAP/EIS ROD, NSB Land Use Plan, and agreements between Kuukpik/ASRC and CPAI. ACMP program terminated.
Enforceable Requirements on Federal Oil and Gas Leases in the project area	1998 Northeast NPR-A IAP/EIS ROD Stipulations.	2008 Northeast NPR-A Final Supplemental IAP/EIS ROD Stipulations (in effect prior to 2013 NPR-A IAP/EIS ROD).
Threatened and Endangered Species	Polar bear not listed. The Pacific walrus and ribbon seal were candidate species. Threatened and endangered species included bowhead whale, spectacled eiders, and Steller's eiders.	Polar bear listed and critical habitat was designated. Bearded and ringed seal designated as threatened in 2012. NMFS rejected the ribbon seal for listing in July 2013. U.S. Fish and Wildlife Service must make a decision on listing the Pacific walrus by October 2017.

In this SEIS, both the time period and geographic scope of the cumulative effects analysis vary according to the resource/activity under consideration.

- Time Frame for Relevant Past and RFF Actions: Past projects date from the 1940s, with military facilities and the U.S. Navy implementation of federal programs to explore for and develop the oil resources of NPR-A. The productive life, including reclamation, for GMT1 is assumed to last for 30-50 years with construction of GMT1 starting in 2016 and initial production in late 2017. For the purposes of this SEIS it is assumed the productive life at GMT1 would be approximately 30 years. The conceptual GMT2 would have a similar duration of impact; however, construction at the conceptual GMT2 site would not begin until sometime in the future. Since production at GMT2 would be dependent upon facilities at GMT1, and road and pipeline systems connecting GMT2, GMT1, and CD5, the abandonment and reclamation of GMT1 facilities could be delayed

beyond the estimated 30-year timeframe. Other key assumptions for the cumulative effects evaluation are presented in section 4.6.1.1.

Geographic Area of Relevant Past and RFF Actions:

- For this analysis, a conceptual GMT2 project study area is established similar to the GMT1 project study area, defined as a 2.5 mile buffer surrounding the conceptual GMT2 project infrastructure; this GMT2 project study area would encompass approximately 7,100 acres. In order to consider the cumulative effects of GMT1 and a conceptual GMT2, these project study areas are considered together in a combined GMT1-GMT2 project study area of approximately 109,600 acres.

- Unless otherwise specified, the geographic extent for the cumulative effects analysis is limited to the Harrison Bay and the Lower Colville River watersheds (see Figure 4.6-1.). The Harrison Bay watershed has a drainage area of approximately 1.7 million acres and contains approximately 57,100 acres of a combined GMT1 and all 7,100 acres of a conceptual GMT2 project study area.

- The Lower Colville River watershed is approximately 2.6 million acres in size and contains approximately 61,400 acres of the GMT1 project study area; the conceptual GMT2 project study area is entirely outside of the Lower Colville River watershed. The community of Nuiqsut, Nuiqsut Spur Road (RFF), Colville River Access Road (RFF), and CD1 (APF), CD2, CD4, and CD5 (RFF) are within the boundaries of the project study area for GMT1.

- From east to west, these two watersheds include the Colville River Unit, the GMTU, and the Bear Tooth Unit (adjoining the northwest boundary of the GMTU) and the Umiat Unit at the southern end of the Colville River watershed. The Kuparuk River Unit and Milne Point Unit, with a developed network of roads, pipelines and production sites interconnects with the Prudhoe Bay Unit and other units with oil and gas infrastructure eastward to the Badami Unit and the Point Thomson Unit boundary at the Canning River. The west boundary of the Kuparuk River Unit is located approximately 10 miles east of the GMTU. The developed oil and gas infrastructure in the Kuparuk River Unit together with the other units at Prudhoe Bay and eastward to Point Thomson were assumed to exist through the year 2100 and were evaluated for cumulative effects by BLM (2012, § 4.8; BLM 2013) and the Corps (2012).

- In summary, the geographic extent for the cumulative effects analysis will be limited to the relationships of the 109,600-acre combined GMT1-GMT2 project study area to the combined 4.3 million acres of the Harrison Bay and Lower Colville River watersheds, unless specified otherwise for a particular resource evaluation.

- For other resources, the area of evaluation extends to the collective impacts of RFF actions in the GMT1 project study area, surrounding lands, adjacent marine waters, and areas previously considered by BLM for the NPR-A extending eastward to the Canning River and to offshore marine waters of the Chukchi Sea and Beaufort Sea (BLM 2012, § 4.8.3.4; BLM 2013).

- <u>Impact Evaluation</u>: Unless specified otherwise, the impact criteria for magnitude (intensity), duration, context, and geographic extent described in sections 4.2, 4.3, and 4.4 are used for the cumulative effect analysis of each respective resource/activity (e.g., impact criteria and conclusions for vegetation and wetlands [Table 4.3-1] have been used

in the cumulative effects evaluation). The analysis also considers the interaction among the effects of the proposed action with the effects of various past, present, and RFF actions as described below:

– Additive - the effects of actions add together to make up the cumulative effect.
– Countervailing - the effects balance or mitigate the effects of other actions.
– Synergistic - the effects of the actions together is greater than the sum of their individual effects.

Impacts from past, present, and RFF actions within these timeframes and geographic areas were combined with those from GMT1 to determine if a threshold of significance would be exceeded. BLM considers mitigation and monitoring requirements to determine if these supplemental protective measures would avoid or minimize impacts.

4.6.2 Activities Included in Cumulative Impact Analysis

The cumulative impact analysis considers impacts of a proposed action and its alternatives that may not be consequential when considered individually, but when combined with impacts of other actions, may be consequential (CEQ 1997). The types of activities analyzed under this cumulative impacts analysis include both oil and gas development and exploration activities. The following criteria were used in evaluating actions for inclusion in this analysis:

- Past actions, including those that involve present operations in the Harrison Bay and Lower Colville River watersheds and more generally the North Slope including the NPR-A, land between the Colville River and Canning River with adjacent State waters, Beaufort Sea OCS, and Chukchi Sea OCS.

- Present actions, including operations that are currently underway or are planned including the NPR-A and eastward to the Canning River with adjacent State and Federal marine waters for the near future.

- RFF actions, including future development in the NPR-A and eastward development to the Canning River with adjacent State and Federal marine waters.

Facilities with very small footprints such as the USGS Fish Creek meteorological station located approximately 2.3 miles northwest of the GMT1 drill site are expected to have a negligible contribution to cumulative impacts and are not included in the cumulative impacts analysis. Likewise, activities that have the potential to adversely impact paleontological and cultural resources are required to have professional inventories and reports filed with the appropriate agencies prior to starting the proposed action, including potential gravel sources, cross-country winter travel routes, ice road and ice pad locations, and temporary summer camps. These requirements provide assurances that adverse impacts to paleontological and cultural resources will be minimized, if not eliminated. Accordingly, paleontological and cultural resources are not discussed further.

4.6.2.1 Past, Present, and Future Activities and Infrastructure

Table 4.6-2 summarizes factors to be considered in the cumulative effects analysis within the Project Study Area, within the Harrison Bay and Lower Colville River watersheds, and the larger area of the North Slope and adjacent estuarine and marine and OCS marine waters for a period extending to about the year 2050. Additional discussion on these factors follows the table.

Table 4.6-2. Major Cumulative Effects Factors

Impact	Time Frame	Geographic Scope	Development Footprint (If Applicable)	Reference
Climate Change	1950s through 2050	North Slope	NA	BLM 2012, § 4.8.7 and Appendix C.
Community Footprint (non-oil and gas)	1970s to though 2050	Nuiqsut (including landfill)	Existing: 341 acres (plus landfill). Colville River Access Road: 59 acres. Nuiqsut Spur Road: 77 acres	BLM 2012, §§ 4.8.2.1, Table 4-33, p. 7 and 4.8.7.3, p. 87.
Military Development	1940s to 2030 (or when these sites are cleaned up/reclaimed)	Kogru, Oliktok, and Point Lonely	5,305 acres	BLM 2012, §§ 4.8.2.2, Table 4-35
Legacy Wells	1940s to 2030 (or when these sites are cleaned up/ reclaimed)	24 sites in the Harrison Bay and Lower Colville River watersheds[1]	12 to 48 acres (based on estimated 0.5 to 2 acres per site.	BLM 2012 Map3.2.11-1 3.2.11; BLM Report 127 2013
Gravel Footprint including gravel mines (oil and gas)	1970s to 2050 (duration of proposed project) Within oil and gas development areas (Umiat to Point Lonely to Prudhoe Bay)	Includes Units in Harrison Bay and Lower Colville River watersheds[2]	GMT (1 and 2): 145 acres[3]. Alpine: 228 acres. Kuparuk: 1,400 acres. CD5: 118 acres. Umiat: 1,450 acres. Umiat Road and Pipeline between Dalton Hwy and Umiat: 1,215 acres[4]. Total: 4,556 acres	BLM 2012, § 4.8.3.5, Table 4-40.
Winter Access (oil and gas and non-oil and gas ice roads, ice pads, ice bridges, snow trails, and seismic data collection.	1970s to 2050 (duration of proposed project)	Harrison Bay and Lower Colville River watersheds	Seismic activity could have a long-term impact to between 1,490 to 2,658 acres within the NPR-A	BLM 2012, Table 2.4 and § 4.8

[1] Inigok, North Inigok, South Harrison, Umiat 1-11, West Fish Creek (and Gubik 1 and 2 on Native Land outside NRPA near Umiat).

[2] Includes the following Units: Bear Tooth, Colville River, Greater Mooses Tooth, Gubik, and Umiat.

[3] Estimated acreage value based on Alternatives A of 72.5 acres including an access road of approximately 8 miles and 12 acre pad at GMT2.

[4] Only a portion of the Umiat Road and Pipeline are in the southern part of the Colville River watershed. Total footprint regardless of location is included.

Climate Change. As described above, climate change momentum has developed in the Arctic environmental system due to the effects of a persistent warming trend that began more than 30 years ago. See Section 3.2.4 for a more detailed description of climate change on the North Slope.

Community Footprint. Nuiqsut is one of the six communities considered in the cumulative effects evaluations described by BLM (2012). The community encompasses approximately 5,760 acres (BLM 2012, § 4.8, Table 4-33, p. 5) and the footprint for infrastructure is 341 acres (BLM Unpublished GIS data). See sections 3.4 and 3.9 of this SEIS for a description of the infrastructure of Nuiqsut. The current population of Nuiqsut, based on the 2010 U.S. Census, is 402 people, up from 128 in 1973 when it was founded (BLM 2012, § 3.4.11.1, p. 476).

Military Development. Former military sites are located at 13 locations scattered along the coast (BLM 2012, Table 4-35, § 4.8, p. 8). Two former military sites, Kogru and Oliktok, are

located within the Harrison Bay and Lower Colville River watersheds and along with Point Lonely, which is not in these watersheds, are also included in the cumulative effects evaluation.

Legacy Wells. From 1944 to 1982 the U.S. Navy and U.S. Geological Survey developed exploratory oil wells in the NPR-A (BLM 2013a). Of the original 136 wells in the NPR-A, five areas ranging from a single well to the 11 at Umiat, are within or adjacent to the Harrison Bay and Lower Colville River watersheds that could be affected cumulatively in relation to the proposed GMT1 project. Among these wells, Inigok No. 1, and Umiat No. 3 and No. 4 will require surface cleanup; Fish Creek No. 1, Umiat No. 1, and Umiat No. 11 will require surface cleanup and plugging; Gubik Test No. 1 and No. 2, which have been transferred to ASRC, will require remediation (BLM 2013a).

Existing Oil and Gas Infrastructure. All existing oil and gas infrastructure in the evaluation area is located in the Lower Colville River Delta. The Alpine production facilities, including CD5, are connected by pipeline and ice roads to the Kuparuk field. The Kuparuk field was established in the early 1980s; it includes 141 miles of access roads (524 acres) and 873 acres for facility pads. Oil and gas infrastructure including gravel roads and pipelines continue eastward to the main production facilities at Prudhoe Bay, the Dalton Highway, and TAPS. The primary public airport is at Prudhoe Bay with smaller airfields at Nuiqsut and Umiat. Private industry owned airfields, associated with operations within the several fields, are also present between Prudhoe Bay and Nuiqsut. Marine docks are located at Prudhoe Bay. Surface travel to the Lower Colville River Unit is by gravel road to the Kuparuk field, then ice roads are used for going westward into NPR-A; there is also ice road access from the Dalton Highway to the Umiat area. See section 3.4.9 for additional discussion of transportation.

Since 2000, industry has drilled 29 wells on federal leases in the NPR-A, including discovery wells at both GMT1 and GMT2 (BLM 2012, § 3.2.6.2, p. 176). Regular oil production from the Alpine Field began in November 2000. Existing oil production facilities include pads at CD1, CD2 (located approximately 3 miles west of CD1), CD3 (north of CD1), and CD4 (located south of CD1). CD1 is connected to CD2 and CD4 via gravel roads. CD3 is accessible only by seasonal ice road or by air, and production drilling at that site occurs seasonally. These facilities are supported by APF (CD1), which includes processing facilities, camp facilities, a drilling mud plant, an airstrip, a maintenance complex, warehouse facilities, disposal wells, an emergency response center, communications and power generation, and various mobile equipment. The estimated footprint of the Alpine field includes 163 acres of roads and pads and 65 acres of gravel extraction (total of 228 acres). Gravel used for construction of Colville Delta roads, pads, and airstrips was obtained from the ASRC Mine Site. All of these facilities are located on non-federal surface and subsurface ownerships.

Umiat was developed by the U.S. Navy in the 1940s and 1950s, and 11 test wells (now Legacy wells) were drilled. Currently there is an airstrip and some year-round support and research facilities there. The airstrip encompasses 1,450 acres. The area includes a road from the airstrip to Seabee pad, approximately 1 mile away. Linc Energy Operations, Inc. has indicated that they will conduct a second winter of exploration drilling there (2013-2014) noting that unlike the previous winter season, the 2013-2014 winter season start of drilling will not be reliant upon a snow road, because the drill rig is already on location in Umiat (Linc Energy Operations, Inc. 2014). To date, Linc Energy Operations, Inc. has relied upon snow and ice roads and ice pads; no permanent infrastructure has been constructed.

Winter Access. Current technology, permitting requirements, and best management practices eliminate long-term direct and cumulative impacts to vegetation, wetlands, and soils from ice roads. Seismic activity could, however, have a long-term impact to between 1,490 to 2,658 acres

of vegetation and wetlands within the NPR-A during the timeframe of cumulative effects analysis.

Proposed and Current Activities

Within the evaluation area, there are some activities currently being implemented and others that have been sufficiently advanced to be considered likely (e.g., are currently undergoing permitting; have been permitted, but not constructed; or have been funded for construction). These include the CD5 Development Project (construction activity underway), the Nuiqsut Spur Road (in final permitting) and Colville River Access Road[12] (federal funding; permitting underway), and current/proposed winter exploration in the general area of the GMT1 and GMT2 (i.e., in the Bear Tooth, GMTU, and Tofkat Unit). A recently proposed gravel road/pipeline system would provide access between the Dalton Highway and the Umiat area. Only part of this road would be located in the Lower Colville River watershed, but is considered in its entirety as a RFF project that would be a connected action for future development of petroleum resources in the Gubik and Umiat fields as well as other resources to the west of Umiat (state funding; permit applications submitted; EIS initiated, but currently on hold). These activities are further described below for the cumulative effects analysis.

CD5 Development Project. The CD5 Development Project includes the CD5 drill site, an access road, pipelines, a bridge across the Nigliq Channel of the Colville River, three additional smaller bridges, communication equipment, and power lines for oil and gas production. The CD5 Development Project would result in the placement of 559,700 cubic yards of fill on 60.5 acres (Corps, 2011, POA-2005-1576, Colville River). The proposed CD5 drill site will be located in the Colville River Unit approximately 6 miles west-southwest of the existing APF. The Kuukpik Corporation holds surface ownership of the CD5 project area with the exception of the bed of the Nigliq Channel, which is owned by the State of Alaska; ASRC owns subsurface rights for the entire CD5 project area. Oil, gas, and water produced from the CD5 facility will be transported via pipeline to APF for processing. The proposed drill site will be operated and maintained by Alpine personnel supported by the existing Alpine infrastructure and APF. This project is a connected action, and development of GMT1 depends upon the construction and development of CD5.

Nuiqsut Spur Road. Kuukpik Corporation proposes to construct a 5.8-mile-long, 24-foot-wide gravel road from the community of Nuiqsut to connect to the CD5 access road to increase user access to subsistence resources, to enhance the ability of Nuiqsut residents to obtain training and employment, to provide year-round access to the Alpine field, and to support Kuukpik Corporation business activities. This project includes a new 10 acre gravel storage pad near the intersection of the Nuiqsut Spur Road and CD5 access road and an upgrade of the existing 0.8 mile long Nuiqsut dump road. The road footprint would impact approximately 76 acres and require 633,000 cubic yards of gravel. The project is located on lands owned by Kuukpik Corporation. The Nuiqsut Spur Road is currently in the permitting process (Corps 2013, POA-213-68, Nechelik Channel, Colville River). If approved, construction is expected to take place during the 2014-15 winter season; however, work on the Nuiqsut dump road may occur earlier.

Colville River Access Road. The Native Village of Nuiqsut filed an application on June 27, 2013 with the Corps to construct the "Colville River Access Road" to provide road access needed to facilitate subsistence related activities along the Colville River. This project would extend the

[12] The 5 mile-long Colville River Access Road is a road extending from Nuiqsut southeasterly to the Colville River for launching boats. It is not the 102 mile-long Colville River Road considered in the ASDP EIS (BLM 2004) that extends from the Dalton Highway in the vicinity of TAPS Pump Station 2 westward to the Umiat area and then north to the vicinity of Nuiqsut.

existing 1.3-mile gravel road to the water supply lake by an additional 3.75 miles to the west bank of the Colville River approximately 5.5 miles upstream from the community. The road footprint would directly impact about 58.5 acres. An estimated 135,000 cubic yards of fill material would come from an existing local gravel source. The application also identifies an alternative undeveloped gravel source about 4 miles west of the landfill that may be used.

Umiat Road and Pipeline. For this cumulative analysis, BLM assumes a road between the Dalton Highway and Umiat would be built to facilitate production of known reserves in the Gubik and Umiat fields and to enhance economic development such as at Wolf Creek to the west of Umiat. Depending on the final design, this road could extend to Nuiqsut. In this case, the road would be approximately 102 miles long, with a footprint of 850 acres for the road and an additional 175 acres for gravel extraction. An elevated oil pipeline would impact about 2 acres for VSMs; a buried gas pipeline would impact an estimated 620 acres. In total the road and pipeline system could have a total footprint of about 1,215 acres (BLM 2012, § 4.8.3.2, p. 103). Most of the road and pipeline system are outside of the Lower Colville River watershed. The primary geographic area of effect has been adjusted to consider this proposed road/pipeline(s) because improved access would likely cause increased interest in developing the Umiat/Gubik fields which are both in the Lower Colville River watershed.

Depending upon which route is selected for the Umiat road, different potential oil and gas resources may be accessed. The Umiat road could lead to increased access and development of oil and gas in or adjacent to the Lower Colville River watershed.

Winter Oil and Gas Exploration. BLM and the State routinely receive applications to conduct winter oil and gas exploration activities. Figure 4.6-1 shows current pending exploration activity in the project area. Activities relevant to the proposed GMT1 project include exploratory drilling in the Bear Tooth Unit, GMTU, Umiat Area, and the Tofkat Unit east of Nuiqsut. These exploration activities are underway this winter (2013-2014) in the Harrison Bay and Lower Colville River watersheds as described below.

- Bear Tooth Exploration Activities - CPAI has conducted exploration drilling activities in the Bear Tooth Unit in the NPR-A in the winter of 2012-2013. Proposed exploration activities include two exploration wells supported by 88 miles of ice roads and ice pads. Drill sites during the 2012-2013 winter are identified as Cassin No. 1 and Cassin No. 6. CPAI is currently evaluating the results of that exploration activity.

- GMTU Exploration Activities - CPAI has filed an application to drill two exploration wells during the 2013-2014 winter season. The two sites (Rendezvous No. 3 and Flat Top No. 1) are about 14 miles southwest and about 5 miles southeast, respectively, from the proposed GMT1 drill site. The Rendezvous No. 3 well site has an approved APD and BLM has received an application APD for the Flat Top No. 1 well site, which has not yet been approved. Project elements include two ice drill pads, 41 miles of ice road, three ice laydown pads, and three staging ice pads. Water for the ice structures primarily would be drawn from lakes that have existing approvals from ADNR and ADFG for winter water withdrawal.

- Tofkat Prospect - Brooks Range Petroleum Corporation has applied to the State to conduct winter exploratory drilling under a State oil and gas lease on State land in the Tofkat Unit, at a site about 2.5 miles northeast of Nuiqsut. The proposed drilling operation would utilize ice roads and an ice pad for drilling.

- Umiat Exploration Activities - Linc Energy Operations, Inc. conducted exploratory drilling on a Federal Oil and Gas Lease at Umiat during the 2012-2013 winter season (Umiat No. 18). BLM has approved exploratory drilling at the Umiat No. 23H well site and the Umiat No. 25 well site. They plan to conduct exploratory drilling this winter (2013-2014) at the Umiat No. 23H well site.

The activities described above are typical of winter exploration drilling programs across the North Slope. The number and location of exploration sites in a given year is variable. BLM and the State have previously determined that this type of activity has short-term site-specific impacts because no permanent facilities are typically allowed. Winter exploration is preceded by summer activity in the area to collect site-specific data for drill sites, ice road routes, lake surveys, steam crossings, wildlife habitat, and cultural resources. Knowledgeable local residents are often requested to identify subsistence activities. Both drill sites in what is now the Bear Tooth Unit, and the two sites in the GMTU were included in areas evaluated by BLM for exploration activity, and were subsequently approved.

Offshore Oil and Gas Exploration. It is recognized that oil and gas seismic and exploration activities in the OCS are, and will, continue to occur during the cumulative effects timeframe considered for the GMT1 project. There is no known direct or indirect relationship between the proposed development of GMT1 and OCS offshore exploration activity.

ASRC Mine Site Expansion. The ASRC Mine Site currently has an estimated 2 million cubic yards of gravel available and permitted. The total estimated gravel requirement for CD5, Nuiqsut Spur Road, GMT1, and possibly the Colville River Access Road is more than 1.95 million cubic yards of gravel. The BLM (2012) and the Corps (2012) considered that the GMT1 Project and the GMT2 Project, along with the Clover Potential Material Source would be developed, and the ASRC Mine Site would continue to be used. The use of these gravel sources depend upon the development of discovered oil and gas fields or discovery and extraction of yet undiscovered oil and gas in areas within existing oil leases.

Reasonably Foreseeable Future Actions

Two proposed future actions in the area of the cumulative effects analysis are the development of the conceptual GMT2 Project and the development of onshore infrastructure or activity (e.g., seismic exploration) associated with offshore oil and gas development. These are described below.

Conceptual GMT2 Project. As described above, development of GMT2 hydrocarbon resources is a reasonably foreseeable action, although the exact location and parameters of development are still under study. For the purpose of this SEIS, a conceptual GMT2 development project is used for analysis, based on descriptions from BLM (2004) and BLM (2012). The conceptual GMT2 Project would be located approximately 22 miles west of Nuiqsut and approximately 8 miles southwest of the proposed GMT1 drill site (BLM 2004, Figure 1.1.1-2). The project design elements are predicted to be generally similar to those described for GMT1 (see Section 2.3). Table 4.6-3 provides a summary of the major elements of the conceptual GMT2 development that would be connected to GMT1 under the action alternatives described above in Section 2.4. Under Alternative E, the conceptual GMT2 drill site would not be constructed because it is dependent on construction of GMT1.

Table 4.6-3. Major Project Elements Required to Construct and Connect the Conceptual GMT2 development to GMT1[1] under the Action Alternatives

Element	Alternatives A, B, and C	Alternative D
Drill Site.	Footprint: 11.8 acres. Fill: 131,000 cubic yards.	Footprint: 15.7 acres. Fill: 174,296 cubic yards[2].
Gravel Road (from GMT1).	Footprint: 60 acres. Length: 7.8 miles. Fill: 488,000 cubic yards.	None.
Ancillary access facilities, including road between drill pad and airstrip.	None.	Footprint: 61.3 acres. Fill: 515,000 cubic yards.
Total fill required and associated gravel source footprint.	619,000 cubic yards and 15 acres.	689,296 cubic yards/16.4 acres.
Elevated Pipeline System (from GMT1).	8.1 miles. Pipelines on VSMs: 6 in gas, 6 in miscible injectant, 20 in crude, 14 in injection water, messenger cables (power and fiber optic) with space for a future 24 inch pipepline[3].	8.1 miles. Pipelines on VSMs: Same as Alternatives A, B, and C plus a 2 in diesel pipeline and a water pipeline.
Ice Road (from GMT1).	8.5 miles for 2 winter seasons.	8.5 miles each winter season.
Permanent Stream Crossings.	Currently undetermined.	Currently undetermined.
Total Permanent Footprint (gravel fill plus mined pit area).	86.6 acres.	93.4 acres.

[1] No Application for developing the conceptual GMT2 site is currently filed with BLM or other permitting entities. All miles, acres, and cubic yards of fill are estimates for comparison purposes only. See sections 2.3 and 2.4 for descriptions of the GMT1 development Alternatives A, B, C, and D.

[2] Calculated on the per acre fill for the GMT1 Project

[3] Minimal footprint associated with VSM installation not included in total.

Offshore Development and Onshore Support Infrastructure

The BOEM, in the high price scenario of their 2012-2017 Outer Continental Shelf Oil and Gas Leasing Program Final Programmatic EIS (BOEM 2012, p. 4-658), projected that assuming an oil price of $160 per barrel and gas prices of $11.39, up to 6.23 billion barrels of oil and 24.75 trillion cubic feet of gas could eventually be produced from federal waters in the Chukchi Sea. This production would occur over a period of 40-50 years. If Chukchi Sea development results in pipelines and possibly other infrastructure in the NPR-A (which at the closest is more than 55 miles offshore from the NPR-A coastline and at least 130 miles from Barrow), oil and gas exploration within the NPR-A could be encouraged and marginal discoveries could be developed. If a Chukchi Sea pipeline came ashore on the North Slope west of the NPR-A it could similarly encourage exploration and potentially discovery and production from lands far west of the project area. Increased future development west of the project area would have synergistic effects within the project area.

The BOEM projected that up to 1.10 billion barrels of oil and 7 trillion cubic feet of gas could eventually be produced from federal waters in the Beaufort Sea (BOEM 2012). This production would likely occur over 40 years. There could be up to 40 exploration and delineation wells, 310 platform production wells, and 25 subsea production wells. The BOEM assumed that to transport the oil and gas would require 423 miles of offshore pipelines and 290 miles of onshore pipelines. The wells would require 30 service vessel and 30 helicopter trips/week. The BOEM also projected 4 new natural gas processing facilities and 4 docks or causeways.

Development in the eastern Beaufort Sea, in the area in which Shell currently plans to explore, could have synergistic effects on the environment. New pipelines from the eastern Beaufort OCS that are at a distance of 12 to 25 miles from onshore infrastructure at Point Thomson, and could connect to the Point Thomson pipeline, which ultimately connects to Prudhoe Bay and TAPS. New pipelines from the western Beaufort OCS connecting to existing infrastructure near Prudhoe Bay could make sub-economic oil and gas fields in the northern NPR-A viable to produce. Development in the Beaufort Sea could increase development in northern NPR-A east of Barrow. Development of oil and gas resources in the Chukchi Sea OCS could have similar effects.

4.6.2.2 Speculative Development

The previous discussion on RFF actions does not include small discoveries and undiscovered resources that are very unlikely to be developed in the next 20 years. With respect to undiscovered resources, it is not reasonable to estimate new infrastructure or predict the effects of development for prospects that have not been located or leased to industry for exploration. Accurate predictions of the location, size, or development schedules are not possible at this time; thus analyzing such development is not within the scope of this SEIS.

The North Slope Science Initiative (NSSI), in partnership with the University of Alaska Fairbanks and GeoAdaptive, LLC, is conducting a scenario planning effort for future development on Alaska's North Slope and the waters of the Beaufort and Chukchi Seas. The intent is to engage a broad stakeholder network including state and federal agencies, local communities, industry, university scientists, and non-governmental organizations to develop plausible energy and resource development scenarios through the year 2040. A range of issues that will affect future development on the North Slope include energy demand and alternative sources; new oil and gas discoveries; local needs and food security; global commodities; social priorities; climate change; and national and international politics. NSSI targets completion of its Scenario Plan in 2016. Consideration of speculative future developments on the North Slope, although outside the scope of this SEIS, will be fully analyzed in this Scenario Plan.

4.6.3 Cumulative Impacts Analysis

The following cumulative effects discussions use the same impact criteria discussed in sections 4.2, 4.3, 4.4, and 4.5 of this SEIS. Each resource discussion includes:

- A summary of the cumulative impact conclusions for all alternatives, derived from sections 4.2, 4.3, and 4.4 of this SEIS, with addition of the conceptual GMT2 Project.
- A summary of the cumulative impact conclusions from BLM (2004) with projected future impacts to the North Slope and adjacent marine waters for 20 years.
- A summary of the cumulative impact conclusions from BLM (2012) with projected impacts to the North Slope and adjacent marine waters to the year 2100.
- A summary of the cumulative impact conclusions from this SEIS that includes the conceptual GMT2 Project and other RFF actions with projected impacts to the North Slope and adjacent marine waters to the year 2100.

Table 4.6-4 describes the time frame, geographic scope, and direct and indirect impacts of the proposed development.

Table 4.6-4. Summary of Resource/Issues Time Frame, Geographic Scope, and Direct and Indirect Impacts of Alternative A

Resource or Issue	Time Frame	Geographic Scope	Direct and Indirect Impacts of Alternative A (SEIS Sections 4.1-4.5)
Terrestrial Environment	1970s through 2050 (through duration of proposed project)	Harrison Bay and Lower Colville River (from Umiat north) watersheds	Physiography: Minor Geology: Minor Petroleum (depletion): Major Soils: Minor Sand/Gravel: Minor
Aquatic Environment	1970s through 2050 (through duration of proposed project)	Harrison Bay and Lower Colville River (from Umiat north) watersheds	Water Resources: Minor Surface Water Quality: Minor
Soil Resources	1970s through 2050 (through duration of proposed project).	Harrison Bay and Lower Colville River (from Umiat north) watersheds.	Minor
Atmospheric Environment	1970s through 2050 (through duration of proposed project).	Nuiqsut area to North Slope.	Climate and Meteorology: Negligible Air Quality: Moderate Noise: Minor
Climate Change	1970s through 2050 (through duration of proposed project).	North Slope including Beaufort Sea OCS and Chukchi Sea OCS.	Negligible
Vegetation and Wetlands	1970s through 2050 (through duration of proposed project).	Project Study Area .	Vegetation and Wetlands: Moderate (Alternatives A and C; Alternatives B and D are minor)
Fish and Fish Habitat	1970s through 2050 (through duration of proposed project).	Harrison Bay and Lower Colville River (from Umiat north) watersheds.	Fish: Minor Fish Habitat: Minor
Birds	1970s through 2050 (through duration of proposed project).	Species dependent, but would include distribution area of birds being analyzed.	Minor
Terrestrial Mammals (caribou)	1970s through 2050 (through duration of proposed project).	Species dependent, but would include distribution area of animals being analyzed.	Caribou: Minor (Alternative A, B and C; Alternative D is Moderate). Other species: Minor
Marine Mammals	1970s through 2050 (through duration of proposed project).	Beaufort Sea from Cape Halkett to Milne Point.	Minor
Threatened and Endangered Species	1970s through 2050 (through duration of proposed project).	Species dependent, but would include distribution area of animals being analyzed.	Spectacled Eider: Minor Steller's Eider: Negligible Yellow-Billed Loon: Minor Polar Bear: Minor Bowhead Whale: Negligible Bearded/Ringed Seals: Negligible
Public Health	1970s through 2050 (through duration of proposed project).	North Slope communities, particularly Nuiqsut.	Minor
Economy	1970s through 2050 (through duration of proposed project).	North Slope Borough and Arctic Regional Corporation.	Positive
Subsistence	1970s through 2050 (through duration of proposed project).	Primarily the Nuiqsut Subsistence Use Area.	Major
Environmental Justice	1970s through 2050 (through duration of proposed project)	Communities of Nuiqsut, Anaktuvuk Pass, Atqasuk, Barrow, and Wainwright	Minor
Land Use and Ownership	2013 through 2050 (2013 IAP/EIS is base year)	Harrison Bay and Lower Colville River (from Umiat north) watersheds	Minor
Recreation	1970s through 2050 (through duration of proposed project)	Harrison Bay and Lower Colville River (from Umiat north) watersheds	Recreation: Negligible Wild-Scenic Rivers: None Wilderness Values: None
Visual Resources	1970s through 2050 (through duration of proposed project)	View Shed near development area	Minor

Table 4.6-4. Summary of Resource/Issues Time Frame, Geographic Scope, and Direct and Indirect Impacts of Alternative A (Continued)

Resource or Issue	Time Frame	Geographic Scope	Direct and Indirect Impacts of Alternative A (SEIS Sections 4.1-4.5)
Transportation Systems	1970s through 2050 (through duration of proposed project)	Harrison Bay and Lower Colville River (from Umiat north) watersheds and Umiat Road/Pipeline between Dalton Hwy and Umiat	Minor
Oil, Saltwater and Hazardous Materials Spills	1940s through 2100	Harrison Bay and Lower Colville River (from Umiat north) watersheds, and coastal regions	(No Impacts; Risks Discussed)

[1] Alternative A is analyzed in Chapter 4 of this SEIS; note that the incremental impacts of the alternatives in relation to cumulative effects are discussed in the text following in this section of the SEIS.

4.6.4 Resource Specific Cumulative Impacts Discussion

The following sections discuss the cumulative impacts for each resource. Unless otherwise stated for a given resource, the following text applies to all resources:

The direct and indirect impacts to resources from the proposed GMT1 project and action alternatives are similar to that described in BLM (2004). Cumulative impacts on resources associated with the conceptual GMT2 Project, and the range of action alternatives, and other RFF projects are similar to those considered by BLM (2008b; 2012; 2013). There have been no substantial changes to the range of RFF projects or technologies considered by BLM in BLM (2012) that suggest the cumulative effects of the proposed GMT1 Project and the conceptual GMT2 Project cumulative impacts to resources would now be different.

If Alternative E were selected, development of GMT1 would be denied and the conceptual GMT2 Project would not occur. However, Alternative E still assumes that exploration would continue as required by existing Unit agreements and leases. As a result many of the cumulative effects of Alternative E would be similar to those of the action alternatives, although Alternative E would not add impacts incrementally.

4.6.4.1 Physical Characteristics

Terrestrial Environment: Physiography, Soils, Permafrost, Geology, and Petroleum

As noted above in section 4.6.2 impacts to paleontological resources are not expected to occur and as a result are not discussed further.

The evaluations in this section describe the direct and indirect effects of gravel fill and gravel mining on cumulative effects evaluations from past, present and RFF projects for Physiography, Soil, and Permafrost (section 4.2.1). The impact criteria would be the same as described in Section 4.2.1.

Additive cumulative effects have occurred from some 40 years of construction activity in the area (including the Native Village of Nuiqsut); maintenance and abandonment of military sites along the coast; development, use, and abandonment of Legacy Wells in the NPR-A; and oil and gas development at Kuparuk, Alpine, and Umiat (including gravel footprint from extraction and construction and winter exploration activity). Future impacts could include pipelines and infrastructure to support oil development off the coast of Alaska as well as the GMT2 Project in the NPR-A. Cumulatively (including the Native Village of Nuiqsut, Military Development, Legacy Wells, Kuparuk, Alpine, Umiat, Umiat Road and Pipeline, and the proposed GMT2), the

footprint is approximately 10,200 acres (based on estimates of 48 acres of surface area for Legacy Wells and 111 acres for Alternative D of the GMT2 Project).

The cumulative impacts from the proposed project and the conceptual GMT2 to the physiography, soil, and permafrost of the area would be directly related to the construction materials needed for production of oil from the GMT1 and the conceptual GMT2 sites. Gravel would be mined from one or both of the existing ASRC Mine Site or the undeveloped Clover site. The ASRC Mine Site is already permitted, so there would be no incremental cumulative impact so long as this site was not expanded to meet other gravel demands in the Lower Colville River watershed.

The GMT1 and conceptual GMT2, in combination with existing gravel footprints and footprints of developments in permitting total approximately 23,000 acres, which represents 0.5 percent of the geographic extent of this analysis. The potential for future impact to the existing physiography, soil, permafrost regimes and to petroleum resources are recognized and cannot be quantified at this time; therefore, analysis of potential future impacts are not included for the approximately 23,000 acres described above. Likewise, the potential remediation/reclamation of former Military Sites and Legacy Wells would have a countervailing impact due to uncertainty of federal funding availability and the relative priority and timing of site cleanup, when compared to similar sites across the North Slope and Alaska.

The duration of the impacts ranges is short-term (one to several years) if the vegetation is disturbed and up to several decades if the soils are destroyed. Incremental impacts of the proposed project would be small (approximately two to three percent) when compared to past, present, and future development. While soils and permafrost impacts are additive, the total and incremental amount of disturbed area is small compared to the total resource within the North Slope region and is not considered to be cumulatively significant (BLM 2004, § 4G.5.3). The short-term impacts are expected to diminish after a few years, with the long-term impact estimated to be about three percent of the original footprint regardless of the alternative (BLM 2012, § 4.8.7.3). The long-term impact resulting from the fugitive dust that roads and pads may contribute to the increased rate of permafrost degradation, which may adversely affect the stability of the gravel fills overtime. Effects would be localized, long-term and potentially major. More gravel and reconstruction may be necessary over the life of project. The decrease in albedo may cause higher temperatures and increase thaw rates.

If global climate change persists, the cumulative effects to soil from oil and gas development, and non-oil and gas development, on the North Slope could be greater than predicted. If the climate warms, the permafrost will thaw to an increased depth each season, which will cause varying degrees of impacts on subsidence, soil moisture, and vegetation. Since there is great depth of the permafrost on the North Slope it would take several decades of warming at the predicted rate before it would transition into discontinuous permafrost. However, if the permafrost continues to warm, its ability to support structures would diminish, which could affect development on the North Slope. Thicker gravel may be needed to support structures, and abandoned work pads and roads could become unusable as they are cut up by deep polygonal troughs over thawing ice wedges, or by other thermokarst degradation (BLM 2012, § 4.8.7.3).

Overall cumulative impacts to the physiography, soil, permafrost, and geology resources would be minor, site specific, and long term. Projects near proposed new access (such as the Umiat Road/Pipeline) would have an additive effect. Cumulative impacts to petroleum resources would be major due to depletion, although primarily limited to the GMTU. Alternative E would not have any disturbance to physiography, soil, permafrost, and geology.

RFF development would increase the direct footprint of gravel fill and gravel mining for all projects (oil and gas and non- oil and gas); these impacts would likely be concentrated along the coast between the Canning River and westward into the NPR-A. The north-south Dalton Highway and TAPS also supports oil and gas development on the North Slope by providing direct access to the rest of Alaska and other markets. A natural gas pipeline system would be located in the vicinity of both the Dalton Highway and TAPS. Overall impacts to the landscape would be minor, site specific, and long-lasting depending on the relationship of a RFF development for projects near existing or proposed new access (such as the Umiat Road/Pipeline).

The proposed action is consistent with the provisions of the federal oil and gas leases in the project area, and the land use plan approved in BLM (2013). Overall, the direct and indirect impacts to physiography, soil, permafrost, and geology, other than petroleum and gravel resources, are predicted to be of moderate intensity and long-term in duration, but of local extent. Because the resources are common as defined in the impact criteria, the overall direct and indirect impacts are characterized as minor for all action alternatives. The cumulative effect of Alternative E, would incur no incremental impacts to gravel or other geologic resources. Petroleum resource impacts would be major across the action alternatives.

Water Resources

Direct and indirect impacts to water resources and water quality in the GMT1 Project study area are evaluated in section 4.2.2 for Alternatives A, B, C, and D. These impacts would result from (1) water withdrawals from lakes, (2) thermokarst from damaged vegetation and streambanks; (3) disruption of natural flows by roads, pads, and river crossing structures; (4) gravel mining; and (5) spills (BLM 2012, § 4.8.7.4, p. 89). The reasonably foreseeable GMT2 Project would have similar, though potentially fewer impacts, than GMT1, which would be additive. The predicted road corridor linking GMT1 with a conceptual GMT2 site would not require major river crossings such as the GMT1 road crossing of the Tiŋmiaqsiġvik (Ublutuoch) River, although at least one relatively small fish-bearing stream would be crossed (tributary to Blackfish Creek west of GMT1). Lakes along the route would be potential water sources for ice road construction. In general, there are fewer streams and lakes in the vicinity of GMT2 compared to GMT1. The cumulative effects of impacts from GMT1, past, present, and RFF projects (including a conceptual GMT2) development will be evaluated in this section.

The BLM (2004) analyzed the potential cumulative impacts of the project to water resources and water quality (BLM 2004, §§ 4G.5.6 - 4G.5.7). It predicted that no cumulative impact to North Slope water supplies from withdrawal of water for construction and operation would occur because the annual yield (runoff and refill of lakes) is many times greater than the amount withdrawn. Further, water use peaks during construction, which is a temporary, not-permanent activity and is generally not consumptive, so a continuous minimal increase in water use was not expected. The BLM (2004) found that localized and temporary impacts may occur at those lakes used for water supply, and that the project was not expected to contribute to cumulative impacts to marine and estuarine water quality.

Seismic and overland travel (including non-oil and gas activities) could result in thermokarst erosion with associated increases in turbidity of adjacent waterbodies. The BLM (2004) determined that construction of gravel roads and pads, road crossing structures and removal of gravel from riverine pools could affect water flow and result in subsequent melting of permafrost (thermokarst) and induce changes to stream morphology (BLM 2004, § 4G.5.6). Dust deposition along roads can increase turbidity of adjacent waterbodies. Snowdrifts along gravel and building structures can increase wintertime soil surface temperatures and result in

increased thaw depths, contributing to thermokarsting (BLM 2012, § 4.8.7.4, p. 91). These impacts would be considered additive, but local, long-term, and minor in effect.

Spills from GMT1 and other oil and gas developments on marine or estuarine waters or along streams draining into such water bodies could impact those waters. The extent of such contamination would be related to the size and timing of the oil spill. Because spill frequency and volume are expected to be low, the cumulative impact from oil spills is not considered to be an additive cumulative impact. If a large (500- to 900-bbl) spill were to occur during the ice-covered season, the effects would be minor. If it were to happen during the open-water or broken-ice seasons, hydrocarbons dispersed in the shallow estuarine water column could exceed acute-toxic criteria during the initial spill period, but would be short-term and localized (BLM 2004, § 4G.5.7). Spills have occurred on the North Slope, but their effects have been minor and have not accumulated.

The BLM (2012) determined that some lakes were being pumped annually along primary transportation routes until development commenced. If lakes do not fully recharge or have water quality changes, future withdrawals may be conditional upon permit stipulations. It is possible that if water is drawn from a majority of lakes in a concentrated area, this could affect the surface flow regime of an area (BLM 2012, § 4.8.7.4, p. 94).

The BLM (2012) analyzed potential cumulative impacts on water resources and water quality from oil and gas development in the Chukchi and Beaufort sea offshore leases, construction of a road and pipeline between Umiat and the Dalton Highway, and construction of a commercial gas pipeline and unconventional oil and gas development east of the NPR-A. Large discoveries of oil in the Chukchi or Beaufort seas offshore could make additional developments in the northern NPR-A more economically feasible, resulting synergistically in even more impacts in the NPR-A. The conceptual GMT2 Project would add another 11.8 acres for the drill pad, and 67 acres of roadway to construct the 8.5-mile road from GMT1 (Table 4.6-3).

Improper siting of gravel mine sites could result in changes to the configuration of stream channels, stream flow hydraulics or lake dynamics, erosion and sedimentation. Gravel removal for roads and pads has resulted in over 6,400 acres of surface impacts through 2011 (BLM 2012, § 4.8.7.4, p. 95), with 4,550 acres rehabilitated by conversion into functional habitat for plants and animals and possible fish habitat. The Clover site and others may be required as development moves west and greater distances from the ASRC Mine Site near Nuiqsut. Gravel mining for oil and gas development is projected to account for a total of 10,950 acres by the year 2100 (Table 4.6-1).

Inadequate design and placement of structures, culverts, or bridges and unbreached or slotted ice bridges could cause impoundments, streambank erosion, and scour and sedimentation at stream crossings, thereby altering natural sediment transport and deposition, and creating scour holes or channel bars. Through 2011, oil and gas activities have caused approximately 18,400 acres of direct impacts and another 18,400 acres of indirect impacts, which included over 9,500 acres of gravel pads and roads constructed in association with oil-field development on the North Slope. Up to 1,106 miles of roadways are projected for maximum development within BLM (2012). A total of 55,895 acres of direct impacts are projected to occur through 2100 (Table 4.6-1).

The BLM (2004; 2012) both concluded non-oil and gas activities such as construction of roads and pads at villages could impact waterbodies and drainage patterns but would be minor due to the slow growth (two percent annually) of the communities.

Overall, it is expected that the combination of lakes in the vicinity of the Native Village of Nuiqsut will continue to meet demand for existing and RFF demand for water to construct ice roads and pads, exploration drilling and for GMT1 and the conceptual GMT2, as well as for a potable water supply. Further, it is expected that existing mitigation requirements (e.g., BMPs and Stipulations) will avoid and minimize impacts to fish and fish habitat.

A large amount of debris was left on the North Slope from Legacy Well exploration and military activities from 1940 to 1970 that impacted water quality, but on-going clean-up efforts since the 1970s have removed some of the remaining debris. These and other remediation and reclamation projects in the Harrison Bay and Lower Colville River watersheds would have a cumulative, long-term, countervailing, and local impact to water quality.

In general, all action alternatives and RFF projects have the potential for long-term cumulative impacts to local water resources resulting from the placement of new infrastructure. During most winters, ice roads are constructed between staging areas in the Kuparuk River Unit to locations within the NPR-A as far as the Barrow area. Water needed for construction of CD5 was available and has been permitted. Water demand for construction of the Nuiqsut Spur Road and Colville River Access Road, and the Umiat Road/Pipeline are expected to be available where and when needed. Water to support the cleanup of abandoned Military sites and Legacy Wells would likely come from the same lakes used originally. None of these water supply lakes are associated with the construction and operations of the GMT1 or conceptual GMT2 Project or with other reasonably foreseeable demand for water in the Nuiqsut area.

Most impacts are related to changes in the drainage pattern, and to a lesser degree stream flow. There also would be short-term, temporary impacts from ice infrastructure (e.g., roads and pads). These impacts tend to be proportional to the amount of area impacted by infrastructure, with modifications due to specific activities and locations. However, for all action alternatives the intensity of impacts is characterized as minor and of localized extent.

Air Quality

Cumulative impacts to the atmospheric environment would be negligible due to the relatively low quantity of emissions and short duration through the construction phase compared to existing North Slope infrastructure.

The BLM (2004) found that the cumulative effects of all projects affecting the Alaska's North Slope in the past and occurring by 2004 caused generally little deterioration in air quality, which achieves national standards. Production levels for the foreseeable future were not anticipated to be higher than the 1996 level. Thus, while reasonably foreseeable North Slope projects are additive, they were not expected to have synergistic cumulative impacts on air quality (BLM 2004, § 4G.5.8).

The BLM (2012, § 4.8.7.1) analyzed potential cumulative effects to air quality across the North Slope. The cumulative effects of all projects affecting the North Slope of Alaska in the past have caused some deterioration in contributed to increases is criteria pollutants, hazardous air pollutants, hydrocarbons, and greenhouse gases. Improvements in air-pollution-control technology would help reduce emissions from historic levels which may be offset somewhat by increasing production. Arctic haze will continue to be of concern on the North Slope, due primarily to air pollutant emissions originating in northern Europe and Asia.

A cumulative impacts analysis utilizes air quality modeling similar to that used for the direct and indirect impacts to air quality. The cumulative effects of the proposed GMT1 Project to air

quality are within the range considered in by BLM (2012), which projected that regional air pollutant emissions generated by North Slope facilities would remain near current levels.

The magnitude and extent of potential cumulative impacts to air quality would depend upon the timing, extent, and design of activities. Cumulative impacts are the result of past, present, and RFF actions by federal, state, and local governments, private individuals, and entities in or near the project area. Cumulative impacts could result from individually minor but collectively significant actions that take place over time.

Impacts may result from collective emissions from fuel-burning equipment at oil production facilities and from vehicle usage. Fugitive dust emissions from road usage and construction activities may also be expected, but are limited to summer months; during winter months the ground is snow-covered reducing fugitive dust emissions. Impacts are regionally additive, however the project area has relatively pristine air quality, and existing and proposed facilities are expected to meet ambient air quality standards.

For the far-field cumulative impact analysis, emissions from each of the modeled alternatives were added to the emissions predicted for reasonable future development (RFD). Impacts to air quality and AQRV were predicted for the three areas of special concern identified in Section 3.2.3.2 for Gates of the Arctic National Park, Alaska National Wildlife Refuge, and the village of Nuiqsut.

Under the Air Quality MOU, emissions from RFD must also be included in the air quality analysis. Consequently, the far-field analysis was performed for the modeled alternative project emissions as well as for emissions from all RFD sources. Emissions from the following RFD sources were modeled in addition to the GMT1 project sources. The predicted impacts from the GMT1 Project and RFD sources were added together to assess the cumulative impacts.

- Shell Discoverer Camden Bay
- Eni Nikaitchuq Development
- TDX Deadhorse Power Plant
- Pioneer Oooguruk Development
- Brooks Range Petroleum North Shore
- ConocoPhillips Alpine CD5
- ExxonMobil Point Thomson Facility
- ConocoPhillips GMT2
- Brooks Range Petroleum Mustang
- BPXA Liberty

For the Draft SEIS, far field modeling included project point and volume source emissions while RFD sources were characterized strictly as volume sources with permitted potential to emit annual emission rates. For the final NEPA document, the RFD (non-project) emissions which

are currently modeled as volume sources will be updated so that they are modeled as collections of point and volume sources potentially using worst-case scenarios similar to the manner in which they were characterized for modeling conducted as part of Alaska State minor and USEPA and Alaska State PSD permitting processes. Because of the close proximity of some of the RFD sources to modeled receptors, and their dominant influence on cumulative impacts, this change in characterization could result in an increase in cumulative results.

Alternative A

The analysis of air quality impacts from NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at the Alaska National Wildlife Refuge, Gates of the Arctic National Park, and the community of Nuiqsut indicated that total maximum ambient concentrations will be below the NAAQS/AAAQS for all pollutants examined for Alternative A combined with RFD sources.

Table 4.6-5. Cumulative Alternative A Air Quality Impacts at Alaska National Wildlife Refuge

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m3)	Ambient Background (µg/m3)	Total Impact (µg/m3)	NAAQS/ AAAQS (µg/m3)	Percent of NAAQS/ AAAQS
NO_2	1-hour [1]	40.79	38	79	188	42
	Period [1, 2]	0.14	2.9	3.0	100	3
SO_2	1-hour [1]	0.76	7.7	8.5	196	4
	3-hour [1]	0.54	18	18.5	1,300	1
	24-hour [1]	0.17	6.8	7.0	365	2
	Period [1, 2]	0.01	0.34	0.35	80	0.4
PM_{10}	24-hour [1]	2.68	48	51	150	34
$PM_{2.5}$	24-hour [1]	0.45	7.1	7.6	35	22
	Period [1, 2]	0.02	2.2	2.2	12	19

[1] The maximum impacts are reported for all averaging periods.

[2] Due to two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

Table 4.6-6. Cumulative Alternative A Air Quality Impacts at Gates of the Arctic National Park

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m3)	Ambient Background (µg/m3)	Total Impact (µg/m3)	NAAQS/ AAAQS (µg/m3)	Percent of NAAQS/ AAAQS
NO_2	1-hour [1]	0.44	38	38	188	20
	Period [1, 2]	0.002	2.9	2.9	100	3
SO_2	1-hour [1]	0.05	7.7	7.8	196	4
	3-hour [1]	0.04	18	18	1,300	1
	24-hour [1]	0.02	6.8	6.8	365	2
	Period [1, 2]	0.001	0.34	0.34	80	0.4
PM_{10}	24-hour [1]	0.33	48	48	150	32
$PM_{2.5}$	24-hour [1]	0.04	7.1	7.1	35	20
	Period [1, 2]	0.003	2.2	2.2	12	18

[1] The maximum impacts are reported for all averaging periods.

[2] Due to two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

Table 4.6-7. Cumulative Alternative A Air Quality Impacts at the Community of Nuiqsut

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m3)	Ambient Background (µg/m3)	Total Impact (µg/m3)	NAAQS/ AAAQS (µg/m3)	Percent of NAAQS/ AAAQS
NO_2	1-hour [1]	2.71	38	41	188	22
	Period [1, 2]	0.15	2.9	3.1	100	3.0
SO_2	1-hour [1]	0.71	7.7	8.4	196	4.0
	3-hour [1]	0.60	18	19	1,300	1.0
	24-hour [1]	0.31	6.8	7.1	365	2.0
	Period [1, 2]	0.02	0.34	0.36	80	0.45
PM_{10}	24-hour [1]	1.35	48	49	150	33
$PM_{2.5}$	24-hour [1]	0.12	7.1	7.2	35	21
	Period [1, 2]	0.03	2.2	2.2	12	19

[1] The maximum impacts are reported for all averaging periods.

[2] Due to two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

Visibility conditions calculated for cumulative impacts using the FLAG method were evaluated at each Class II area of concern to determine if the 98th percentile change in light extinction exceeds the 10 percent change in light extinction thresholds (equivalent to 1.0 dv). The cumulative visibility impacts, however, exceed both the 0.5 and 1.0 ddv thresholds at both Sensitive Class II areas for Alternative A. The cumulative impacts are likely controlled by the nearby offshore and onshore sources and their proximity to the Alaska National Wildlife Refuge. Additional model runs with refined source data would be expected to show reduced cumulative impacts on visibility.

Table 4.6-8. Cumulative Alternative A Number of Days Greater Than 0.5 ddv

Area	Number of Days Greater Than 0.5 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	80	103	91
Gates of the Arctic National Park	8	11	18

Table 4.6-9. Cumulative Alternative A Number of Days Greater Than 1 ddv

Area	Number of Days Greater Than 0.5 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	49	58	48
Gates of the Arctic National Park	1	1	2

Table 4.6-10. Cumulative Alternative A Maximum ddv Impact

Area	Maximum ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	9.016	8.628	7.772
Gates of the Arctic National Park	1.242	1.039	1.154

Table 4.6-11. Cumulative Alternative A 98th Percentile ddv Impact

Area	98th Percentile ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	3.614	4.267	4.502
Gates of the Arctic National Park	0.521	0.558	0.684

When proposed GMT1 Project emissions are combined with RFD emissions, the cumulative deposition impacts exceed the DAT at the Alaska National Wildlife Refuge for nitrogen, but are below the DAT for the Alaska National Wildlife Refuge for sulfur and for both pollutants at Gates of the Arctic National Park for Alternative A. As with the predicted cumulative visibility impacts, deposition is likely affected by the nearby offshore and onshore sources.

Table 4.6-12. Cumulative Deposition Impacts for Alternative A

Area	Pollutant	Averaging Period	Maximum Impact (kg/ha/yr)	DAT (kg/ha/yr)	Percent of DAT
Alaska National Wildlife Refuge	Nitrogen	Annual [1]	2.33E-02	0.005	466
Gates of the Arctic National Park	Nitrogen	Period [2]	4.54E-03	0.005	91
Alaska National Wildlife Refuge	Sulfur	Annual [1]	3.90E-03	0.005	78
Gates of the Arctic National Park	Sulfur	Period [2]	7.85E-04	0.005	16

[1] Maximum cumulative deposition impacts occur in year 2008, thus represent a true annual impact.

[2] Maximum cumulative impacts occur in the second portion of year 2009 (7,230 hours), thus do not represent a true annual impact. The conversion from g/m2/s to kg/ha/yr assumes 8,784 hours, therefore; reported impacts are conservatively high.

Alternatives B and C

Far-field cumulative impacts from Alternatives B and C were not modeled but it is expected that the Alternative A analysis of cumulative impacts adequately represents potential impacts from Alternatives B and C. Infill drilling was the scenario selected for far-field modeling as the project-related activity with the highest amount of fuel use and the greatest potential for far-field impacts. Infill drilling activities would use the same equipment and have the same duration under Alternatives A, B, and C.

Based on Alternative A results, the analysis of air quality impacts from NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at the Alaska National Wildlife Refuge, Gates of the Arctic National Park, and the community of Nuiqsut indicate that total maximum ambient concentrations will be below the NAAQS/AAAQS for all pollutants examined for Alternatives B and C combined with RFD sources.

The cumulative visibility impacts exceeded both the 0.5 and 1.0 ddv thresholds at both Sensitive Class II areas for the Alternative A analysis. The cumulative impacts are likely controlled by the nearby offshore and onshore sources and their proximity to the Alaska National Wildlife Refuge. Additional model runs with refined source data would be expected to show reduced cumulative impacts on visibility. These results are also assumed to be representative of Alternatives B and C.

Alternative D

An additional turbine would potentially be installed at APF under Alternative D due to power requirements for roadless GMT1 and GMT2 pads. The GMT1 well site is anticipated to increase power demand on APF by 1 to 2 megawatts electrical (MWe), depending on the season, due to required lighting, heat trace on piping, and heating modules. If Alternative D were to be constructed, the GMT2 pad would also be roadless with an additional 2.5 MWe electrical demand placed on Alpine generators. Electrical demand on the Alpine facilities fluctuates between a peak of 30 MWe winter demand and 20 MWe summer demand. The current permitted electrical capacity at Alpine is 37.6 MWe (ISO), plus an additional 11 MWe (ISO) backup power generation. This electrical power is provided by stationary combustion turbines. The installation of one 15 MWe (ISO) stationary combustion turbine would be expected to meet the total additional demand of 10 MWe (with a sufficient safety margin) for roadless GMT1 and GMT2 pads. Turbine installation would require permitting prior to construction. The additional turbine emissions which would result at Alpine were not included in the Alternative D emission inventory.

The analysis of air quality impacts from NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at the Alaska National Wildlife Refuge, Gates of the Arctic National Park, and the community of Nuiqsut indicated that total maximum ambient concentrations will be below the NAAQS/AAAQS for all pollutants examined for Alternative D combined with RFD sources.

Table 4.6-13. Cumulative Alternative D Air Quality Impacts at Alaska National Wildlife Refuge

Pollutant	Averaging Period	Maximum Predicted Impact (µg/m3)	Ambient Background (µg/m3)	Total Impact (µg/m3)	NAAQS/AAAQS (µg/m3)	Percent of NAAQS/AAAQS
NO_2	1-hour [1]	41	38	78.8	188	42
	Period [1,2]	0.14	2.9	3.04	100	3
SO_2	1-hour [1]	0.76	7.7	8.46	196	4
	3-hour [1]	0.54	18	18.5	1,300	1
	24-hour [1]	0.17	6.8	6.97	365	2
	Period [1,2]	0.013	0.3	0.31	80	0
PM_{10}	24-hour [1]	2.7	48	50.7	150	34
$PM_{2.5}$	24-hour [1]	0.45	7.1	7.55	35	22
	Period [1,2]	0.023	2.2	2.22	12	19

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8760 hours and conservatively represent an annual average.

Table 4.6-14. GMT1 Alternative D Air Quality Impacts at Gates of the Arctic

Pollutant	Averaging Period	Maximum Predicted Impact ($\mu g/m^3$)	Ambient Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS/AAAQS ($\mu g/m^3$)	Percent of NAAQS/AAAQS
NO_2	1-hour [1]	0.44	38	38.4	188	20
	Period [1,2]	0.0024	2.9	2.90	100	3
SO_2	1-hour [1]	0.046	7.7	7.75	196	4
	3-hour [1]	0.038	18	18.0	1,300	1
	24-hour [1]	0.017	6.8	6.82	365	2
	Period [1,2]	0.0010	0.3	0.30	80	0
PM_{10}	24-hour [1]	0.33	48	48.3	150	32
$PM_{2.5}$	24-hour [1]	0.037	7.1	7.14	35	20
	Period [1,2]	0.0032	2.2	2.20	12	18

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8760 hours and conservatively represent an annual average.

Table 4.6-15. Cumulative Alternative D Air Quality Impacts at Community of Nuiqsut

Pollutant	Averaging Period	Maximum Predicted Impact ($\mu g/m^3$)	Ambient Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS/AAAQS ($\mu g/m^3$)	Percent of NAAQS/AAAQS
NO_2	1-hour [1]	2.7	38	40.7	188	22
	Period [1,2]	0.17	2.9	3.07	100	3
SO_2	1-hour [1]	0.71	7.7	8.41	196	4
	3-hour [1]	0.60	18	18.6	1,300	1
	24-hour [1]	0.31	6.8	7.11	365	2
	Period [1,2]	0.025	0.3	0.33	80	0
PM_{10}	24-hour [1]	4.8	48	52.8	150	35
$PM_{2.5}$	24-hour [1]	0.15	7.1	7.25	35	21
	Period [1,2]	0.029	2.2	2.23	12	19

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8760 hours and conservatively represent an annual average.

Visibility conditions calculated for cumulative impacts using the FLAG method were evaluated at each Class II area of concern to determine if the 98th percentile change in light extinction exceeds the 10 percent change in light extinction thresholds (equivalent to 1.0 dv) for Alternative D. The cumulative visibility impacts, however, exceed both the 0.5 and 1.0 ddv thresholds at both Sensitive Class II areas. The cumulative impacts are likely controlled by the nearby offshore and onshore sources and their proximity to the Alaska National Wildlife Refuge. Additional model runs with refined source data would be expected to show reduced cumulative impacts on visibility.

Table 4.6-16. Cumulative Alternative D Number of Days Greater Than 0.5 ddv

Area	Number of Days Greater Than 0.5 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	86	108	96
Gates of the Arctic	11	12	19

Table 4.6-17. Cumulative Alternative D Number of Days Greater Than 1.0 ddv

Area	Number of Days Greater Than 1.0 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	50	59	48
Gates of the Arctic	1	1	2

Table 4.6-18. Cumulative Alternative D Maximum ddv

Area	**Maximum ddv**		
	2007	**2008**	**2009**
Alaska National Wildlife Refuge	9.016	8.628	7.791
Gates of the Arctic	1.243	1.039	1.182

Table 4.6-19. Cumulative Alternative D 98th Percentile ddv

Area	**Maximum ddv**		
	2007	**2008**	**2009**
Alaska National Wildlife Refuge	3.623	4.267	4.504
Gates of the Arctic	0.566	0.586	0.784

When proposed GMT1 Project emissions are combined with RFD emissions, the cumulative deposition impacts exceed the DAT at the Alaska National Wildlife Refuge for nitrogen, but are below the DAT for the Alaska National Wildlife Refuge for sulfur and for both pollutants at Gates of the Arctic National Park for Alternative D. As with the predicted cumulative visibility impacts, deposition is likely affected by the nearby offshore and onshore sources.

Table 4.6-20. Cumulative Alternative D Deposition Impacts

Area	Pollutant	Averaging Period	Maximum Impact (kg/ha/yr)	DAT (kg/ha/yr)	Percent of DAT (%)
Alaska National Wildlife Refuge	Nitrogen	Annual [1]	2.37E-02	0.005	474
Gates of the Arctic	Nitrogen	Annual [1]	4.68E-03	0.005	94
Alaska National Wildlife Refuge	Sulfur	Annual [1]	3.91E-03	0.005	78
Gates of the Arctic	Sulfur	Annual [1]	7.93E-04	0.005	16

[1] Maximum cumulative impacts occur in year 2008, thus represent a true annual impact.

[2] Maximum cumulative impacts occur in the first portion of year 2007 (7100 hours), thus do not represent a true annual impact. The conversion from g/m2/s to kg/ha/yr assumes 8784 hours, thus reported impacts are conservative.

The results of the far-field modeling for Alternatives A and D provide the following comparisons:

- Alternatives A and D are predicted to have the same impacts at the Alaska National Wildlife Refuge when comparing the percentage of the NAAQS/AAAQS for each pollutant and averaging period.
- Alternatives A and D are predicted to have the same impacts at Gates of the Arctic National Park when comparing the percentage of the NAAQS/AAAQS for each pollutant and averaging period.
- Alternative D is predicted to result in higher nitrogen and sulfur deposition at the Alaska National Wildlife Refuge and Gates of the Arctic National Park than Alternative A.

Cumulative impacts are predicted when all RFD is included in the modeling due to the projected scope of oil and gas development on the North Slope.

Noise

The project area is remote and sparsely populated with few existing sources of man-made noise. Existing sources of noise include: vehicle operations; aircraft operations, boat operations (outboard motors), and oil and oil field equipment operations. Operation of equipment during exploration, drilling, facility construction (including mining activities) and production and use of aircraft for transportation of personnel and materials contribute noise to the environment. During peak periods of construction and drilling, noise levels would be considerably higher than during operations, but would be short-term and would not occur for all facilities at the same time.

The potential noise associated with Alternatives A and B of the GMT1 Project and the conceptual GMT2 Project is unlikely to impact the community. However, residents of the Native Village of Nuiqsut travel widely for subsistence and may come within the auditory range of one of these stationary noise sources (see Figure 3.4.3-1). Alternative C would have greater noise impacts to the community of Nuiqsut resulting from the proximity of air traffic, construction, and use of the Nuiqsut Airport and planned Nuiqsut Spur Road to the Native Village of Nuiqsut. Alternative D would utilize aircraft to access the GMT1 site and the noise from aircraft flying between APF and GMT1 may be detectable at the Native Village of Nuiqsut under certain weather conditions. Project-specific noise impacts to the Native Village of Nuiqsut would likely be less under the conceptual GMT2 Project due to its distance from the community.

Subsistence gatherers may be exposed to noise above ambient levels if they are seeking caribou or other subsistence resources in the vicinity of GMT1. Noise levels would be similar for Alternatives A, and B with respect to potential aircraft noise (fixed-wing and helicopters). The cumulative impact of noise from increased use of aircraft at the Alpine Airport, under Alternatives A and B would be minor intensity and interim duration for CPAI's proposed project. Cumulative impacts of noise would continue with construction and operation of GMT2, and would last through reclamation of that pad.

Alternative D would use aircraft to access GMT1, which would continue for the entire project life; a substantial part of the total annual increase aircraft use under Alternative D would be for helicopter access. Aircraft access for construction of the conceptual GMT2 would be similar to the construction of GMT1, but would not occur for several years after the GMT1 Project has been completed. Alternative E would have no incremental adverse cumulative impact from noise.

The cumulative impact of the increased vehicle noise due to use of the GMT1 road would be minor intensity and long term in duration. Under Alternative D, noise from aircraft and traffic on annual ice roads likely would have a greater cumulative impact than noise from Alternatives A, B, and C due to the synergistic effects by airports at GMT1, GMT2, and Umiat in a relatively short flight distance. Noise impacts from vehicle access to the Umiat area via the Umiat Road/Pipeline(s) also would be moderate and long term. See the discussions on sections 4.3.3, 4.3.4, 4.3.5, and 4.4.3 for the evaluation of vehicle and aircraft noise to wildlife and to subsistence.

The BLM (2004, § 4G.5.9) found that because the Native Village of Nuiqsut is several miles from the proposed development, noise impacts would be minor unless future development occurred much closer to the village of Nuiqsut or any other village. The project would result in negligible incremental increases in localized ambient noise from construction and operations equipment and aircraft. The 2004 cumulative analysis estimated that noise effects from infrastructure and activities related to past, present and reasonably foreseeable would be localized and short-term, and the sources of noise would not be geographically concentrated, however, new information indicates that some impacts may be major and potentially long-term as development continues on the North Slope.

The direct, indirect, and cumulative impact from noise associated with the proposed GMT1, conceptual GMT2, and completion of CD5 and the Nuiqsut Spur Road would be moderate and long-term. Noise from construction and gravel mining would be limited primarily to the winter months and would terminate after about two years. Primary noise impacts from RFF offshore development would be aircraft use, notably helicopters. Cumulative impacts to noise from RFF onshore oil and gas activities west of the Alpine field, such as in the Bear Tooth Unit, would be similar to those associated with the GMT1 Project, would be additive, and are expected to be localized and potentially long-term.

Climate Change

BLM (2012, § 4.8) provides an updated analyses and conclusions about the cumulative effects of oil and gas development in NPR-A which includes the GMT1 and the conceptual GMT2 Project study area. These evaluations and conclusions are incorporated by reference and summarized below.

> *"Emissions from sources have contributed to increases in criteria pollutants, hazardous air pollutants, hydrocarbons, and greenhouse gases. It may be difficult*

> *to discern whether global climate change is already affecting resources within and adjacent to the [NPR-A]. Projected changes are likely to occur over several decades to a century. Therefore, many of the projected changes associated with climate change that could affect air quality, visibility, and atmospheric deposition may not be measurable within the reasonably foreseeable future. Existing climate prediction models are global or continental in scale. There are no tools available to estimate potential impacts of a single greenhouse gas emission source on global climate change."* (BLM 2012, § 4.8.7.1, p.72)

> *"Although the cumulative effects of global greenhouse gas emissions are well-understood, our current scientific understanding of climate change does not allow us to relate specific sources of greenhouse gas emissions to any specific climate-related regional or global impacts. Further, since the specific effects of [oil and gas development projects in NPR-A], which may or may not contribute to climate change, cannot be determined, it is not possible to determine whether any particular action will lead to significant climate-related environmental effects."* (BLM 2012, § 4.8.7.1, p. 75)

Although the project is not anticipated to cumulatively impact climate change, the effects of climate change for each resource are fully described in the Affected Environment section, Chapter 3.

BLM (2012, § 4.8.7) concluded the cumulative effect of climate change is likely more pronounced on the North Slope than elsewhere in Alaska and may include an increase in particulate matter to the extent shallow lakes and ponds dry up or are smaller, watersheds would experience a change to drier soils, and thermokarsting may increase as ice-rich permafrost becomes unstable with increases in ambient surface temperatures.

The cumulative effects of Alternatives A and B on climate change are considered to be identical. Alternative C would have a very slight increase in cumulative impacts because of a greater overall distance of vehicle traffic on gravel roads between Nuiqsut, GMT1, GMT2, and Alpine. Alternative D eliminates gravel road traffic and substitutes winter ice road access and aircraft to both GMT1 and the conceptual GMT2 which may produce more emissions that the other action alternatives. There may be fewer incremental impacts if Alternative E is selected through the reduction or elimination of emissions that may contribute to climate change.

4.6.4.2 Biological Resources

Vegetation and Wetlands

Impacts to vegetation and wetlands would result from construction, operations, and abandonment or rehabilitation of sites. The land area within the project study area is approximately 97 percent wetlands (see Section 4.3.1). The cumulative impacts to vegetation and wetlands include the direct loss of land cover due to placing gravel fill on the tundra and by mining gravel, and indirect loss of land cover as a result of the location of fill, modification of surface drainage, gravel spray and dust (extending outward 300 feet from the facility footprint).

As discussed in section 4.3.1, the direct footprint of Alternatives A, B, and D would be less than 0.1 percent of the total project study area, while the direct footprint of Alterative C would be 0.1 percent of the project study area. Alternatives A, B, and D would indirectly impact less than one percent of the project study area, while Alternative C would indirectly impact 1.3 percent. The impacts of Alternatives B and D to vegetation and wetlands are characterized as minor in magnitude, long-term, the resource is important in context as wetlands are protected by legislation, and the geographic extent is considered local. The impacts of Alternatives A and C to vegetation and wetlands are characterized as moderate in magnitude, long-term, the resource is important in context as wetlands are protected by legislation, and the geographic extent is considered local. Alternative E would not have any adverse impacts on vegetation and wetlands.

Direct and indirect impacts on vegetation and wetlands from the conceptual GMT2 Project are expected to be similar to those of the GMT1 project. However, the location of the GMT2 Project area is to the west of the GMT1 Project area, and as such, the GMT2 Project has the potential to affect different amounts of vegetation types and wetlands. Cumulative impacts from the addition of the GMT2 Project would be additive.

The BLM (2004) predicted the potential cumulative impacts to wetlands and vegetation to be minor (BLM 2004, § 4G.6.1). The incremental contribution to cumulative impacts from CPAI's proposal would be minor, unless a large oil spill was to occur. Impacts to the North Slope vegetation communities from ASDP termination activities would result in a small temporary contribution to cumulative impacts and a recovery over the long term, although the benefit would be very small relative to the total area of tundra vegetation. The affected area is a small fraction of the total North Slope acreage. It is also not expected that synergistic impacts (whether beneficial or adverse) to vegetation would occur as a result of developing additional acres. The potential cumulative impacts to vegetation and wetlands of the proposed project are within the range analyzed by BLM in 2004.

According to BLM (2012, § 4.8.7.6) oil and gas development offshore in the Chukchi and Beaufort seas, construction of a road and pipeline(s) between Umiat and the Dalton Highway, construction of a commercial gas pipeline and unconventional oil and gas development east of the NPR-A could affect up to 50,100 acres of wetlands and floodplains. The total future direct and indirect impacts to wetlands and floodplains on the North Slope would be the sum of impacts from the gravel footprint, excavation of material sites, and construction of elevated and buried pipelines. The total area of direct, long term impacts to wetlands from future development would be approximately 47,000 acres, which would be additive to the acres already impacted from past and present oil and gas activities. Based on an eight to one ratio for indirect to direct impacts (based on Alternative A indirect and direct impacts), a total of approximately 376,000 acres of wetlands could be indirectly impacted over the long term by gravel from future oil and gas development in the NPR-A (BLM 2012, § 4.8.7.6).

Although the increase in the amount of area disturbed by oil and gas development has slowed dramatically in recent years, the 2012 IAP/EIS estimated that an additional 3,750 acres could be covered by gravel and 750 acres impacted by gravel mines east of the NPR-A between 2012 and 2100. Approximately 27,000 acres of vegetation would be indirectly affected by dust, changes in hydrology, and thermokarst (BLM 2012, § 4.8.7.5).

The Alpine Satellite Development Project facilities (except CD3) and all of the Nuiqsut Spur Road, Colville River Road Access, and the community of Nuiqsut are within the boundaries of the project study area and thus, construction in these locations would have additive impacts to vegetation and wetlands. This cumulative impact evaluation assumes that any infrastructure

associated with the conceptual GMT2 Project would be in wetland vegetation types, which is true for the proposed GMT1 Project and several other projects in the Nuiqsut area.

The vegetation and wetlands impacts of the action alternatives are within the range of cumulative impacts of oil and gas activities analyzed in 2012 (i.e., minor and localized; BLM 2012, Table 4.8, p. 74). Alternative C would have approximately 30 percent greater area of direct impact to vegetation and wetlands compared to the other action alternatives. Non-oil and gas development and oil and gas activities would occupy a total of less than 14,000 acres within the largely undeveloped 4.3 million acres area comprising the Harrison Bay and Lower Colville River watersheds. Future impacts to vegetation both inside and outside of the NPR-A are additive to the impacts to vegetation that have accumulated in the past and persist today, but in the context of the entire North Slope, these cumulative impacts would be relatively minor. Climate change may eventually lead to shifts in the composition of Arctic tundra. Permafrost may thaw to an increased depth each season, which will cause varying degrees of impacts on subsidence, soil moisture, and vegetation. The potential for many shallow streams, ponds, and wetlands in the Arctic to dry out under a warming climate is increased by the loss of permafrost. Such impacts of climate change could accumulate with any changes in soil thermal regimes that might occur as a result of past and future non-oil and gas and oil and gas activities in and near NPR-A, potentially leading to synergistic impacts to vegetation.

As oil and gas development and production increase on the North Slope, the more need there will be for removal of infrastructure and rehabilitation of vegetation. Removal of aboveground facilities, pipelines, bridges, and power poles would have a minor impact on vegetation. Roads and pads will remain unaffected if they are maintained, but once maintenance ceases, thaw subsidence in ice-rich areas could result in settling of the gravel structures into thermokarst troughs. Removal of the roads and pads would accelerate thaw subsidence, but would also accelerate the reclamation process. Removal of gravel fill has recently been done in wetlands, and preliminary studies suggest that wetland mosaics of vegetation can be restored, although the method is expensive and finding acceptable locations for the fill can be difficult.

The primary impact to vegetation and wetlands associated with the proposed project, conceptual GMT2 Project, and other RFF projects are the permanent loss of vegetation and wetlands through the placement of gravel to support infrastructure and transportation systems such as roads. The loss of vegetation and wetlands through the development of GMT1, GMT2, and other RFF projects will also affect other resources, which rely on these for habitat. For example, the footprint of the Umiat Road/Pipeline would affect about an additional 185 acres of vegetation and wetlands that may be used for habitat. Development of the Umiat Road and a road leading from the Dalton Highway to the boundary of the NPR-A could make additional developments within the Umiat area and NPR-A more economical, causing a synergistic increase in the amount of vegetation and wetlands lost in the NPR-A through both direct and indirect actions.

The effects of continued development west of GMT1 in the Bear Tooth Unit would be expected to have the same small incremental effect on vegetation and wetlands as is currently occurring. Permanent loss of vegetation and wetlands used for habitat would likely be negligible due to the small number of acres likely to be affected.

In addition to the permanent loss of vegetation and wetlands to development, these resources may also be impacted by spills. Under the RFF scenario the amount of oil produced on the North Slope is expected to continue to decrease from historic high levels. As oil production slows, coupled with improvement in spill prevention, control technologies and training, the potential for effects to vegetation and wetlands should decline over time.

Overall, the direct, indirect, and cumulative impact to vegetation and wetlands associated with the proposed GMT1, conceptual GMT2, and completion of other RFF projects would be moderate intensity and long term duration.

Fish and Fish Habitat

The potential impacts to fish as a result of oil and gas development associated with CPAI's proposed project include injury at water-use intakes, altered water quality, physical habitat changes (water quantity, flow patterns, and geomorphology), point and non-point source pollution, increased turbidity and sedimentation, and barriers to fish movements. Collectively, these could contribute to reduced success at different life history stages, behavioral changes, diminished condition, susceptibility to pollutants or disease, shifts in fish species distribution, and mortality.

Impacts under CPAI's proposed project are expected to be higher during the construction phase. In general, the greater amount of infrastructure and activities, the higher the expected incidents of impacts to fish and fish habitats. As such, the highest anticipated impacts would occur under Alternatives A and C followed by Alternatives B and D. Alternative B, which would avoid pipeline crossings of two tributary streams, potentially reducing the likelihood of a large spill reaching a river, although under all of the action alternatives, there will be at least one water body crossed by a pipeline. Overall impacts under Alternatives A and C are anticipated to be similar. With respect to Alternative D, the lack of road and associated bridges and culverts would avoid many of the potential disruptions to fish and fish habitats, although annual ice roads would be required for the life of the project (long term) to provide access for heavy equipment to the GMT1 site. Alternative D would also require additional pipelines (diesel and water), which would pose an incremental spill risk.

The overall anticipated impacts for the action alternatives (A, B, C, and D) for CPAI's proposed GMT1 Project with respect to fish and fish habitat are expected to be similar with respect to intensity (minor), extent (local), and context (important) and duration (long term). Overall, all of the action alternatives are expected to have a minor overall impact on fish and fish habitat. Alternative E, would have no impacts to fish or fish habitat.

The predicted road corridor linking GMT1 with a conceptual GMT2 site would not require major river crossings such as the GMT1 road crossing of the Tiŋmiaqsiġvik (Ublutuoch) River, although at least one relatively small fish-bearing stream would be crossed (tributary to Blackfish Creek west of GMT1). Lakes along the route would be potential water sources for ice road construction, although only a few of the lakes near the conceptual GMT2 access road route are identified as containing species in addition to ninespine stickleback (Figure 3.3-4). In general, there are fewer streams and lakes in the vicinity of GMT2 compared to GMT1.

The BLM (2004) found that the direct, indirect, and cumulative impacts to fish and fish habitats are expected to be localized, minor, additive, and are not expected to be synergistic. Although there is a potential for large impacts to fish from large oil spills, the risk of such spills is relatively small. The probability is higher for smaller spills, but the impacts from such spills, if they entered freshwater habitats, would likely be small, temporary, and additive and unlikely to severely affect fish populations, especially in light of control and cleanup activities implemented in response to spill events (BLM 2004, § 4G.6.2). Effects on fish from North Slope oil spills on land thus far have not accumulated because the spills have been small and cleanup and rehabilitation efforts have generally been successful (BLM 2012, § 4.8.7.7). A large spill reaching Crea Creek or the Tiŋmiaqsiġvik (Ublutuoch) River could have long-term adverse

impact to fish; the risk of such a spill is considered unlikely. No adverse effect to essential fish habitat is expected from project facilities.

The 2012 IAP/EIS found that gravel infrastructure (roads, pads, airstrips) and gravel mining associated with North Slope oil and gas development and production have caused effects on fish that have accumulated by impeding fish movements and significantly altering the physical and chemical conditions of fish habitat. Oil and gas development and production in the Chukchi Sea, Beaufort Sea, or to the east of the NPR-A would require additional facilities and infrastructure that would cause impacts on fish that would be additive to impacts from NPR-A development. Other construction projects, such as a road connecting Umiat with the Dalton Highway or commercial gas pipelines from the North Slope to southern regions, would increase the likelihood of development impacts on North Slope fish. Impacts to fish from the current proposed project are within the range considered by BLM (2012, § 4.8.7.7).

If predicted shifts in physiochemical characteristics of the environment occur with climate change, this could contribute to an increased level of cumulative impacts on fish in the Arctic. For example, if water temperatures increase excessively, metabolic stress for many fish species would be greater and result in lower tolerance thresholds to land-use impacts. Changes in hydrologic regimes could include timing and quantity of flow and could contribute to fish passage problems at stream channel or wetland road crossings. Potential effects from climate change could be positive for fish, as well. If the ice-free period for freshwater and marine habitats increases significantly, this would mean a longer feeding season for fish and shorter periods of stress during winter. A moderate increase in water temperature could also contribute to a more productive feeding season and further enable fish to survive the winter and additional stress from oil and gas activities (BLM 2012, § 4.8.7.7).

To date, very little abandonment (except for single exploration or development wells) has occurred anywhere on the North Slope. However, abandonment of gravel pads and roads, as well as pipelines, would most likely only have a temporary impact on local aquatic habitats. Removal of problematic stream crossing structures would contribute to positive cumulative effects on fish by allowing fish to reach habitats that were previously made inaccessible. Since many abandoned North Slope gravel mines have provided additional overwintering and spawning habitat for fish, it is assumed that future efforts would produce similar results and lead to cumulative effects that are positive for fish (BLM 2012, § 4.8.7.7). Thus there is countervailing potential that reclamation of the Clover site might be converted to a deep water lake providing overwinter fish habitat. Likewise, final cleanup at the Umiat landfill would be beneficial and important.

Construction of new gravel roads provides improved access to subsistence and sport harvest of fish from waters that were previously remote. Improved access carries a risk that small populations of slow growing fish may be overharvested. Although this is possible, it is unlikely that substantially increased harvest levels would go unnoticed or unchecked. Accordingly, there is a risk of overharvesting local populations of fish.

The direct, indirect, and cumulative impact to fish and fish habitat associated with the proposed GMT1, conceptual GMT2, and other RFF projects would be additive and in some scenarios, could be synergistic. Most of the RFF projects would result in some cumulative impacts to fish and fish habitat to the extent that they increase the footprint of gravel pads and roads. Projects which introduce infrastructure across fish-bearing streams or are perpendicular to hydrologic flow would have a greater cumulative impact to fish and fish habitat.

Oil and gas development and production to the east of the NPR-A would require additional facilities and infrastructure that would be additive to impacts from NPR-A development. A road and pipeline connecting Umiat with the Dalton Highway would increase the likelihood of additional impacts to the east of and within the NPR-A. This road to Umiat could also lead to synergistic pressures on fish in the Colville River and its tributaries due to greater use of the area for sport and subsistence fishing.

Collectively, these cumulative effects from onshore oil and gas development and production could reduce the size and structure of fish populations, diminish individual fish condition, and shift local fish community composition and species distribution.

Cumulative impacts are expected to have a negligible effect on fish populations in the project study area or in the Harrison Bay and Lower Colville River watershed. Most RFF projects would only have additive cumulative impacts in the localized area of development. Alternative E would have no incremental adverse cumulative impact to fish and fish habitat.

Birds

As noted in section 4.3.3, all of the action alternatives associated with CPAI's proposed GMT1 Project have the potential, via direct and indirect impacts, to affect birds, bird behavior, and their nesting, brood-rearing, foraging, and molting habitats through habitat loss, alteration, and disturbance, such as physical changes resulting in loss of habitat, displacement from habitats altered by vehicle noise, dust deposition, and thermokarst, attraction to habitats altered by thermokarst and early green-up adjacent to gravel infrastructure, or disturbance from increased aircraft noise or visual stimuli.

With respect to CPAI's proposed project, Alternative D would have the greatest potential impact to birds of the four action alternatives. Direct impacts to bird habitats from gravel placement would be greater for Alternative D than Alternatives A, B, and C. Alternatives A and B would be similar in terms of potential cumulative direct impact to birds. Alternative C would have greater indirect effects than the other action alternatives with respect to fugitive dust and mortality risk from vehicle strikes. Alternative B, while having a similar road length to A, would affect greater area of potential high value waterbird habitat than Alternative A, due to its more southern route through drained lake basins. Alternative A would have the least amount of potential cumulative impact to birds among all of the action alternatives with other direct and indirect impacts predicted to be less than Alternatives B, C, and D. Alternative E would not have any positive or negative impacts on birds.

Direct impacts to birds associated with the GMT1 Project are expected to be localized and moderate in nature with no adverse effects expected at the population level. The direct, indirect, and cumulative habitat loss of bird habitat generally would be of low intensity, long-term in duration, localized, and minor. Overall, it is anticipated that less than 1 percent of the estimated total bird habitat in the project study area would be impacted by any single action alternative.

Potential impacts to birds from the GMT2 Project are expected to be similar to those of the GMT1 project. However, the GMT2 Project study area has the potential to impact different proportions of specific bird habitats, as habitat types may occur in different quantities and locations throughout the conceptual GMT2 project study area. Additionally, lakes along the predicted road that would link GMT1 with GMT2 would be potential water sources for ice road construction. This use of water could potentially impact bird habitat or food sources in affected lakes. Together, the cumulative impacts of GMT2 and GMT1 on birds would be additive.

The BLM (2004) found that the additive impacts of past, present, and RFF activities are not expected to cause pervasive cumulative impacts, including impacts from synergistic effects to bird populations on the North Slope BLM (2004, § 4G.6.3.2, p. 1273). BLM expected that the effects of facilities for future projects on bird populations, though additive, would be substantially less than those of past projects because of the smaller areas involved. Oil spills would not significantly add to cumulative impacts, except for an unlikely to very unlikely large spill to aquatic habitats. Increased harvests resulting from increased access to remote areas via new roads, especially from subsistence hunting, were characterized as a serious cumulative factor. Subsistence harvest within the ASDP Area would affect approximately 2,800 birds and eggs, compared to an estimated 950 nesting waterbirds and ptarmigan affected by habitat loss, alteration, and disturbance caused by reasonably foreseeable future development within the Plan Area. Overall direct mortality effects due to collisions with vehicles, aircraft, buildings, pipelines, powerlines and communications towers were estimated to occur only at very low levels in the North Slope oilfields during present and future developments. BLM pointed out that NRC (2003) concluded that reduced productivity was the most substantial cumulative impact to bird populations due to oil and gas development activities, and that determination was based on decreased productivity due to increased levels of predators attracted to the development area. The NRC (2003) review focused on the Prudhoe Bay Oilfield, with most studies conducted through the mid 1990s when the landfill and dumpsters were accessible by gulls, ravens, bears and foxes. Since the late 1990s, the landfill has been fenced to exclude bears, and animal proof dumpsters have been installed throughout North Slope oilfields (BLM 2004, § 4G.6.3.2, p. 1273).

The BLM (2012, § 4.8.7.8) analyzed potential cumulative impacts across the North Slope to non-special status bird species occurring in the NPR-A and came to the following conclusions: Effects on birds from non-oil and gas activities that are part of BLM operations or authorizations were not expected to accumulate. Oil and gas development in the Chukchi and Beaufort seas offshore leases, construction of a road and pipeline(s) between Umiat and the Dalton Highway, and construction of a commercial gas pipeline and unconventional oil and gas development east of the NPR-A could cause direct and indirect impacts to bird habitat. Large discoveries of oil in the Chukchi or Beaufort seas offshore could make additional developments in the northern NPR-A more economically feasible, resulting synergistically in even more habitat and disturbance impacts to birds in the NPR-A. Cumulative effects on bird productivity and abundance are likely to be long-term and could result in adverse effects on productivity of some species of birds. If climate change over the next several decades were to result in substantial changes in weather patterns, vegetation types and distribution, and insect abundance, habitat disturbance effects from oil and gas activities could be exacerbated additively, and perhaps synergistically, and extend beyond the life of the oil and gas fields. Changes in vegetation as a result of climate change would directly impact the amount and types of habitat available to tundra nesting birds. Such impacts of climate change could accumulate with any changes in soil thermal regimes that might occur as a result of past and future non-oil and gas and oil and gas activities in and near the NPR-A, potentially leading to synergistic impacts to bird habitat (BLM 2012, § 4.8.7.8).

All future impacts will be additive to the impacts to birds and bird habitat that have accumulated in the past and persist today, but in the context of the entire North Slope west of the Canning River, these cumulative impacts are expected to be relatively small. The 2012 IAP/EIS found that if current rates of development continue into the future, about 3,750 additional acres of bird habitat would be lost through the construction of pads, roads and airstrips through the year 2100 and 750 acres by gravel mines. About 27,000 additional acres would be indirectly affected by dust, changes in hydrology, and thermokarst through 2100. The effects of the proposed GMT1 project are within the range considered by BLM (2012).

Further development in the cumulative effects evaluation area related to the conceptual GMT2 development and other RFF projects may also impact birds as described above and result in a cumulative reduction in avian habitat and an increase in disturbance. These impacts are not expected to cause pervasive cumulative impacts as the effects of CPAI's currently proposed and RFF projects on bird populations, though additive, would be less than those of past projects because of the smaller areas involved and the large amount of avian habitat existing in the area of evaluation. The contribution from the GMT1 Project is expected to be negligible with respect to the cumulative effects evaluation area, and would be decreased from that approved in BLM (2004a) based on a reduction of the overall project footprint of 38 acres. Alternative E would not have any incremental cumulative impacts to birds.

The combination of impacts from GMT1, coupled with impacts from the conceptual GMT2 and other RFF projects in the Nuiqust area and Umiat areas, would be additive, long-term, and localized with the contribution from the GMT1 project having overall minor impact to birds. Impacts from RFF projects are anticipated to be of a similar nature as those of the proposed project considering the range of action alternatives. A synergistic effect to bird habits at Umiat and the Nuiqsut area are not expected. The overall cumulative impact to bird for the Harrison Bay and Lower Colville River watersheds for the proposed project, conceptual GMT2, and other RFF projects is considered to be minor.

Terrestrial Mammals

Caribou

Cumulative impacts on caribou as a result of habitat loss and disturbance to animals are discussed in general terms under impacts on terrestrial habitats. Caribou may be affected by temporary ice roads and pads, and by disturbance caused by construction and operations, especially during migration and calving periods.

Both the Teshekpuk Herd (TH) and the Central Arctic Herd (CAH) use the project study area in low densities for calving, and for winter/summer forage during one or more seasons each year. The TH tends to use the area more than does the CAH. Although the footprint of facilities is a good indicator of potential impact to caribou, the activity occurring at the production pad, road and airfields produce different effects to caribou. The combined GMT1 and conceptual GMT2 project would have the greatest impact under Alternative C followed by Alternatives D, B, and A. Impacts associated with vehicle traffic would be greatest under Alternative C, due to the increased distance vehicles would have to travel. Alternative D would have no road traffic, but the absence of impacts from roads are likely offset by the increase in impacts from air traffic at the Nuiqsut Airport, APF, at GMT1, and at the conceptual GMT2 site. The use of aircraft at four airports that are 11 to 19 miles apart under Alternative D is expected to have the greatest overall impact to caribou. Data is presented for caribou in Sections 3.3.4.1 and 4.3.4, *Mammals,* Sections 4.3.2 and 4.4.1, *Vegetation and Wetlands*, and (Sections 3.4.3 and 4.4.3). In addition to direct and indirect impacts to caribou from the GMT1 project and conceptual GMT2 project, the addition of the GMT2 project could add increased hunting pressure to caribou herds due to increased access via a westward expansion of development. As noted in section 4.3.4, the GMT1 project and reasonably foreseeable GMT2 project are not located within the current high-density calving ranges of the TH or CAH caribou.

As described in BLM (2004), cumulative impacts on caribou from road traffic would be expected to have short-term displacement, especially during calving when maternal caribou avoid areas within 1.2 to 2.5 miles (2-4 km) of roads, but generally would not be expected to have measurable effect on herd abundance or large-scale patterns of distribution (BLM 2004, p.

1276). The contribution from all alternatives of the GMT1 Project is expected to be minor or negligible, and synergistic effects at the herd level would not be anticipated. This is within the range of cumulative impacts addressed in BLM (2004).

Oil and gas development in the Chukchi and Beaufort, construction of a road and pipeline(s) between Umiat and the Dalton Highway; construction of a commercial gas pipeline and unconventional oil and gas development east of the NPR-A could cause direct, terrestrial impacts on up to 12,630 acres of mammal habitat and indirect impacts on 37,585 acres (BLM 2012, § 4.6.7.8). Impacts to all mammalian populations from the combined effects of vegetation change (from both human activities and climate change) and climate change induced weather patterns could prove to be synergistic rather than additive. Impacts from the current project are within the range considered in 2012. The TH calving distribution has been expanding in recent years, so future impacts are difficult to predict. Some caribou could be displaced from insect-relief areas in the summer, but this impact could be offset by the creation of new insect-relief areas. Additional details of cumulative effects of both the proposed GMT1 and conceptual GMT2 development are described below.

Overall, industry and agency actions on the North Slope are expected have minor impacts to caribou herd productivity. The area between the Colville and Canning rivers represents much of the range of the CAH. In some winters, this area is also important habitat for some TH caribou. Cumulative impacts on caribou are within the range of cumulative impacts from oil and gas activities considered by BLM (2012), which estimated there would be a direct reduction of 43,150 acres of caribou habitat by 2100 (Table 4.6-2). The Umiat Road/Pipeline(s) project could have negative impacts to caribou migration to the extent that it would intersect spring/winter migration routes across the Brooks Range; the Umiat Road/Pipelines(s) could also have significant negative impacts on subsistence activities affecting primarily Anaktuvuk Pass and Nuiqut. The Umiat Road could have traffic amounts similar to the Dalton Highway opening a large, currently non-easily accessible, area to the public. Non-local hunters could use the road to hunt caribou. The road would result in easy public access to the Colville River and thus by boat to the Colville Delta and Beaufort Sea as well as to any navigable tributary of the Colville. The road, pipeline, traffic, and hunters would be in the path of north-south migration routes and could potentially affect caribou from the TH and CAH during some autumn and spring migrations. Alternative E would have no incremental adverse cumulative impact to caribou populations and distribution on the North Slope.

Grizzly Bear, Fox, and Other Terrestrial Mammals

Impacts under the proposed project's action alternatives are expected to be higher during the construction phase. Construction of the project action alternatives would result in long-term, direct and indirect habitat loss due to gravel extraction and the placement of gravel for roads, pads, and an airstrip (Table 4.3-15). Once construction is completed, the drilling and operation phase would affect terrestrial mammals and their habitats through medium-term habitat alteration and disturbance, medium-term potential for vehicle collision and human safety mortality, and medium-term altered survival or productivity. Potential impacts from the conceptual GMT2 project are expected to be similar to those associated with the GMT1 project. Given the proximity of GMT2 to GMT1, direct and indirect impacts to specific habitats from both projects would be cumulatively additive. Construction and operation of the GMT2 project would allow for increased access to westward habitat types, and thus species residing within them, which has the potential to increase hunting pressure on species present in the areas in or adjacent to the GMT2 project.

Overall, Alternatives A, B, and C are expected to result in minor impacts to terrestrial mammals. Alternative D is expected to result in overall moderate impacts to terrestrial mammals. Alternatives A, B, and C would have similar impacts to terrestrial mammals, with impacts due to habitat loss and alteration expected to be of minor intensity, long-term duration, and local extent (Table 4.3-17). The affected resources, which in this case include important subsistence food resources for the local community, are rated important because caribou fill a distinctive ecosystem and ecological service role within the locality and region.

The BLM (2004) found that oil development on the North Slope would likely result in increased abundance of arctic foxes near development areas, which may present a rabies health hazard to humans in the oilfield areas. The attraction of grizzly bears to human refuse would lead to the loss of bears as the result of interactions with humans, which would lead to an eventual decline in bear abundance near development areas. The cumulative effects on muskoxen, moose, wolves, wolverines, and small mammals from oil and gas development on the North Slope would be local and short term, within 1 to 2 miles of exploration or development facilities, and with no adverse effects on populations (BLM 2004, § 4G.6.4.1).

The BLM (2012, § 4.8.7.9) analyzed potential cumulative impacts across the North Slope to mammals occurring in the NPR-A. Some impacts that could prove to be synergistic rather than additive are the combined effects of vegetation change (from both human activities and climate change) and climate change induced weather patterns on the productivity of all mammalian populations; vegetation change, climate change induced weather patterns, increased insect activity, and year-round development effects on the productivity of caribou populations; and predation, oil development and climate change on muskoxen. Mammalian populations have inherent levels of resilience, through behavioral flexibility and movement, to change in different factors affecting survival and productivity. Development of oil and gas in the NPR-A, alone or in combination with similar development elsewhere on the North Slope or offshore, could result in a decrease in this level of resilience. For some species, the magnitude of decrease may be adequate to result in negative population level responses.

Although the footprints would increase when GMT1 and the conceptual GMT2 are combined, the cumulative impacts to grizzly bear, foxes and other terrestrial and marine mammals are expected to be similar to those described for GMT1 and its action alternatives due to the generally widely dispersed habitat requirements of these species; these impacts are expected to be minor under Alternatives A, B, and C and moderate under Alternative D. Some mammal populations (e.g., fox and grizzly bear) have been little affected from development on the North Slope. The greatest threat to grizzly bears is increased hunter access under Alternatives A, B, and C, as well as a potential increase in mortality in the defense of life and property at the GMT1 and the conceptual GMT2 sites. Fox populations may increase, but mitigation measures should minimize any potential expansion of fox populations in the project study area.

The cumulative impacts to grizzly bear, foxes, and other terrestrial and marine mammals would be additive when considering other RFF projects, which would extend the area of impact to a much larger area. Of the RFF projects, the Umiat Road/Pipeline and offshore development with its associated onshore development, would likely have the greatest additive impact based on the area affected. In the case of the Umiat Road/Pipeline, with 102 miles of proposed roadway, mammals on the North Slope, which may have experienced little impact to date, could be impacted more widely based on the expanded network of development and farther reaching access for hunters. The addition of the Colville River Road Access would complete a road connection providing year-around vehicle access to fish and wildlife resources along the Colville River and its Delta, as well as to estuarine and marine resources along the coast. Offshore

development and development of onshore support facilities would have cumulative additive impacts to marine mammals and their habitats. This impact would be anticipated to be long-term, localized, and depending on the species and location would range in intensity.

Marine Mammals

Marine mammals are not expected to occur either within the project study area, or north of the project study area along the coastline of Harrison Bay. The exceptions are polar bear (which are covered under Threatened and Endangered Species), spotted seal, and the beluga whale. Other marine mammals, which rarely occur in the Beaufort Sea, are not expected to experience actual or cumulative impacts from the development. These species include ribbon seal, gray whale, minke whale, narwhal, harbor porpoise, and killer whale. Sections 3.3.4 and 4.3.4 discuss the remote chance of spotted seal or beluga whales being impacted during an oil spill reaching open water. If spotted seals or beluga whales were to come into contact or ingest oil, it could lead to negative impacts for survivability and fitness of the local population, especially if the occurrence was repetitive.

Oil and gas development could affect these species as a result of noise and disturbance. Disturbance associated with air traffic could result in potential adverse effects to distribution and cause shifts in areas of regular use, such as Colville River Delta haul-outs for spotted seal. The location of the GMT1 project is such that impacts to marine mammals are considered to be minor. Due to the location of the conceptual GMT2 project being similarly distant from the coast, impacts to marine mammals would be additive, but still minor.

The BLM (2004, § 4G.6.4.2) found that onshore development with associated facilities along the Colville River would expose some spotted seals to increased noise and disturbance associated with vessel and air traffic. Future facilities in river deltas and elsewhere along the coast and near rivers would have the potential to affect seals and whales. Beluga have already been exposed to oil-exploration activities in the Beaufort Sea, including seismic surveying, drilling, air and vessel traffic, dredging, and gravel dumping. A future increase in these activities in the Beaufort Sea (especially barge traffic to the North Slope, and some icebreaker activity to support oil exploration) could affect how seals are distributed near the activity for one season (less than one year) during high levels of activity. However, some seals would adapt to marine and air traffic, industrial noise, and human presence. Displacement from cumulative industrial activities is not likely to affect the overall abundance, productivity, or distribution of seals and beluga whales in Alaska's Beaufort Sea (BLM 2004, § 4G.6.4.2).

The BLM (2012, § 4.8.7.10) found that the contribution of effects from the NPR-A to the overall cumulative effects to non-special status marine mammals will likely be relatively small. Climate change, offshore oil and gas exploration, development and production, and commercial shipping and fishing could have large effects on marine mammals in the future. Those effects will be from anthropogenic sounds, ship strikes, and possible discharges, including spilled oil.

The possible marine activities associated with oil and gas and other activities within the NPR-A are relatively small compared to the many other large changes that are occurring in the Arctic Ocean. Therefore, activities associated with NPR-A will likely have only a small contribution to cumulative effects to marine mammals in the Beaufort and Chukchi seas. Climate change, including ocean acidification, commercial shipping and offshore industrial development are likely to have the greatest influence on marine mammal populations in and adjacent to the NPR-A. Species resilience and resistance to the changes associated with climate change as well as feedback and interactions remain highly uncertain (BLM 2012, § 4.8.7.10).

Further development in the cumulative effects evaluation area related to the conceptual GMT2 development and other RFF projects may also impact beluga whales and spotted seal through a cumulative increase in disturbance. These impacts are not expected to cause pervasive cumulative impacts, as the effects of the currently proposed and RFF projects on beluga whales and spotted seal, though additive, would be less than those of past projects due to the on-shore nature of the facilities.

The combination of impacts from GMT1 coupled with impacts from the conceptual GMT2 and other RFF projects in the Nuiqsut and Umiat areas, would be additive, long-term, and localized. The contribution to cumulative impacts from the GMT1 Project would have negligible direct, indirect, and cumulative impacts to marine mammals. Impacts from RFF projects, other than offshore development, are anticipated to be of a similar nature to those of the proposed project. Offshore development and development of onshore support facilities would have cumulative additive impacts to marine mammals and their habitats. This impact would be anticipated to be long-term, localized, and depending on the species and location would range in intensity. The overall cumulative impact to marine mammals, notably beluga whales and spotted seal, for the Harrison Bay and Colville River Delta for the proposed project, conceptual GMT2, and other RFF projects is considered to be negligible.

Threatened and Endangered Species

Threatened and endangered species are known to occur in the project study area and cumulative effects evaluation area. Overall impacts to threatened and endangered species are expected to be minor, localized, and negligible on a population basis. The following evaluations for threatened and endangered species reflect the impacts from GMT1 together with RFF projects in the Nuiqsut and Umiat areas. Unless otherwise noted in the subsequent discussions, Alternative E would have no incremental adverse cumulative impact to threatened and endangered species populations and distribution on the North Slope.

Spectacled and Steller's Eider

Section 3.3.5.1 discusses the distribution, population, and habitat associations of the spectacled eider. There is no designated critical habitat for the spectacled eider on the North Slope. Multi-year surveys show the spectacled eider is present in the project study area; with the species occurring in high concentrations on the Colville River Delta and north of the Native Village of Nuiqsut. The closest spectacled eider nest is about 0.8 mile from an existing or proposed facility. Habitats utilized by the spectacled eider adjoin the conceptual location of the road, production pad, and pipeline system of the proposed GMT1 project. The spectacled eider could be impacted by the proposed project under the action alternatives as a result of direct habitat loss, disturbance and displacement, obstruction of movement, and mortality.

Section 3.3.5.2 discusses the distribution, population, and habitat associations of Steller's eider. There is no designated critical habitat for the Steller's eider on the North Slope. Multi-year surveys show Steller's eiders are present in the general area to the north and west of road and pipeline system to the GMT1 and the conceptual GMT2 production pad, road, and pipeline system, but not within the project study area. The type of impacts to the Steller's eider for all the proposed project alternatives and RFF projects are expected to be the same as for the spectacled eider, as described above. It is noted however, that the probability of impacts to the Steller's eider is considerably lower because they occur infrequently in the project area.

Under Alternative A of CPAI's proposed GMT1 project, no significant impact to the spectacled eider population is expected due to the low population density in the vicinity of the proposed facilities. All of the action alternatives have the potential to result in direct habitat loss; direct

habitat loss under Alternative A would be less than the other action alternatives. Alternative A would have less indirect habitat loss than Alternatives B and C, and greater indirect habitat loss than Alternative D. Disturbance and displacement is expected to be lowest under Alternative A. While Alternative D would decrease the disturbance and displacement associated with a permanent gravel road, the construction and operation of an airstrip could increase these impacts. All action alternatives associated with the proposed project could increase the presence of avian predators, which are drawn to man-made facilities. Under alternatives A, B, and C, the construction of a road system could improve access for hunting of birds. Alternative E may have a positive impact with respect to the spectacled eider by retaining habitat.

Potential impacts to eiders from the GMT2 project are expected to be similar to those of the GMT1 project. However, the GMT2 project study area has the potential to impact different proportions of specific eider habitats, as habitat types may occur in different quantities and locations throughout the conceptual GMT2 project study area. Additionally, lakes along the predicted road that would link GMT1 with GMT2 would be potential water sources for ice road construction. This use of water could potentially impact eider habitat or food sources in affected lakes. Together, the cumulative impacts of GMT2 and GMT1 on eiders would be additive.

The BLM (2004) found that the incremental contribution of the Alpine Field to the cumulative effects on spectacled and Steller's eiders on the ACP was likely to be limited to occasional disturbance from aircraft overflights resulting in temporary, nonlethal effects. Disturbance of some individual eiders as a result of both onshore and offshore oil and gas operations would likely be unavoidable over the long term. The effects from typical activities associated with cumulative exploration and development of oil and gas prospects on the North Slope and adjacent marine areas may include small declines in local nesting or loss of small numbers of spectacled eiders (and potentially Steller's eiders). These impacts would occur through disturbance effects, on survival and productivity, predation pressure enhanced by human activities, and collisions with structures and vehicles. Increased human access via new roads and highways may result in locally severe increases in subsistence hunting pressures. Alternatively, subsistence hunting may decrease if hunters choose to avoid developed areas. The cumulative activities discussed above may cause localized effects with the Colville River Delta but are unlikely to cause significant cumulative population effects (BLM 2004, § 4G.6.5.2).

The BLM (2012, § 4.8.7.11) analyzed potential cumulative impacts across the North Slope to spectacled and Steller's eiders occurring in the NPR-A. Development activities that could contribute to cumulative effects to spectacled and Steller's eiders habitat and their habitat on the North Slope include onshore oil and gas development by federal, state and native entities; federal and state offshore oil and gas development (including the construction of onshore infrastructure); oil and gas transportation, including commercial gas pipelines; and road construction. All of these activities involve construction of infrastructure that would directly destroy habitat within the immediate footprint of the project and indirectly affect Special Status Species and their habitats through disturbance, predation, dust, flooding, changes in natural drainage patterns, thermokarst, snow drifting, and oil and chemical spills. Development in the northern portion of the NPR-A could have a synergistic effect on spectacled eiders using the Colville River Delta by the need for increased infrastructure or air or ground traffic in the delta to transport oil and gas, or corresponding supplies and equipment, to or from the NPR-A.

Effects on spectacled and Steller's eiders from seismic activities and exploration in the NPR-A, lands to the east, and in the Chukchi and Beaufort seas (i.e., the current project, conceptual GMT2, and other RFF projects) would be additive, and would likely accumulate. Development of a road between Umiat and the Dalton Highway could increase exploration operations along that

road and also within NPR-A due to improved accessibility. Changes to habitat as a result of climate change would lead to synergistic impacts, as described above in cumulative impacts to birds.

All future impacts would be additive to prior and current impacts to spectacled and Steller's eiders and their habitat. However, in the context of the North Slope west of the Canning River, these cumulative impacts would be relatively small (BLM 2012, § 4.8.7.11) and would be dependent upon RFF project locations relative to prime habitat and bird populations.

Further development in the cumulative effects evaluation area related to the conceptual GMT2 development and other RFF projects may also impact spectacled and Steller's eiders through a cumulative reduction in habitat and an increase in disturbance. These impacts are not expected to cause pervasive cumulative impacts, as the effects of the currently proposed and RFF projects on spectacled and Steller's eider population, though additive, would be less than those of past projects due to smaller project areas (by comparison) and the large extent of existing habitat in the area of evaluation. The contribution from the GMT1 Project is expected to be negligible with respect to the cumulative effects evaluation area, and would be decreased from that approved in the 2004 ASDP ROD due to the reduced footprint of the proposed project.

The combination of impacts from GMT1 coupled with impacts from the conceptual GMT2 and other RFF projects in the Nuiqsut and Umiat areas, would be additive, long-term, and localized. The contribution to cumulative impacts from the GMT1 Project would have negligible direct, indirect, and cumulative impacts to spectacled and Steller's eiders. Impacts from RFF projects are anticipated to be of a similar nature to those of the proposed project. A synergistic effect to spectacled and Steller's eider habitats in the Umiat and Nuiqsut areas is not expected. The overall cumulative impact to spectacled and Steller's ediers for the Harrison Bay and Lower Colville River watersheds for the proposed project, conceptual GMT2, and other RFF projects is considered to be negligible.

Yellow-Billed Loons

Section 3.3.5.3 discusses the distribution, population numbers, and habitat associations of yellow-billed loons. There is no designated critical habitat for this candidate species on the North Slope. NPR-A IAP/EIS Map 3.3.8-4 (BLM 2012) shows there is a concentration of yellow-billed loons associated with the lake area upstream from the confluence of the Tiŋmiaqsiġvik (Ublutuoch) River with Judy Creek. Deep water lakes with fish are preferred yellow-billed loon habitat. Several deep water lakes with fish are located within the general project study area and within the larger cumulative effects evaluation area; none of these lakes are in close proximity to proposed facilities for GMT1 or the conceptual GMT2. Under all of the action alternatives, deep water lakes in the cumulative effects evaluation area could be used for winter water withdrawals; these withdrawals are not expected to adversely affect yellow-billed loons. Overall impacts from the proposed project are expected to be minor to yellow-billed loons under all of the action alternatives.

Cumulative impacts to the yellow-billed loon across the North Slope were analyzed in the 2012 NPR-A IAP/EIS. Potential cumulative impacts to loons would be the same as those summarized above for spectacled and Steller's eiders.

The proposed project, in conjunction with the conceptual GMT2 and other RFF projects, could have a small additive cumulative effect with respect to yellow-billed loons as further development may result in additional infrastructure and ice roads/pads over a wider area. In addition, the development of offshore development and associated onshore facilities may also

have an additive cumulative effect with respect to yellow-billed loons, as this species has been known to utilize marine waters. At any given location, the additive cumulative location would be dependent upon RFF project locations relative to prime habitat and bird populations.

Polar Bear

Section 3.3.5.4 discusses the distribution of polar bear, a wide-ranging animal that can be found along the coast of the entire North Slope. Maternal polar bear dens are documented along the mouth of the Colville River Delta, but have not been documented inside the project study area (BLM 2012, Map 3.3.8-6). There is no designated critical habitat for this threatened species on the North Slope. The zone of previously designated critical habitat extended southward from the shoreline of the Beaufort Sea a distance of 5 miles in this area. This 5-mile zone includes CD5, but does not include the APF. GMT1 is more than 12 miles inland from the coastline and the conceptual GMT2 project is about 23 miles from the coast. Approximately 2 miles of the GMT1 pipeline system to and from CD5 are within or immediately adjacent to the 5-mile zone. CPAI has an approved polar bear plan for its existing operations on the North Slope. This plan would be expanded to incorporate operations for the GMT1 and the conceptual GMT2 project.

Impacts to polar bears from the proposed GMT1 project could result through habitat loss, disturbance, incidental harassment, intentional hazing, or mortality. Polar bears are likely to be impacted in similar ways to terrestrial mammals. Under the action alternatives, polar bears may be drawn or attracted to human activity associated with the proposed project resulting in incidental or intentional harassment. Under Alternatives A, B, and C, which add permanent gravel roads, there is an increased risk of collision with vehicles. These alternatives also increase the local transportation network, thus allowing easier access for subsistence hunters. Alternative C may cause a greater disturbance to polar bears than Alternatives A and B as the Nuiqsut Spur Road passes within one mile of potential polar bear denning habitat. Under Alternative D, there would be little or no habitat loss and less obstruction of movement; Alternative D may increase disturbance due to increased air traffic. Overall, under the action alternatives, impacts to polar bears are considered to be minor. Alternative E would have no negative impacts to polar bears.

Oil and gas activities may result in disturbance to individual polar bears and may prevent some polar bears from using small portions of habitat. In particular, some polar bear denning habitat has likely been altered or made unavailable as a result of construction and human activity. The amount and effect is unknown, but likely minimal, since the majority of historic dens were offshore and most land dens were to the east of major development (Amstrup and Gardner 1994). The main land-based polar bear travel corridor (within one mile of the coast) and nearshore area have been fragmented to some extent; but the effect has likely been minimal. This minimal effect can be attributed to the small amount of development that has occurred related to total area, and the ability of polar bears to cross man-made routes, including roads and causeways. Whereas industry activities have had some effects on individual polar bears, there is no evidence these effects have resulted in changes to polar bear populations (BLM 2012, § 4.8.7.11). While other threats are managed or are not currently thought to be significant threats to polar bear populations, each could become significant in combination with future effects of climate change and the resultant loss of sea ice. Changes in the extent and timing of sea ice are expected to have a significant impact on polar bears through alteration of their distribution, nutritional status, reproductive success, and ultimately their abundance.

Cumulative impacts to polar bears from activities across the North Slope were fully considered in BLM (2012). Oil and gas development in the Chukchi and Beaufort Seas has the greatest potential to lead to additive effects for polar bears. Even small spills that could not be

completely remediated could accumulate over time and could include direct fouling of polar bears, their prey, or their habitat. These spills could foul ice and shorelines, so the continued risk of direct exposure remains, as does the risk of long-term contamination of both marine and terrestrial habitats (BLM 2012, § 4.8.7.11). Proposed activities with the most potential to affect polar bears in the NPR-A include oil and gas exploration and development, aircraft and watercraft traffic, winter overland travel, and recreational and research activities. These activities could affect polar bears by causing direct mortality from defense of human life, accidental oil spills, and lethal impacts during research activities; altering polar bear behavior, physiology, or movements; or disturbing or destroying snow dens, which could cause impacts to cubs at critical life stages, resulting in mortality (BLM 2012, § 4.8.7.11).

When evaluating the currently proposed project in conjunction with the conceptual GMT2, climate change, and other RFF projects, these projects could have an additive cumulative effect with respect to polar bears. Further development may result encroach upon polar bear denning habitats and the placement of additional infrastructure would increase disturbances, the potential for encounters, and obstruction to movement. Offshore development and development of onshore support facilities would have cumulative additive impacts to polar bears and their habitats. This impact would be anticipated to be long-term, localized, and depending on the species and location would range in intensity.

Bowhead Whale, Beringia DPS Bearded Seal, and Ringed Seal

In the Arctic, industrial sounds and other disturbances have displaced whales from preferred habitats; these effects can be difficult to quantify and to determine if they accumulate. In addition to noise and disturbance from existing oil development, seals and bowhead whales could be affected by future offshore development in the Beaufort and Chukchi seas.

Three species of marine mammals listed under the ESA are present in the Beaufort Sea: the bowhead whale (endangered), Beringia DPS bearded seal (threatened), and ringed seal (threatened). As discussed above for polar bears, all but the CD5 pad, a short section of pipeline system from GMT1, and a short section of pipeline system from CD5 to CD1 are further than 5 miles from the coast. This infrastructure would not likely impact these species. The probability of a spill reaching marine waters under the proposed project is very low (see Section 4.4.4.10). In the event of a spill reaching marine waters, the spill would need to reach waters of greater depth well offshore from the coastline to coincide with the seasonal preference of these three species for an impact to occur.

Under all of the action alternatives for the proposed GMT1 project, the impact to bowhead whales, Beringia DPS bearded seals, and ringed seals is considered negligible based on the project location relative to these species. Alternative E would have no incremental impact due to the lack of development. The conceptual GMT2 project, in conjunction with the GMT1 project, would still have a negligible cumulative impact for the same reasons discussed above.

The BLM (2004) found that the overall cumulative effects of the proposed development and other past, present, and reasonably foreseeable future activities would be minor. Impacts were expected to be the potential loss of up to several hundred seals and walruses, and probably less than 10 gray whales. In the event of a 1,000-bbl spill, pinniped and gray whale populations would be expected to recover within one year. Cumulative noise and disturbance in the Beaufort Sea and on the North Slope are expected to briefly and locally disturb or displace a few seals and gray whales. (BLM 2004, § 4G.6.4.2).

The potential impacts of future oil and gas development on the North Slope to special status marine mammals was analyzed in BLM (2012). If a large oil spill were to occur as a result of (1) development and production associated with any past, present, or reasonably foreseeable future development project on the North Slope or in the Beaufort or Chukchi seas, or (2) grounding of a large commercial vessel, some bowhead whales, ringed, and bearded seals would likely be impacted. However, most whales directly exposed to spilled oil would likely experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals could be killed if they were to experience prolonged exposure to freshly-spilled oil. Reproductive effects are also possible. Effects to seal species would depend on a number of factors such as the amount and duration of exposure, and proportion of oiled prey consumed. Reduction in food resources would be more detrimental to seal species due to their life history characteristics when compared to long-lived bowhead whales with large stored energy supplies. Oil spill clean-up activities (e.g., vessel and aircraft traffic) could displace some bowhead whales, should those activities coincide with the fall migration.

If there is increased offshore exploration and development activities, the potential for cumulative impacts to marine mammals by noise or other activities would increase. Whale species most likely to experience cumulative effects include gray whales. Increases in ice-free periods and ice retreat may be accompanied by a northward shift in commercial fisheries and shipping traffic, potentially increasing rates of disturbance, entrapment, entanglement, and vessel strikes. Offshore oil and gas exploration and development, should it occur in areas occupied by whales, would result in disturbance effects and may impact foraging success, possibly to the extent that fitness is reduced. Contribution of effects from onshore NPR-A activity to the overall cumulative effects to special status marine mammals will likely be relatively small (BLM 2012, § 4.8.7.10). While specific effects of climate change and ocean acidification on bowheads, ringed, and bearded seals are uncertain, ice seals, in particular, may experience loss of habitat and changes in prey distribution and availability. Effects of the currently proposed project are within the range of effects analyzed in BLM (2012).

An oil spill could affect marine mammals in offshore or coastal areas, with the impacts depending on the location and amount of oil spilled and time of year. The effects of future habitat alteration associated with gravel island construction, platforms, or other structures related to oil development would likely be minor. The presence of small amounts of hazardous materials, including hydrocarbons and previously used insecticides, would likely have minor effects on marine mammals.

Of the RFF projects, development of offshore developments and onshore support infrastructure would have the greatest potential impact to these species based on the location of these projects. The impacts would be additive to those of GMT1 and future onshore development in the NPR-A. A full evaluation of how potential offshore development and associated onshore support infrastructure could impact these three species is outside of the scope of this SEIS.

4.6.4.3 Social Systems

Socio-Cultural

The cumulative effects of oil and gas development on sociocultural patterns over the last 50 years are hard to establish with quantitative precision given the lack of baseline data. Nonetheless, there is evidence that North Slope sociocultural systems have been subject to both

positive and negative ongoing, additive, and synergistic cumulative impacts from oil and gas activities. Stresses on North Slope sociocultural systems include residents' inability to access traditional use areas, threats to resources, and to spiritual connection with the land, having to deal with multiple environmental impact assessments and other development processes and the public meetings these entail, and being ignored or discounted by agency representatives. Long-term stresses would result in greater impacts to sociocultural systems. The possibility of a major oil spill in the marine environment and its effects on bowhead whales, other marine mammals, and fish is residents' greatest concern—now increased significantly by the greater likelihood of offshore oil and gas activity in both the Chukchi and Beaufort seas. These and other stresses accumulate because they interact and are repeated with each new lease sale, EIS, development proposal, and facility expansion. Income from royalties, taxes, and jobs, generated by oil and gas activity and available to residents of the North Slope would be anticipated to offset some increased costs associated with travelling further to hunt. The following is a discussion of the cumulative effects of the proposed project on social organization, economic organization, community institutions, community health and welfare, and population and employment. BLM (2012) included an in-depth discussion of the cumulative impacts of past and present activities on North Slope socio-cultural systems.

North Slope Iñupiat have experienced the impacts of development on their social organization since their initial contact with non-Iñupiaq explorers in the early 19th century. The traditional social structure, which was based around extended kinship ties, trading partnerships, and friendships, underwent numerous changes through the 19th and 20th centuries. These changes include the centralization of residents into permanent communities through mandatory education; the introduction of modern technology and changes to the traditional subsistence-based economy through the introduction of a cash economy; and the incorporation of the Iñupiat into new systems of laws and governing systems. Today, oil and gas development on the North Slope is a primary source of impacts on social organization among the Iñupiat, especially for the community of Nuiqsut.

The BLM (2004) found that overall, both additive and synergistic impacts to the socio-cultural characteristics of North Slope communities associated with the CPAI Development Plan and past, present, and reasonably foreseeable future development may occur. Changes to community structure, cultural values and community health and welfare, predate oil and gas development on the North Slope. However, change in community socio-cultural characteristics has continued during the period of oil development. As the area impacted by oil development in the future increases, especially in proximity to local communities, cumulative impacts are likely to increase. For example**,** Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass are currently dependent on subsistence caribou harvest from the CAH and TH; additional future development may have additive impacts to subsistence harvest from these herds leading to synergistic impacts on subsistence-harvest patterns (including disruption of community activities and traditional practices for harvesting, sharing, and processing subsistence resources), social bonds, and cultural values. (BLM 2012, § 4G.7.1.1)

The BLM (2012) found that the overall extent of expected cumulative effects on socio-cultural systems would vary depending on the alternative selected, but that no scenario was expected to result in overall impacts that would be more substantial that those caused by technology, other aspects of modernization, and climate change.

Proposed and current activities in the Nuiqsut area include development of CD5 (including a bridge over the Nigliq Channel), the Nuiqsut Spur Road, the Colville River Access Road, development of the Umiat Road/Pipeline which is proposed to extend from the Dalton Highway

to Umiat on the Colville River, expansion of the ASRC mineral sites, winter oil and gas exploration to the west of the community, and offshore oil and gas exploration. RFF activities that could affect social organization on the North Slope include the conceptual GMT2, development of a natural gas pipeline from the North Slope to Valdez or Cook Inlet; and offshore oil and gas development as well as the onshore infrastructure to support it. All of these activities, in combination with the development of GMT1, will increase the potential for interactions between Nuiqsut residents and non-local workers as well as the potential for conflicts within the community of Nuiqsut regarding their support for or opposition to these projects. Tensions between different community institutions could result in additional strains on social cohesion. The Umiat Road/Pipeline could potentially provide public road access to traditional hunting areas along the Colville River, thus resulting in even greater potential for human competition and interactions with non-Iñupiaq individuals who may not share the same cultural values and respect for the land. Increased employment of Nuiqsut residents could disrupt social systems by removing residents for extended periods of time from their families and reducing their ability to participate in subsistence activities, thus weakening social ties within the community. Increased income may also result in income disparities between households and families in the community, adding to social tensions.

The cumulative impacts of past, current, and RFF actions on subsistence activities are discussed below, under "Subsistence." Subsistence activities are key to maintaining social ties within Iñupiaq communities, and therefore any disruption to the hunting, harvesting, processing, distribution, and consumption of subsistence resources will also have impacts on social organization in the community. The potential for additional exploration to the west of the community (including the conceptual GMT2 development) in addition to the oil and gas exploration to the south of the community associated with development of the Umiat Road/Pipeline will result in residents feeling even more surrounded by development, and left with fewer options for hunting in areas where no oil and gas infrastructure exist. The incremental construction of development-related infrastructure throughout the community of Nuiqsut's traditional hunting and harvesting areas may result in the erosion of identity or cultural connection with those lands. This impact has already occurred with traditional use areas or camps within existing development areas that are no longer accessible to local residents. As discussed in the BLM (2012, §§ 4.8.7.13 and 4.8.7.14), several effects of climate change are particularly significant in the western Arctic, could further affect subsistence resources and land uses, and are therefore likely to create significant social anxiety for the Iñupiat.

With completion of the Nuiqsut Spur Road, residents of Nuiqsut will have improved access to subsistence resources in the Colville River Delta as well as being able to travel via road to employment opportunities in the Alpine Field including (under alternatives A, B, and C) construction of facilities for the GMT1 and the conceptual GMT2 project. Residents of Nuiqsut have expressed concern that development of the GMTU would adversely impact their ability to harvest caribou. However, there would be long-term road access that should facilitate access to subsistence resources in the same manner contemplated by the Kuukpik Corporation when applying for the Nuiqsut Spur Road.

The cumulative impacts of the past, present, and RFF activities on economic organization are tied closely to cumulative impacts on subsistence. The community of Nuiqsut participates in a mixed subsistence-market economy. The increasing presence of development activities in and around the community may disrupt the economic organization of the community through changes in subsistence activities and participation in the cash economy. If subsistence activities or resources are disrupted to the extent that overall harvests of subsistence resources decline,

then residents may begin to rely more heavily on wage employment and participate less in traditional subsistence activities. As discussed in section 4.4.3, disruptions to subsistence activities may be highest under Alternative D due to increased helicopter traffic associated with that alternative. Alternatively, increased income in the community either through Native corporation dividends or wage employment, under Alternatives A, B, C, and D, may provide more people with opportunities to participate in subsistence activities, including residents who previously could not participate in subsistence activities due to a lack of equipment or money for fuel. The cumulative impacts on the overall economy are discussed below (under "Economy").

The GMTU is located within the jurisdictions of several entities. These include the BLM for federal land in the NPR-A (including both BLM-managed surface and subsurface, as well as land that has been selected by Kuukpik Corporation but not yet conveyed), the NSB, Kuukpik Corporation as a surface landowner, and ASRC as the owner of the subsurface rights under Kuukpik Corporation land. The GMT1, conceptual GMT2 project, and other RFF activities on the North Slope do not change the scope of authorities of these institutions but may change where said authorities are applied if land and subsurface federal ownerships are transferred to the two Native Corporations. Cumulative impacts associated with community institutions as they relate to socio-cultural systems include increased tension among community and regional institutions including the Native Village of Nuiqsut, the City of Nuiqsut, Kuukpik Corporation, ASRC, BLM, and the NSB regarding their role in and jurisdiction over development activities on the North Slope.

The GMT1 project, in addition to past, present, and RFF activities on the North Slope, is not expected to result in substantial changes to population or employment levels for the community of Nuiqsut. Increasing development activities on the North Slope, particularly those that occur in areas accessible from the community of Nuiqsut by road, may result in more residents obtaining employment in the oil and gas industry. The combination of GMT1 and the conceptual GMT2 would have the same impacts as GMT1 alone, with the principal differences of a second employment opportunity for residents and two construction/development phases (there likely would be several years between the start of production at GMT1 and the start of construction for GMT2). A phased construction/development scenario is expected to result in only minor, if any, changes in the number of permanent residents at Nuiqsut, primarily due to the relatively small scale of development and few opportunities for long-term employment during operations. A phased construction schedule would have positive benefits for employment for residents at Nuiqsut. Alternatives A, B, C, and D would have similar impacts to population due to the scale of development. Alternative C may provide the greatest opportunity for employment simply because more road and airport development work would occur near town.

Public Health

Impacts to human health under all of the action alternatives are anticipated to be localized and temporary with no measurable impact on a population level. Potential impacts under the proposed project could include diverting hunters and animals, noise from increased air traffic, perception that traditional foods are contaminated, increased travel time and costs for subsistence, and poor air quality episodes. Under all of the action alternatives, an increase in workers could impact the local community with respect to availability of medical care and emergency services. Impacts under all of the action alternatives are expected to be similar, with a few notable exceptions, which are discussed below. Alternative B, which avoids activities near Fish Creek, could reduce the impact on subsistence hunting areas and travel times and cost associated with subsistence would not be as high as Alternative A. Alternative C, which includes an aircraft extension and additional infrastructure in and around Nuiqsut would increase the potential for noise and poor air quality episodes. Alternative D, which does not

include the construction of a road, would have the least impact of any of the action alternatives by reducing potential impacts related to perception of food contamination, noise (from road traffic), and avoidance of infrastructure at subsistence sites. Alternative D will however have an increase in noise associated with its airstrip, but that noise will not likely be heard in Nuiqsut. Alternative E (No Action) would result in no change from the current baseline conditions.

Impacts to human health associated with the conceptual GMT2 project would be similar to those under the range of action alternatives for the GMT1 project. Development of GMT2 would have additive negative impacts with respect to public health. The additional footprint to the west would likely have an additive impact with respect to diverting animals and thus hunters, and an increased amount of air emissions and potential for spills. Further, the increased personnel required to construct and operate GMT2 would require additional flights (increasing noise and potentially affecting air quality), and would be an additive strain on existing medical care and emergency services. As with the GMT1 project, these impacts would be greatest during the construction phase of the conceptual GMT2 and would be reduced once operations are underway.

The 2012 IAP/EIS public health cumulative effects analysis (BLM 2012, § 4.8.7.21) described both positive and negative health effects for North Slope residents due to changes that have occurred in the last 50-100 years, as well as RFF actions such as oil and gas exploration and development, scientific research activities, mining projects, military developments and activities, transportation plans, community development projects, and recreation and tourism activities. As stated in the analysis, rapid modernization over the last 100 years has led to significant changes in diet, housing, employment, and traditional culture. This has led to positive health changes including an increase in life expectancy, a decrease in infant mortality and infectious disease rates, improved health care services, public health programs, and municipal health infrastructure such as sanitation and water treatment facilities. This same transition has also led to negative health outcomes including increases in chronic diseases such as cancer, cardiovascular disease and metabolic disorders, and increases in alcohol and substance misuse, suicide, violence and other social dysfunction.

The pattern of oil and gas development that has taken place in and near the NPR-A, combined with the area's unique culture and geography has led to the creation of certain health concerns that are of particular importance. These health concerns represent areas of vulnerability whereby further oil and gas-related development may have a disproportionate impact on health and safety, and include: injury and trauma, which may be linked to the adaptation by hunters to travel further away from development to conduct subsistence activities; increases in social pathologies such as alcohol and drug misuse, social dysfunction and violence, in part due to increased opportunities to import alcohol and drugs; and health disparities due to the uneven distribution of the rewards and risks of development. Of particular significance for public health and safety is the potential for further increases in offshore oil and gas exploration, development and production. A ramp-up of offshore development is expected to lead to potentially substantive changes in public health outcomes via three pathways: a) the displacement of marine mammals and the subsequent reduction of success and safety of subsistence hunting; b) the potential for contamination and the fear of contamination through oil spills or routine discharge; and c) substantially increased economic returns to the NSB, village corporations and individuals with resulting positive and negative health effects and disparities.

When evaluating the currently proposed project in conjunction with the conceptual GMT2 and other RFF projects, these projects could have an additive cumulative effect, generating potentially substantive changes, with respect to public health as described above and in BLM

(2012, § 4.8.7.21). The community of Nuiqsut will be most impacted by the proposed and conceptual GMT2 projects and less affected by other RFF projects to the extent that they do not connect into the existing and proposed roads or require the use of the airport at Nuiqsut. The cumulative effects of increased development to the south, west, and north of Nuiqsut, associated with the proposed Umiat Road/Pipeline, exploration and development in the NPR-A, and offshore development, may have synergistic effects with respect to disturbance of animals. This may result in changes to traditional hunting grounds and may require further energy (time and travel costs) to reach these resources. Additionally, the increase in development could result in a cumulative negative impact to human health resulting from impacts to air quality, water quality, or spills. Other RFF developments are not likely to have a direct impact on the availability of local emergency services.

Economy

Production of oil from the GMT1 and the conceptual GMT2 would, for a substantial period into the future, be a source of revenue to the NSB, which in turn, becomes part of the source of allocations to local communities. Production of oil resources from the GMTU under the cumulative case would be one of the sources of oil and tax revenues that would go to the NSB. For the purposes of this analysis, it is assumed that Alternatives A, B, C, and D would generate similar tax revenues. Alternative E would provide no revenues to the NSB since there would be no production from the GMTU. Production of oil from the conceptual GMT2 site would likewise result in economic benefits on both the borough and local levels by extending operations at the Alpine field. Alternative E will not add an incremental beneficial cumulative impact to the state, NSB, or local economies as a direct result of reduced oil and gas revenues since development GMT1 would be denied, and the conceptual GMT2 project would not occur. Conversely, the reduction of oil and gas activities in the NPR-A might have beneficial impact to local mixed economies such as Nuiqsut's, where a majority of the residents rely on subsistence resources for food security. Specific cumulative impacts to economies at the state, NSB, and local level for the action alternatives are discussed briefly below.

Impacts to the State economy are based on the assumption that there are commercial quantities of recoverable oil and gas in the GMTU in addition to those that would be extracted at the GMT1 site (i.e., that the conceptual GMT2 project would be economically viable). GMT1 and the conceptual GMT2 would go on line at different times; phased construction and production would extend the overall economic effect of the revenue stream to the State from the GMTU over time. The cumulative effect of production and a pipeline system to CD5 would have a beneficial effect on other undiscovered oil and gas resources in the GMTU by having road access into the GMTU under Alternatives A, B, and C.

The BLM (2004) describes cumulative impacts to the economy as potential gains in direct employment, which would include additive jobs in petroleum exploration, development, and production, and oil spill cleanup activities (BLM 2004, § 4G.7.2.1). Cumulative effects are projected to generate additive employment and personal income increases for local, NSB, and state residents.

Economic impacts from oil development across the North Slope are discussed fully in BLM (2012). The NSB has transformed to a mixed cash-subsistence economy. Particularly in the last 40 years, residents have both benefited and grown accustomed to the result of modern capital development on the North Slope. In addition to the petroleum industry, the NSB has become a dominant economic organization on the North Slope. The NSB taxes the oil and gas facilities and uses the revenues to provide education and a wide array of other public services within its

boundaries. Property taxes on oil and gas infrastructure provide over 82 percent of the total revenues received by the NSB in 2009 (BLM 2012, § 4.8.7.20).

Events that would affect the economy of the NSB and the State of Alaska result from existing and future onshore and offshore oil and gas leasing and development, assisted by the potential construction of natural gas pipelines and an Umiat Road/Pipeline. Oil and gas exploration and development will occur on existing leases on State and Native-owned lands east of the NPR-A, Federal and Native-owned leases in the NPR-A, and Federal and state leases in the Beaufort and Chukchi Seas. Future oil and gas lease sales with subsequent exploration and development may occur in the NPR-A, Chukchi Sea, Beaufort Sea, and lands east and west of the NPR-A. Construction of a natural gas pipeline is required to take North Slope gas to market, and would be important to the local and state economy. A foothills route for the Umiat Road/Pipeline from the Dalton Highway to the Colville River or into the NPR-A would improve the economic potential of oil and gas resources in that area, probably leading to earlier production schedules and possibly resulting in development of some marginal accumulations. Economic impacts to the State, Borough, and local economies are within the range analyzed in BLM (2012 § 4.8.7.20).

Kuukpik Corporation collects revenues from their ownerships in the Alpine field and for permits to use Kuukpik land. Kuukpik Corporation owns surface lands within the project area, and Arctic Slope Regional Corporation Native regional corporation owns the subsurface oil and gas leases. Development in the Alpine field would directly benefit these entities, as described in section 4.4.2. The royalties to Arctic Slope Regional Corporation from production of these fields would generate revenues for the corporation and its shareholders. Seventy percent of these petroleum royalties will be shared with the other Alaska Native regional corporations in accordance with section 7(i) of Alaska Native Claims Settlement Act.

Kuukpik and ASRC will likely benefit from other RFF oil and gas activities in the area as mentioned, and ASRC benefits economically from the oilfield services it provides. Additionally, proximity of NPR-A communities, particularly Nuiqsut, to development in and near the NPR-A can provide opportunities to those communities. These opportunities could extend to community businesses that might provide goods and services, as well as residents who might obtain work as a result of the development and production activities.

Revenues from exploration and development of oil and gas resources in the NPR-A and elsewhere on the North Slope have added economic stability to local communities. The cumulative economic impacts also apply at the local community level. Although smaller scale the economic ramification can be of high intensity, long-term, localized, and major since communities in the NPR-A receive revenue from oil and gas through land ownerships used by industry, distribution of special funds unique to the NPR-A, and appropriations for a variety of services from the State government. A substantial number of jobs in Nuiqsut are technically NSB but paid for with NPR-A Impact funds from the State's 48 percent of revenues collected from federal development. Continuing or expanding those opportunities are dependent on NPR-A royalty revenues. Climate change could negatively impact the economy for the North Slope; because villages are primarily located at or near sea level, any increase in mean sea level or violent storms may require relocation of part or all of villages and subsistence camps. This would have a major negative economic impact to the villages and the NSB, and a substantial impact to the state if it must help fund the relocation. Overall cumulative economic impacts resulting from increased development on the North Slope would have benefits at state, regional, and local levels.

Subsistence

North Slope Iñupiat have experienced the impacts of development and other activities on the North Slope since the mid-19th century, when commercial whaling introduced various changes to the economy, social organization, settlement patterns, and health of the Iñupiat. Today, oil and gas development is a primary source of subsistence impacts on the North Slope, particularly for the community of Nuiqsut. The community of Nuiqsut was reestablished in 1973, and soon after, the Trans-Alaska Pipeline System was built and production at Prudhoe Bay began. Since that time, oil and gas development has expanded to the west, encroaching on traditional subsistence use areas and resulting in various conflicts between industry and Nuiqsut subsistence harvesting activities. Other activities, such as scientific research and tourism, also contribute cumulatively to the impacts of oil and gas development.

Under Alternatives A, B, C, and D, Nuiqsut residents would experience direct impacts to subsistence use areas, particularly those for caribou, geese, and furbearers such as wolf and wolverine. Some winter fishing activities such as Arctic cisco and burbot fishing may also be impacted. Direct impacts on subsistence use areas would be lowest during the summer months as many of the subsistence activities that occur in the project study area take place during late fall through early spring. Except for areas of high snow drifting, user access will not be restricted for residents who wish to conduct subsistence activities in the project study area as the pipeline will be elevated to seven feet and the roads will be open to local use. User avoidance is expected to be the primary impact related to user access, as Nuiqsut residents will likely avoid the project study area drill pad and pipeline corridor. Subsistence harvesters often avoid areas of development due to concerns about contamination and because of residents' discomfort with hunting near human or industrial activity.

In terms of overall subsistence impacts, Alternatives A and B would likely have the fewest impacts to subsistence because they require less air traffic close to the community and because development related ground traffic would be limited to the road between CD5 and GMT1. Alternative C would likely have more impacts than Alternatives A and B, because it would move development related ground traffic closer to the community, along the road between Nuiqsut and CD5, and because the community would experience more air traffic if used as a hub, which could result in deflection of subsistence resources near the community. Alternative D would likely have the greatest impact to subsistence uses and activities of all the alternatives, as it would result in increased air traffic in hunting areas west of the community and would create a new source of air traffic that did not exist before.

This high intensity impact to subsistence would be of interim duration for construction and long-term duration during operation and it would affect multiple generations of subsistence users. While the spatial extent of impacts during construction and certain operational impacts (e.g., direct loss of subsistence use areas) would be localized, the indirect effects of operation (e.g., increased cost, time, effort) could extend beyond the local area and affect the whole of Nuiqsut's subsistence activities (i.e., regional) in addition to introducing disruptions to caribou availability and other resources that could extend outside of the project study area and to a broader area-wide level. Lastly, the context of subsistence is an important resource that fills a unique role in the regional sociocultural environment. Thus, the overall degree of impact to subsistence is expected to be major because it is a high intensity impact, will have effects of long-term duration, extend to regional extents, and is an important resource. The BLM (2004) found that additive impacts that could affect subsistence resources included potential oil spills, seismic noise, road and air traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. Based on potential cumulative, long-term displacement and/or functional loss, habitat available

for caribou may be reduced, unavailable, or undesirable for use. Changes in population distribution due to the presence of oilfield facilities or activities may affect availability for subsistence harvest in traditional subsistence use areas. Overall, impacts to subsistence harvest and use may have synergistic impacts with community health, welfare, and social structure. To the extent that subsistence hunting success is reduced in traditional use areas near Nuiqsut from the presence of oilfield facilities and activities, subsistence hunters will need to travel to more distant areas to harvest sufficient resources in order to meet community needs. This will result in greater time spent away from the community for some household members and competition for resources with members of other communities. These changes in subsistence patterns may result in stress within households, family groups, and the community. The BLM (2004) analysis indicated that there may be significant impacts to subsistence.

The BLM (2012) includes an in-depth discussion on the cumulative effects of past and present activities on North Slope subsistence users. Potential cumulative effects would be tied to altered migration routes of subsistence animals, reduced access and disturbance to subsistence use areas, and creating potential conflict over harvest areas within a community (BLM 2012, § 4.8.7.13).

The proposed road and associated pipeline to Umiat from the Dalton Highway could have substantial negative impacts on subsistence activities, in particular for Anaktuvuk Pass and Nuiqsut as discussed in the Caribou section. The state is undergoing the permitting process to build the road with the hope that it will help promote oil and gas development in the area and within NPR-A. The project could likely make it economical to develop more oil and gas fields within the NPR-A. These developments would cause synergistic cumulative disturbances to subsistence use areas and possibly to subsistence resources.

Climate change and the associated effects of anticipated warming of the climate regime in the Arctic could significantly affect subsistence harvests and uses if warming trends continue as predicted (National Research Council 2003, Arctic Climate Impact Assessment 2004). The reduction, regulation, and/or loss of subsistence resources would have severe effects on the subsistence way of life for residents of NPR-A communities. If permafrost loss increases as predicted, there could be synergistic cumulative effects on infrastructure, travel, landforms, sea ice, river navigability, habitat, availability of fresh water, and availability of terrestrial mammals, marine mammals, waterfowl and fish, all of which could necessitate relocating communities or their population, shifting the population to places with better subsistence hunting, and causing a loss or dispersal of community (National Research Council 2003, Arctic Climate Impact Assessment 2004).

Proposed and current activities in the Nuiqsut area include development of CD5 (including a bridge over the Nigliq Channel), the Nuiqsut Spur Road, the Colville River Access Road, development of the Umiat Road/Pipeline, expansion of the ASRC mineral sites, and winter oil and gas exploration to the west of the community. All of these activities, in combination with development of GMT1, could further increase potential for conflicts between subsistence users and oil and gas activities. RFF activities that could contribute to cumulative effects on subsistence include the conceptual GMT2; development of a natural gas pipeline from the North Slope to Valdez or Cook Inlet; and offshore oil and gas development in the Beaufort and Chukchi seas with associated onshore support infrastructure. The cumulative impacts of Alternatives A, B, and C would be similar to one another, as each of these alternatives could lead to future expansion of oil and gas exploration to the west of the Colville River. Expansion further to the west of the Colville River would result in increased impacts on Nuiqsut subsistence use areas, particularly those along Fish Creek, and could potentially introduce oil

and gas development into areas used by other North Slope communities such as Barrow and Atqasuk. Alternative D, the roadless alternative, would be less likely to facilitate westward oil and gas development. However, this alternative would create more helicopter traffic in areas used by Nuiqsut subsistence users. In Nuiqsut, disturbance from helicopter traffic is one of the most frequently reported impacts associated with oil and gas development (SRB&A 2012); Alternative D would contribute to the cumulative impacts of helicopter traffic on the North Slope.

Increasing the number of oil and gas developments within Nuiqsut's existing subsistence use areas reduces the area available to subsistence users and may add to the existing impacts of development by increasing the incidence of potential impacts on resource availability and user access (including user avoidance). If Nuiqsut hunters use the permanent roads built under Alternatives A, B, and C, the community could gradually experience a shift in their subsistence harvesting patterns whereby the road becomes a hunting corridor. Such changes have been documented in other rural communities where roads have been introduced. One such example is the community of Tyonek in southcentral Alaska, where now-abandoned logging roads have become a common mode of travel to subsistence harvesting areas (SRB&A 2007). Conversely, in Northwest Alaska, the community of Kivalina has reported a diversion of caribou near the Delong Mountain Transportation System road due to associated traffic (SRB&A 2009b). While the roads may facilitate movement and access to subsistence resources, they may also introduce increased competition among local harvesters in areas accessible by road. Other hunters may avoid the new oil and gas infrastructure, including roads, altogether, resulting in a potential loss of hunting areas for those individuals. Several studies have documented user avoidance of oil and gas infrastructure and activities within traditional subsistence use areas, in addition to the gradual shifting of Nuiqsut subsistence use areas away from Prudhoe Bay as new developments, including Tarn, Meltwater, Ooguruk, and Alpine, have expanded further west toward the community (RFSUNY 1984; IAI 1990b; Pedersen et al. 2000).

While the GMT1 and conceptual GMT2 developments would introduce the first permanent oil and gas infrastructure into subsistence use areas west of the community of Nuiqsut, the proposed Umiat Road/Pipeline would introduce new permanent infrastructure in subsistence use areas to the south and southeast of the community, leaving only the southwest direction as one unmarked by oil and gas infrastructure. However, because the Umiat Raod/Pipeline would likely open up areas to the west of Umiat to further development, the combination of these activities together would result in the community of Nuiqsut essentially being surrounded by development. This could pose difficulties for those hunters who avoid oil and gas infrastructure altogether. As noted above, the shifting of Nuiqsut subsistence use areas away from oil and gas infrastructure has been documented in various sources (RFSUNY 1984; IAI 1990b; Pedersen et al. 2000), and the GMT1 project could contribute to those changes. In addition to opening up new areas to oil and gas development, the Umiat Road/Pipeline could result in increased public access to the Colville River area for nonlocal hunters and tourists, thus increasing competition for local subsistence users.

Overall, the GMT1 project in addition to other current and RFF activities could increase the severity of existing impacts on Nuiqsut subsistence uses in addition to introducing impacts on subsistence uses for other North Slope communities, particularly those whose subsistence use areas are located to the west of Colville River. These effects include continued hunter avoidance of industrial areas, continued disturbance of hunters and wildlife from increased air and road traffic, reduced access to or loss of subsistence use areas, and reduced availability of subsistence resources in development areas. In addition, if displacement of subsistence resources occurs in Nuiqsut subsistence use areas, hunters may travel farther west to access hunting grounds,

increasing the potential for competition between hunters from different communities such as Barrow. These impacts could result in increased investments in time, money, fuel, and equipment and potentially affect hunting success. As oil and gas development activities occur over a larger area and impact a greater portion of subsistence use areas, North Slope subsistence users may alter their harvesting patterns and potentially result in a loss of opportunities to harvest subsistence resources in traditional use areas. This loss of opportunity could have effects on future generations, as harvesters may no longer be able to teach younger hunters about subsistence uses in traditional harvesting areas.

In addition to the cumulative impacts associated with oil and gas activities, several effects of climate change are particularly significant in the western Arctic. As described in BLM (2012 § 4.8.7.13), the reduction, regulation, and/or loss of subsistence resources due to climate change would have severe effects on the subsistence way of life for residents. If permafrost loss increases as predicted, there could be synergistic cumulative effects on infrastructure, travel, landforms, sea ice, river navigability, habitat, availability of fresh water, and availability of subsistence resources. These impacts could necessitate relocating communities or loss or dispersal of communities.

Environmental Justice

Effects to subsistence comprise direct effects to the Iñupiat, a recognized minority population and the primary subsistence harvesters on the North Slope. Impacts from GMT1 and GMT2 to human health and well-being, social systems, and cultural values of the Iñupiat would cumulatively lead to disproportionate effects on this minority population.

The analysis of impacts related to environmental justice considers if implementation of one of the proposed alternatives would result in disproportionately high and adverse environmental effects to the minority community of Nuiqsut. Environmental justice analyses weigh the benefits of a proposed project (e.g., increased economic activity or access to improved infrastructure) on the minority community, which may offset the adverse environmental effects from construction, drilling, or operation. The potentially affected resource in the environmental justice analysis is the community of Nuiqsut, which is characterized as unique in context. The duration of effects under all the action alternatives would be long-term and of regional extent.

Overall, impacts to the minority community resulting from GMT1 Alternatives A, B, and C, and conceptual GMT2, are expected to be long term and of medium intensity. In A, B, and C, the improved permanent access to subsistence use areas is expected to have a long-term, beneficial effect for many residents of Nuiqsut while diminishing the value of the area for others. Alternative D under GMT1, and conceptual GMT2 would result in increased aircraft noise in the project study area and would not include the mixed effects of the road, therefore resulting in long-term, medium intensity, and significant effects to the community. There would be negligible overall effects on environmental justice under Alternative E, no action.

The ANILCA § 810 analysis for the proposed project concluded that, under all action alternatives, the effects fall above the level of significantly restricting subsistence use for the community of Nuiqsut. The potential impacts to subsistence resources by displacement and impacts to access by subsistence users must, in the case of the Native Village of Nuiqsut,be considered as significant Environmental Justice issues.

The BLM (2004) found that development as contemplated in the cumulative case could cause long-term displacement and/or functional loss of habitat to caribou over the life of the proposed development. This could result in a significant impact on this important subsistence resource.

Impacts would be considered disproportionately high adverse effects on Alaska Natives. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources could change if oil development were to reduce the availability of resources or alter their distribution patterns. Potential spill impacts would also have disproportionately high adverse effects on Alaskan Natives (BLM 2004, § 4G.7.4).

Environmental justice issues associated with NPR-A development are discussed in BLM (2012 § 4.8.7.15). Military activities and other non-oil and gas development and oil and gas exploration and development have had cumulative impacts to Iñupiaq culture and to fish and wildlife used for subsistence. Non-oil and gas development associated with military, residential, and commercial development has directly impacted several thousand acres of fish and wildlife habitat and has also indirectly affected habitat and animal behavior; these impacts have accumulated and persist today. Oil and gas exploration and development conducted by the federal government and industry have directly impacted the habitat use and behavior of subsistence species, and these impacts persist today. These effects have disrupted subsistence uses, and may, in part, account for some of the social problems seen in the villages today. Climate change can be understood as an environmental justice issue and the Iñupiaq of the North Slope are disproportionately impacted by it both by the fact that climate changes effects are more pronounced in the western Arctic and by the fact that Iñupiaq subsistence activities are particularly dependent on ice, wind, and permafrost conditions.

Under the cumulative case, proposals for offshore oil and gas development in the Chukchi and Beaufort seas cause the greatest concern, while the potential impacts of increasing onshore development made possible by pipelines to transport offshore product may also be important. Iñupiaq users would be less likely to utilize for subsistence an area from 5 miles to 25 miles around permanent facilities and any possible environmental justice issues associated with development will be largely determined by the location of future development and by the economic benefits it brings (BLM 2012, § 4.8.7.15).

Disturbance of caribou and other subsistence resources caused by additional development would accumulate with impacts from existing disturbances. Permanent infrastructure in the area will likely contribute to future effects on fish that could accumulate. Oil and gas activities near the project area have already deterred subsistence hunters from using traditional hunting, fishing, and camping sites. Continued expansion of activity and infrastructure near the project area will increase the area considered off-limits by resource users, could deflect or divert important subsistence resources from their normal routes, and require users to travel further to harvest subsistence foods at a greater cost in terms of time, fuel, wear and tear on equipment and people, and lost wages.

Additionally, climate change could cause changes to the environment of the North Slope that could affect subsistence resources and users. The reduction of sea ice has exacerbated coastal erosion, the weather has become less predictable, the shore ice in spring is less stable for whaling, fall travel for caribou is hampered by a late and unreliable freeze up, ice cellars provide less reliable food storage, and the number of marine mammals that are experiencing habitat loss is apparent. All of these issues create significant concerns for the Iñupiat because they are perceived as factors that cannot be controlled and that are threatening their way of life. When taking into consideration the proposed GMT1 project and conceptual GMT2 project, the cumulative effects of these developments would be similar. As a larger area would be impacted, the effects could be additive, but are not anticipated to be synergistic. Some of the cumulative effects of development of GMT1 and GMT2 would be countervailing. For example, industrial roads can provide vehicle access for subsistence users at a distance of up to 20 miles

that is now primarily limited to ATV and snowmachine access by the residents of Nuiqsut. Similarly, revenues are important to Nuiqsut in providing goods and services.

Proposed and current activities in the Nuiqsut area included in the cumulative effects analysis, include development of CD5 (including a bridge over the Nigliq Channel), the Nuiqsut Spur Road, the Colville River Access Road, development of the Umiat Road/Pipeline, expansion of the ASRC mineral sites, and winter oil and gas exploration to the west of the community. RFF activities that could contribute to cumulative effects on environmental justice include the conceptual GMT2, which is more directly to the west of Nuiqsut; development of a natural gas pipeline from the North Slope to Canada, Valdez, or Cook Inlet; and offshore oil and gas development in the Beaufort and Chukchi seas with associated onshore support infrastructure. The cumulative impacts of Alternatives A, B, and C would be similar to one another, as each of these alternatives could lead to future expansion of oil and gas exploration to the west of the Colville River. Expansion further to the west of the Colville River would result in increased impacts on Nuiqsut subsistence use areas, particularly those along Fish Creek, and could potentially introduce oil and gas development into areas used by other North Slope communities such as Barrow and Atqasuk. Alternative D, the roadless alternative, would be less likely to facilitate westward oil and gas development. However, this alternative would create more helicopter traffic in areas used by Nuiqsut subsistence users. In Nuiqsut, disturbance from helicopter traffic is one of the most frequently reported impacts associated with oil and gas development (SRB&A 2012); Alternative D would contribute to the cumulative impacts of helicopter traffic on the North Slope.

In evaluating GMT1, the conceptual GMT2 project, and other RFF activities, the cumulative impacts to the community of Nuiqut would likely be additive to the extent that other RFF developments within the cumulative effects evaluation area could deflect or divert subsistence resources further away from the community. The development of other RFF projects would also increase the footprint of development into currently undeveloped areas, which would have further reaching effects. RFF projects, outside of the conceptual GMT2 project, would likely not be countervailing unless they tied directly into the local transportation network or expanded network that would be developed if the GMT1 were constructed.

In the RFF, development of oil and gas facilities is unlikely to change the population in the project study area. BLM has carefully considered community views when developing and implementing mitigation strategies to reflect the needs and preferences of these populations, to the extent practicable. Some lands have been made unavailable for oil and gas leasing, including a large portion of the eastern coastal plain of the NPR-A which is used by Nuiqsut subsistence users (BLM 2013).

Overall, the GMT1 project in addition to other current and RFF activities could increase the severity of existing impacts on Nuiqsut. As oil and gas development activities occur over a larger area direct effects to Iñupiat would be significant and could have long-term effects affecting both current and future generations. Alternative E would have incremental adverse cumulative impact to environmental justice on the North Slope.

Cultural Resources

Cumulative impacts to cultural and archaeological resources could occur in the project footprint due to additive direct impacts. Direct impacts could occur from ground disturbing activities including excavation of gravel; construction and maintenance of gravel roads, pads, airstrips, bridges and culverts; construction of ice roads and pads; construction of VSMs for power lines and pipelines; and any other disturbance of the ground surface in the proximity of project

components. Other activities and events that could cause direct effects to cultural resources include damage caused by equipment during the construction, drilling, and operation phases of the project, and unanticipated accidents such as blowouts, spills, or fires and subsequent cleanup activities. The act of placing fill over the existing surface is preceded by inventories by qualified archaeologists and is not expected to adversely impact any known or unknown cultural and archaeological resources. There may also be adverse impacts to undiscovered cultural and archaeological resources to the extent culverts create gullying during spring breakup. Development of the Clover material source, as well as gravel mining at the existing ASRC Mine Site, is analyzed across all alternatives for development of GMT1 and would also be necessary for any future development of GMT2.

Cumulative impacts to cultural and archaeological resources could also occur from indirect impacts in the 2.5-mile project study area including removal, trampling, or dislocation of cultural resources and culturally sensitive areas by personnel and visitors, complete or partial destruction of a site from erosion, melting permafrost, vibrations, or other landscape changes caused by GMT1 project components; the loss of traditional meaning or importance of a resource or loss of cultural association with a resource; neglect of a resource that causes deterioration; and transfer, lease or sale out of federal ownership without proper restrictions.

The BLM (2004) concluded that the cumulative effects of the proposed Alpine Field development and other reasonably foreseeable future development on cultural resources would be minimal. Development would be expected to impact cultural resources to some degree; these impacts would be additive. Because of the nature of cultural deposits (their generally unpredictable location and context, on surface or near surface), the magnitude of the impact is difficult to estimate. However, it is expected that if current procedures for survey and inventory before exploration and development activities were to be continued, the impact to the resource would be minimal (BLM 2004, § 4G.7.5). Alternative E would have no incremental adverse cumulative impact to cultural and archaeological resources on the North Slope.

Although there are differences between the alternatives in terms of the number of cultural resources affected and the level of potential noise impacts, the nature and overall degree of impacts on cultural resources do not vary substantially by alternative. Table 4.4-5 provides a summary of expected effects for Alternatives A through D. In contrast to the BLM (2004), the current analysis identifies that the intensity of potential impacts to cultural resources would be medium, because the impacts to the cultural landscape would result in a detectable alteration. This is supported by the documentation and recent update of the Nuiqsut Cultural Landscape (SRB&A 2013a) and consideration of the impacts of the project on this cultural landscape, which had previously not been assessed in either of BLM's previous EISs (BLM 2004; 2012).

Increased oil and gas development activities on the North Slope would result in an increased need for gravel for infrastructure construction. The excavation of up to 150 million cubic yards of gravel equates to about 2,200 acres of surface/near-surface impact on the North Slope by the end of this century. Many prehistoric and historic sites are located on well-drained ground, and on much of the North Slope, well-drained ground often equates with gravel deposits. Gravel deposits are not common in the northern portion of the NPR-A and as a consequence will probably be fully exploited. As more gravel deposits are excavated, the probability for impacts to cultural resources increases. As previously mentioned, pipeline construction, especially buried pipelines, pose a heightened threat to cultural resources.

Current, proposed, and reasonably foreseeable future activities that would likely increase the cumulative effects to cultural resources include construction of GMT2, CD5 and the associated

road and bridge, the Nuiqsut Spur Road, the Colville River Access Road, and pipelines and onshore infrastructure to support offshore oil and gas activity in the Beaufort Sea.

New innovations in technology that reduce the amount of surface disturbance associated with oil and gas activities and the current slowing of oil and gas development on the North Slope, will contribute to the future protection of cultural resources and slow the cumulative impacts. As in the past, assessments to identify and protect cultural resources prior to the initiation of surface disturbing activities will be a major factor in reducing future cumulative adverse effects to cultural resources. Climate change will cause alterations to the environment, ecosystems, and habitats of the North Slope, and potential thawing of permanently frozen ground could result in the erosion of riverbanks and beach bluffs, which could result in impacts to known and undocumented vertebrate paleontological deposits.

From a cumulative perspective, more cultural sites have been disturbed and cultural material removed from the North Slope in general and the NPR-A in particular as the result of scientific studies than has been destroyed or removed through unauthorized collection resulting from oil and gas exploration and development as well as other construction related activities. While the scientific value and significance of the material that was obtained through scientific work is known, the value and significance of material obtained through unauthorized collection or that was destroyed will never be known. This is the greatest potential cumulative impact to cultural resources.

Because of the varying circumstances of occurrence surrounding the location and vulnerability of cultural resources, the significance of future impacts to the resource is difficult to assess in terms of the cumulative case. However, if the protections that are currently in place carry forward, then the cumulative impact would be expected to be minor within the NPR-A.

It should be mentioned that the future effects of climate change are currently unknown regarding future potential cumulative impacts to cultural resources. Climate change will cause alterations to the environment, ecosystems, and habitats of the North Slope, and if substantial enough could affect cultural resources. The thawing of permanently frozen ground could result in the erosion of river banks and beach bluffs, which could result in impacts to known and undocumented cultural deposits. Climate change will probably cause the alteration of weather patterns and an increase in the frequency and intensity of spring and fall storms with the potential to adversely affect near-shore cultural sites (BLM 2012, § 4.8.7.12).

Additional cumulative effects not described in BLM (2012) could include effects to other aspects of the cultural landscape including subsistence camps and cabins, trails, traditional use areas, traditional cultural properties, and sacred locations. Additional effects could include changes in use of or access to culturally important locations, loss of cultural connections, decreased use of the landscape in the vicinity of project components, disruptions to ambient noise levels and changes to the viewshed in culturally sensitive areas, or gradual shift of cultural activities away from development. When taking into consideration, the proposed GMT1 project and conceptual GMT2 project, the cumulative effects of these developments would be similar and additive. As noted above, impacts to cultural resources are primarily limited in extent to areas where gravel would be mined. As development of GMT1 would likely exhaust the currently available supply of gravel at the ASRC Mine site, construction associated with a conceptual GMT2 project, or other RFF projects, which will require gravel to construct, the cumulative impact will be additive. To the extent that cultural resources are removed or destroyed as a result of gravel mining, these resources cannot be restored and thus are unique and impacts are long-term.

Evaluating impacts associated with undocumented cultural deposits in an area where RFF projects could occur cannot be quantified and is outside the scope of this SEIS.

Overall, the GMT1 project in addition to other current and RFF activities would increase the amount of gravel required, resulting in additional disturbance to currently undeveloped areas. However the severity of impacts will vary as not all sites that may be disturbed as a result of development have cultural resources of importance. Planned developed that avoids known cultural deposits, could have a countervailing impact with respect to the cumulative case. Alternative E would have no incremental adverse cumulative impact to cultural and archaeological resources on the North Slope.

Land Use

The combination of GMT1 and the conceptual GMT2 project would not change existing land use of federal land in the NPR-A, reflecting a DOI decision to issue oil and gas leases with an implied expectation by the lease holder that environmentally responsible development of discovered commercially recoverable oil and gas resources would be approved. Alternative A was cited and designed to comply with all relevant lease stipulations, as well as most of the BLM (2013) BMPs governing surface uses. Land owned by the Kuukpik Corporation is designated for a mixed use, which includes oil and gas production facility operations associated with Alpine. The conceptual GMT2 involves an area selected by the Kuukpik Corporation. Until these lands are conveyed, BLM manages all selected land in the same manner as federal land in the NPR-A. Overall, the cumulative impact to land use by construction of the GMT1 and the conceptual GMT2 under any of the action alternatives is not expected to change the land uses now in place. Alternative E would deny the development of GMT1 and the conceptual GMT2 would not occur.

The 2004 ASDP EIS stated that additive cumulative impacts on land use, habitats and subsistence on the North Slope would be expected to occur from current and future development and operation of energy, transportation, and utility facilities. The continued development of previously undisturbed areas on the North Slope will change the character of land use, cause increases in noise and disturbance, and potentially adversely affect habitats and subsistence. Most of the cumulative impacts from future development were expected to be localized to the development facilities.

Other related cumulative effects to land use are discussed under Subsistence and Recreation. Alternative E may not have an adverse cumulative impact to the overall land ownership on the North Slope since land ownership is fixed by Federal law. However, the location of unfilled land entitlements for the State and to Native Corporations may move to other valid existing selections by the Kuukpik Corporation within NPR-A. Selected land associated with GMT1 and the conceptual GMT2 may not transfer from federal to private ownership because it is reasonable to conclude that most of these selections were based on prospective oil and gas development. The extent that existing valid selections by the Kuukpik Corporation would or would not continue to patent is beyond the scope of this SEIS.

When taking into consideration the proposed GMT1 project and conceptual GMT2 project, the cumulative effects of these developments would be similar and would not change existing land use. Other RFF projects considered in this SEIS (i.e., Umiat Road/Pipeline, offshore oil and gas development, etc.) would have an additive impact with respect to land use to the extent that development associated with RFF projects may extend into areas which have not be set aside for oil and gas development. Changes to visual resources, subsistence, land use, and other resources will occur as the result of development in currently undeveloped areas increases.

Recreation

Public recreational facilities in the project study area are nonexistent and recreational opportunities in this area are a function of the natural setting. Primitive unconfined recreational opportunities (e.g. backpacking, sightseeing, and hunting) are possible, but access is limited due to the remote nature of the area. Public recreation in the area is of low intensity and primarily limited to non-local visitors who float the Colville River between Umiat and Nuiqsut. Types of impacts to recreation would occur from construction and operation of facilities, and decreased access or solitude in nearby areas.

Impacts to recreation during drilling and operations are considered to be minimal due to the lack of access and limited in extent. Under Alternatives A, B, and C, the construction of new gravel roads would increase recreational access to a larger area than is currently accessible via roadway. Alternative D would not provide additional opportunity for public access as a road would not be constructed and travel in and out of the associated airstrip would be limited to industry. Alternative E would have a very small but adverse cumulative impact to public access to recreation resources on the North Slope, as no new roadways would be constructed and access would remain limited.

The conceptual GMT2 project, under Alternative A, B, and C would increase access to the area that may be available for future public use by adding approximately 9 miles of industrial gravel road from the GMT1 site. Residents of Nuiqsut would have similar access to the conceptual GMT2 area via the Nuiqsut Spur Road under these 3 alternatives. Alternative D is unlikely to provide any increased opportunity for public access to the general project study area since there is no permanent surface access and the two new airports (except for emergency situations) would not be available to private aircraft. Alternative E would maintain existing recreation resources and opportunities in the project study area, although public access will not be improved.

The BLM (2004) predicted that short-term impacts, such as green trails and disturbance from noise and other activities, would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, and gravel pads would accumulate and would result in the long-term loss of solitude, quietude, naturalness, or primitive/unconfined recreation, and wilderness-type values. These impacts could be locally adverse (BLM 2004 § 4G.7.7)

The BLM (2012) considered impacts to recreation across the North Slope. Future oil and gas activities, the road to Umiat and associated activity, the Chukchi Sea development, and the alternatives found in this IAP would have an additive cumulative effect on recreation resources in the NPR-A. As the climate warms in future years, the timing and location of recreation activities could change. For instance if wildlife changes the areas that they inhabit then both wildlife viewers and hunters would correspondently change the location that they recreate. Cumulatively there would be more activity, more human presence, increased noise, increased aircraft use, change in location of recreation activities, and correspondingly greater impacts on the setting, experiences, and desired beneficial outcome from use of public land. Also in the future as the climate gets warmer, the timing and location of recreation activities could change. The impacts to recreation associated with the proposed project are within the range of impacts considered by BLM (2012, § 4.8.7.16).

Of the proposed and RFF projects, the Umiat Road and Pipeline has the greatest potential to impact recreational opportunities in the cumulative effects evaluation area. The construction of the Umiat Road and Pipeline would add approximately 102 miles of new roadways and tie into the Dalton Highway. This tie in could increase access for potential recreationalists along the

road corridor and in the Umiat area. Likewise, other developments, to the extent that they connect to the Umiat Road and Pipeline system would also have an additive impact in opening up the area for recreation. The road would result in easy public access to the Colville River and thus by boat to the Colville Delta and Beaufort Sea as well as to any navigable tributary of the Colville. Thus, the potential impact to recreation although overall is considered to be negligible, would be minor in the Umiat area.

Wild and Scenic Rivers

The Nuiqsut area does not involve any existing or potential wild and scenic rivers. The Colville River at Umiat was identified as a potential wild river but the river and east bank are not in non-federal ownership.

The action alternatives of the proposed GMT1 project would have no effect on existing or future potential of the Colville River to be added to the National Wild and Scenic Rivers system. It is also unlikely that Alternative E would increase the future potential that the Tiŋmiaqsiġvik (Ublutuoch) River or Fish Creek be added to the National Wild and Scenic River system at a future date given the general priority of oil and gas resource exploration and development in the project area. The conceptual GMT2 project in combination with the Alternatives A, B, C, D, and E would have no cumulative impact on wild and scenic rivers. Similarly, other RFF projects in the cumulative effects evaluation area are not anticipated to have cumulative impacts with respect to wild and scenic rivers.

Wilderness

The proposed GMT1 project area and adjacent federal, private, and state lands, have substantial development, including the community of Nuiqsut and active oil and gas projects, are not located within or near any Congressionally-designated Wilderness, and do not involve federal land where the responsible federal land managing agency (in this case BLM) has made a recommendation for Wilderness designation. Subject to valid existing rights granted by federal oil and gas lease, BLM will continue to manage federal land in NPR-A for existing naturalness, ecological, geological or other features of scientific, education, scenic, or historical value. Alternatives A, B, C, and D would result in permanent oil and gas facilities that are not compatible with Wilderness designation. Oil and gas activities would be governed by the applicable BMPs and Stipulations described in the RODs that approved the APDs and rights-of-ways on federal land in the NPR-A, as described in section 4.7. BLM has determined that existing wilderness characteristics/values on federal land in NPR-A that are generally further than 5 miles from a community are not adversely impacted. It is assumed that this 5-mile standard applies to oil and gas facilities in NPR-A. Under Alternative E, the GMT1 project would be denied and the conceptual GMT2 project would not occur. It is beyond the scope of this SEIS to speculate on the future outcome of Alternative E on future Wilderness designations for federal lands previously opened to oil and gas activities or withdrawn.

Impacts from long-term or permanent facilities such as roads, pipelines, and gravel pads would accumulate and would result in the long-term loss of solitude, quietude, naturalness, or primitive/unconfined recreation, and wilderness-type values. In the future, supplemental values of ecological, geological, or other features of scientific, education, scenic, or historical value to wilderness characteristics may be affected if the climate continues to warm in the NPR-A. The contribution from the GMT1 Project to the loss of wilderness values is expected to be negligible and within the range of cumulative impacts addressed by BLM (2012; 2013).

Past, present, and RFF activities in the vicinity of GMT1, when considered together, would cause a permanent loss of wilderness characteristics for the RFF, which could be considered

negative. Of the RFF projects, the Umiat Road/Pipeline and the Colville River Road have the greatest potential cumulative impacts. Both of these roads would permanently change the characteristic of the landscape, introduce public access into currently non-easily accessible areas, increase the overall noise level, and increase the viability of further development in the Umiat area and within the NPR-A. BLM has determined that existing wilderness characteristics generally further than 5 miles from a community are not adversely impacted. Impacts from long-term or permanent facilities such as roads, pipelines, and gravel pads would accumulate and would result in the long-term loss of solitude, quietude, naturalness, or primitive/unconfined recreation, and wilderness-type values. Overall, the cumulative impact to wilderness is expected to be negligible.

Visual Resources

Oil and gas activities, including the action alternatives associated with the GMT1 project would result in changes to the existing undeveloped nature of the project area. During the construction phase, the primary negative impact to visual resources from the action alternatives would result from the presence of drill rigs in the project area. During drilling and operations, pad facilities and communication towers would introduce a strong contrast to the natural landscape. The addition of gravel roads, pads, and airports as well as above-grade pipelines and bridges would also alter the existing visual landscape.

With all of the GMT1 action alternatives, there would be a cumulative adverse impact on visual resources within approximately 5 miles of proposed permanent facilities. Visual impacts under Alternatives A and B would be essentially the same. Alternative C would have similar impacts to Alternatives A and B over a slightly larger footprint due to the addition of the Nuiqsut Spur Road and upgrades at the Nuiqsut airport. Alternative D would eliminate the visual impact of a permanent gravel road to the GMT1 pad, but would include an elevated pipeline. This would be counterbalanced by the establishment of a new airport and instrumentation. The effects of new facilities would change the existing visual resources associated with the GMT1 project. For new facilities, the impact to visual resources would be of moderate intensity, long-term, and regional in extent. New facilities constructed adjacent to existing facilities or added to existing VSMs would not change the existing visual character associated with existing oil and gas facilities. All four of the action alternatives are consistent with VRM Class IV land management objectives and would impact the visual resources moderately. Alternative E would have a beneficial effect on visual resources. There would be additional beneficial effect to retaining the existing visual character of the North Slope to the extent that oil and gas activities in remote areas be reduced or foregone.

The conceptual GMT2 project would have additive impacts to those of the proposed GMT1 project by extending the changes to existing visual resources to the GMT2 pad. The conceptual GMT2 project would have similar visual impacts to those described for GMT1 under the action alternatives. Under Alternative D, the conceptual GMT2 would include construction of another airport and an elevated pipeline to connect the conceptual GMT2 to GMT1 and the APF.

The BLM (2004) considered cumulative impacts to visual resources from the proposed Alpine development. Short-term impacts such as green trails would not accumulate, and would naturally recover. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate and would result in the loss of scenic quality. Long-term impacts from future development with a possible life span of over 30 years would affect the visual resources for the North Slope. These impacts would be expected to be greatest within a half-mile radius of each developed site. Pipelines could be elevated above ground level. Except during construction and repair of pipelines, there would be no associated on-the-ground activity.

Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond approximately a half-mile (BLM 2004, § 4G.7.8).

BLM (2012, Map 2-5) identifies the visual resources in the project study area as being managed as a Class IV resource. The overall cumulative impact to visual resources in the area production facilities, elevated pipeline system, gravel road, and airports would be high. BLM (2012) concludes the cumulative effect of oil and gas development on the visual resources of the North Slope generally would be limited to the foreground-middleground zone of the viewer BLM (2012, p. 135). The project study area is one characterized as low relief with very low vegetation cover, suggesting the cumulative effect to visual resources could extend over a mile on a clear day. Lights at permanent facilities would also be seen from a distance of several miles during winter. Climate change could affect visual resource values by altering the current conditions of color, vegetation, land formation, adjacent scenery, and the presence of water.

The cumulative effect of oil and gas development on the visual resources of the North Slope generally would be limited to the foreground-middle ground zone of the viewer. Although BMPs, lease stipulations, and mitigation measures would be taken to help blend structures and permanent facilities into their surroundings, the overall cumulative impact to visual resources in the immediate area of production facilities, elevated pipeline, gravel roads, and airports would be high. The cumulative impacts from the currently proposed project are within the range analyzed in BLM (2012).

Proposed and RFF projects, in conjunction with the range of action alternatives for the proposed GMT1 project and the conceptual GMT2, would have an additive cumulative negative impact which would permanently alter the existing visual resources. Of the RFF projects, the Umiat Road/Pipeline and the Colville River Road have the greatest potential cumulative impacts. Both of these roads would permanently change the characteristic of the landscape, introduce public access into currently non-easily accessible areas, increase the overall noise level, and increase the viability of further development in the Umiat area and within the NPR-A. As development expands across the North Slope, primarily into areas where no infrastructure currently exists, so will the extent of impact on visual resources.

Local Transportation

The cumulative effect of GMT1 would be focused on the construction of an industrial gravel road system in an area currently roadless. For the GMT1 project impacts to local transportation would occur during both the construction and operation phase. Under Alternatives A, B, and C, which have similar transportation components and include linking GMT1 to existing gravel roads and infrastructure, minor impacts to local transportation are expected as most construction would take place on industry-constructed ice roads with no public impacts. These alternatives would have a minor impact over an interim duration (during construction only) on a regional basis. Under Alternative C, the six-mile long Nuiqsut Spur Road would be widened to accommodate industrial traffic from the Nuiqsut Airport to the Alpine Field, which could be considered a beneficial effect. Alternative C would also include improvements to the Nuiqsut Airport, which would be beneficial to the local community. Alternative D would not include a road connection to GMT1 and would require construction of a new airport at the GMT1 drill site. Alternative D, with its limited access, would result in a large increase in air traffic, which would occur for the entire duration of the proposed project. As such, Alternative D would have a moderate impact for a long duration on a regional basis.

All of the action alternatives (Alternatives A, B, C and D), would increase access to the general area around GMT1. The overall increase in permanent road access, under alternatives A, B, and

C, may be beneficial to future discoveries of commercially recoverable oil and gas resources in the GMTU depending upon on the location of the oil and gas resource. Having a gravel road system is likely beneficial to residents of Nuiqsut seeking access to traditional subsistence areas now limited to travel by ORV/snowmachine. Conversely, improved year around access may adversely impact the ability to harvest subsistence resources in the immediate area of the road and other facilities. Alternative E would result in no new access within the NPR-A.

Adding the conceptual GMT2 would increase the transportation network from GMT1 to GMT2; the overall cumulative impacts from the conceptual GMT2 would be similar to those for the alternatives associated with the proposed project.

The 2004 ASDP Final EIS found that the proposed Alpine Field development, along with continued oil and gas development throughout the North Slope, would result in substantial increases in both road and air traffic levels, particularly on the central oil and gas transportation infrastructure in the Prudhoe Bay area. However, most of the transportation infrastructure on the North Slope is restricted to industry and local resident use, and operated well below capacity. Despite the substantial increase in activity levels, the existing infrastructure combined with the proposed roads and airstrips serving remote facilities, was expected to be sufficient to accommodate these increased demands for air and overland transportation. Therefore, the BLM (2004) did not anticipate any adverse cumulative effects on transportation resources on the North Slope (BLM 2004, § 4G.7.9.1). The transportation impacts considered there are consistent with those for the currently proposed project.

The addition of the Colville River Road Access would complete a road connection providing year-around vehicle access to fish and wildlife resources along the Colville River and its Delta, as well as to estuarine and marine resources along the coast. The cumulative effects of these new local transportation facilities in the Nuiqsut area would be intense and long-term and would have both localized and regional benefits.

The proposed Umiat Road/Pipeline(s) would provide year-around access between the Dalton Highway, TAPS, and a commercial gas pipeline system and the recreation and subsistence resources at Umiat as well as for prospective transportation of oil and gas resources in the Gubik Unit, Umiat Unit, and other areas in the southern parts of the NPR-A. The cumulative effects of these new transportation facilities, as they provide opportunities for other RFF projects to occur in the Umiat area, would be intense and long-term and would have both localized and regional benefits. Other RFF projects could have a synergistic cumulative effect to the extent that new offshore and onshore developments connect to project infrastructure expanding the local transportation network and providing access to subsistence resources.

4.6.4.4 Oil, Saltwater, and Hazardous Material Spills

To date, the majority of spills on the North Slope have been less than 100 gallons with releases primarily occurring within secondary containment or onto gravel pads or roads. Impacts from these spills have been limited in area (e.g. local), duration (temporary), and size and have not occurred frequently or at large enough volumes for their effects to have accumulated. Spills have the potential to occur at any phase (e.g. construction, drilling, or operation) of the proposed project, the conceptual GMT2, or other RFF projects. Impacts associated with spills are discussed in further detail in Section 4.5 and discussed in the preceding sections with respect to the various resources.

Development of GMT1 and its associated infrastructure is not expected to increase the likelihood of a very large spill, or negatively impact marine mammals, if a spill were to enter a river and make its way to the Beaufort Sea. BLM (2012, § 4.12.4) analyzes the potential effects of a very large oil spill in the NPR-A. The potential of an oil spill reaching coastal habitats from the proposed GMT1 project is extremely low. The cumulative impacts from each of the GMT1 action alternatives are similar in that each action alternative creates the potential for oil spills. Alternatives A, B, C, and D are all anticipated to have a minor impact with respect to spill potential. Action alternatives (A, B, and C) that have a road located near the pipeline mitigates some of the potential for a major or undetected spill by allowing better access for surveillance and monitoring by operators. In addition, the presence of the road in close proximity to the pipeline allows better access for emergency and spill response activities, which would in turn limit the spread and overall area impacted by a spill. Alternative D may have a slightly higher impact than Alternatives A, B, and C, due to its lack of road, which may allow a leak or spill to go undetected for a longer period of time. Alternative E (No Action) would have no negative impact with the respect to the potential for oils spills. Alternative E would have a beneficial effect by eliminating the potential for spills of saltwater of hazardous materials from the GMT1 and conceptual GMT2 projects. There could be a reduction on the risk of spills in other remote area on the North Slope due to the associated potential reduction in development of oil and gas activities based on that decision.

Spills are inevitable, and any spills resulting from development of GMT1 would add to the number of spills annually from other oil industry and other RFF developments on the North Slope. Four very large spills have occurred on the North Slope; three associated with the operation of TAPS and one at BP's Gathering Center 2.Due to the relatively small size of pipelines serving GMT1, and the conceptual GMT2, along with industry standards on block valves and monitoring pipeline systems, it is unlikely that a large spill would be reasonably expected to occur from the interconnecting pipeline systems. There is nothing to suggest that the cumulative effects of the proposed GMT1 project and the conceptual GMT2 project would result in a large spill of crude oil spill or product spill on the North Slope. The incremental cumulative impact of spills is confined to the drill pad, where containment and cleanup supplies are located, is expected to be minor for all of the action alternatives. Spills associated with vehicle use on gravel or ice roads are mitigated by the drips and drops program in place at most North Slope facilities. Spills confined to roads (and pads) can typically be cleaned up without substantial damage to water or vegetative resources.

Proposed and RFF projects, in conjunction with the range of action alternatives for the proposed GMT1 project, could have an additive cumulative negative impact with respect to spills; specifically the Umiat Road and Pipeline and Offshore Development. The construction of the Umiat Road and Pipeline would add approximately 102 miles of new roadways and an elevated or buried pipeline. The addition of another pipeline and associated facilities and roadways, increase the amount of stored and transferred oil and other petroleum and gas related fluids, which in turn would increase the potential for spills. Likewise, the development of offshore infrastructure and onshore support infrastructure would also have an additive cumulative impact as the potential for spills increases. Additionally offshore development and the transfer of offshore oil and gas to onshore facilities would increase the probability of a spill to water based on the location of infrastructure.

Although development of the proposed project, conceptual GMT2, and other RFF projects would increase the potential for spills, BMPs; Stipulations; Alaska Statutes and regulations; and actions taken by the operators (monitoring, spill prevention and response planning, etc.) can help mitigate the potential for a large spill.

4.7 Mitigation Measures

NEPA regulations (40 CFR 1508.20) define mitigation as avoiding, minimizing, rectifying, reducing over time, or compensating for impacts of a proposed action. For actions on federal land in the NPR-A, the BLM has developed a series of protective measures to mitigate potential impacts. These are defined and evaluated as part of the IAP/EIS process, and adopted in the ROD. RODs and permits may include additional mitigation. Mitigation may also be incorporated into project design. (CEQ 2011, p, 5)

In analyzing the GMT1 project, protective measures required by BLM for activities in the NPR-A, mitigating requirements of BLM (2004a), and mitigation incorporated by CPAI into ASDP project design and practices are considered for their effectiveness in avoiding or reducing potential environmental impacts.

Due to the timeframe from exploration to development, the GMT1 project has been subject to various BLM requirements, as summarized below:

- The BLM approval for permitting the ASDP (including GMT1) included prescriptive lease stipulations adopted by the 1998 Northeast NPR-A IAP/EIS ROD, as well as other project-specific measures to mitigate potential impacts of development (2004 ASDP ROD);
- In 2008, in adopting a new IAP for the Northeast NPR-A, the BLM adopted two types of performance-based protective measures analogous to those that had been adopted in the Northeast NPR-A (BLM 2008b): lease stipulations and required operating procedures (ROPs). The analysis included a comparison of the 1998 stipulations and the 2008 lease stipulations and ROPs (BLM 2008b, § 2.7, Tables 2-2 and 2-3). CPAI updated GMT1 lease obligations to comply with the 2008 lease stipulations;
- The 2008 performance-based lease stipulations and ROPs differ from the 1998 prescriptive stipulations in two general ways. The 2008 lease stipulations and ROPs: (1) reduced replication of other laws and regulations; and (2) provided more utility and effectiveness in accommodating the variation and complexity associated with North Slope activities, as well as greater ability to adapt management as new information becomes available and construction/operations methods improve. By focusing on results, the performance-based measures provide BLM with greater flexibility achieving resource protection objectives (BLM 2008b, § 2.3.5);
- In 2013, BLM adopted an IAP for all lands and waters administered by the BLM in the NPR-A. BLM (2013) supersedes BLM (2004e) and BLM (2012, § 1.6.1). The two types of protective measures were maintained, and although the term BMP replaced the term ROP, the definition was retained[13].

For the GMT1 project, the 2013 BMPs will be in effect, but no changes to the current lease stipulations will occur without further evaluation and discussion with the BLM. Certain 2008 lease stipulations (D-1, D-2, E-2, E-3, G-1, K-1, and K-2) applicable to this project present

[13] Required Operating Procedure: Mitigation developed through the BLM planning process/NEPA process that is not attached to the oil and gas lease but is required, implemented, and enforced at the operational level for all authorized (not just oil and gas) activities in the planning area (BLM 2008, NE NPR-A Supplemental IAP ROD, p. 35).

BMP: Mitigation developed through the BLM planning process/NEPA process that is not attached to the oil and gas lease but is required, implemented, and enforced at the operational level for all authorized (not just oil and gas) activities in the planning area (2013 NPR-A IAP ROD, p. 39).

essentially the same level of protection as the 2013 BMPs. In 2013, the 2008 Stipulation E-17 was dropped in deference to ROP E-11; however, due to project location, Stipulation 17 is not applicable to GMT1.

As described in Section 1.4.2.1, the Corps will require compensatory mitigation based on the functional value of each acre of the direct project footprint, plus the lost functional value associated with impacts to the aquatic ecosystem surrounding the project footprint. For the nearby CD5 project, also located within wetlands, the Corps required three acres of replacement wetlands compensation for each acre of the project footprint located outside the Colville River delta. BLM's current Draft Regional Mitigation Manual states that it may be appropriate for BLM to require compensatory mitigation to be performed outside the area of impact when other types of mitigation are insufficient to mitigate direct and indirect impacts to an acceptable level at the project location. Based on this policy, and considering the Corps' will require compensatory mitigation for impacts to the aquatic ecosystem, BLM-Alaska is considering additional compensatory mitigation for impacts resulting from BLM authorizations that occur beyond impacts compensated for by the Corps permit.

Table 4.7-1 summarizes the mitigation measures in place through BLM (2013), the BLM (2004a), and CPAI design features and practices implemented for ASDP projects, including GMT1. Additional permitting requirements will be implemented by other federal, state and local agencies.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
PHYSICAL ENVIRONMENT			
Physiography	C-2, E-5, 6, and 8, E-12, L-1		
Permafrost	A-1 through A-7, A-9, A-10, C-2, E-4, 5, 6, 8 and 12, L-1		
Sand and Gravel Resources	E-5, E-8		
Hydrology and Water Quality	A-1 through A-7, B-1, B-2, C-2, C-3, C-4 E-2, E-3, E-4, E-6, E-8, K-1, K-2	Prior to lake water withdrawals, lake monitoring studies that evaluate lake habitat recharge and actual recharge during breakup will be completed at BLM direction. The permittee will submit to the Authorized Officer for approval, a monitoring plan for lakes where withdrawals are expected. In order to ensure that lakes maintain their natural ability to support the same suite of species as they have in the past without water withdrawal, the plan will be for monitoring water quantity and quality throughout the period of withdrawal and the rest of the year. The monitoring will continue as long as withdrawals take place or until BLM determines that further monitoring is unnecessary. The permittee will implement a monitoring program that is approved by the Authorized Officer, which incorporates the collection of samples of suspended sediment upstream and downstream of the Tingmiaqsigvik (Ublutuoch) River bridge. This monitoring program will assist in the analysis of scour and fill processes occurring in the vicinity of the bridge and determine future erosion abatement measures to be taken. The monitoring will continue until BLM determines that further monitoring is unnecessary. Monitor sedimentation upstream and downstream of the Tingmiaqsigvik (Ublutuoch) River bridge. The road and pipeline bridge across the Tingmiaqsigvik (Ublutuoch) River would extend from bank to bank defined as the active flow-way and the frequently active floodplain between topographical rises. This would require a bridge approximately 350 ft long at the currently proposed location; though, the bridge could be relocated close to the proposed crossing where the bank-to-bank span would be less. Approaches to the Tingmiaqsigvik (Ublutuoch) River bridge would provide for natural water flow.	In the GMT1 project study area, bridges and culverts are designed to withstand a 50 year (Q50) return flood event plus 3 ft of freeboard To protect against scour and bank migration, bridge abutments are armored and piles are set deep enough so that the structures would remain stable during the design scour event. Bridge structural design accounts for the higher-magnitude, less frequent floods, and slope-protection armor would protect against the more frequent, lower-magnitude floods. A monitoring program which will assist in the analysis of scour and fill processes occurring in the vicinity of the Tingmiaqsigvik (Ublutuoch) River and Crea Creek bridges. This could involve cross-section or bathymetric surveys to establish baseline conditions once the bridges are built. This will require monitoring of breakup discharges at bridges. Continuous monitoring of the Tingmiaqsigvik (Ublutuoch) River will be done the first year until flow ceases. The design of culverts along the GMT1 road has incorporated the findings of fish surveys and hydrologic modeling into their design. The permittee, under the direction of the AO, will undertake monitoring of culverts during breakup for impoundments, erosion, scour, and deposition created by placement of culverts. Streamflows through Clover site will be monitored during breakup and scour, or sedimentation will be documented, Rehabilitation plans will be evaluated for effectiveness and additional remediation.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Hydrology and Water Quality (Continued)	A-1 through A-7, B-1, B-2, C-2, C-3, C-4 E-2, E-3, E-4, E-6, E-8, K-1, K-2	Bridge abutments would be armored, with sheet-pile wing walls. Incorporation of the findings of fish surveys and hydrologic modeling into the design of proposed bridges and culverts and subsequent monitoring of culverts and remedial measures based on this monitoring. A program to monitor water quality above and below the proposed Tingmiaqsigvik (Ublutuoch) River bridge and, if necessary, identify additional erosion abatement measures.	
Air Quality	A-9, A-10, E-1, E-8	The permittee will implement a plan approved by the Authorized Officer for limiting fugitive dust. Methods of dust control could include road watering, vehicle washing, covering of stockpiled material, ceasing construction during wind events, the use of chemical stabilizers, and chip seal, and could vary for the frozen and non-frozen seasons.	Drill rigs use reduced sulfur diesel-generated power. Vehicles are equipped with block heaters. Idling practices are to shutoff and plug in vehicles in temperatures of -30 F or above to conserve fuel and reduce emissions. Finewater Mist is used in place of Halon, one of the substances believed to damage the environment. Management of Change procedures are maintained to ensure environmental considerations occur prior to purchasing new tanks or adding new air sources which may affect the environment or operating permits.
Noise	F-1		Electric power generator sets are totally enclosed or acoustically packaged to abate noise emissions. Mufflers and other measures are used to abate noise from exhaust systems of engines and turbines.
Paleontology	E-13, K-2		
Hazardous and Solid Waste	A-1 through A -7, E-4		New chemicals being considered for use in the field are reviewed to ensure that the materials will minimize the generation of hazardous waste or risk to employees. Wastes are managed according to the Alaska Waste Disposal and Reuse Guide (the "Red Book"). Most wastes are injected into the subsurface in disposal wells or used for enhanced oil recovery. Drill cuttings are disposed via annular disposal/ injection instead of using surface pits.
BIOLOGICAL ENVIRONMENT			
Vegetation and Wetlands	A-1 through A-7, A-11 A-12, C-2, E-1, 4, 8 and 12, I-1, K-1, L-1, M-2, M-3	Where necessary, fill slopes will be stabilized using revetments, soil binders, or other methods approved by the Authorized Officer. Construction, development, and operations actions will be conducted in a manner that avoids riparian shrub areas whenever possible.	Gravel roads are watered to minimize dust and maintain integrity of the roads. Permanent camp facilities are consolidated, not spread among drill sites. Roads are built to the minimum width necessary for adequate operations and safety. Pads are designed for the minimum footprint required for the activity.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Vegetation and Wetlands (Continued)	A-1 through A-7, A-11 A-12, C-2, E-1, 4, 8 and 12, I-1, K-1, L-1, M-2, M-3	The footprint will be reduced by minimizing pad size and drilling multiple wells from a single pad and by minimizing the road footprint while avoiding the most important wetlands. Construction of facilities will occur to the greatest extent possible on relatively higher elevation and less critical wetlands. Only 6 % of the gravel footprint west of the Nigliq Channel (10.6 acres of 172 acres) would be on key wetlands. The overwhelming proportion (80%) of the gravel footprint west of the Nigliq would occur on relatively dry moist sedge-shrub meadow and moist tussock tundra. This habitat also accounts for approximately 90 % of the land to be excavated at the Clover site. Extraction of gravel and construction of gravel roads, pads, and pipelines will occur in winter using ice roads, thus minimizing potential impacts to the tundra. Road watering would occur to help control dust. Bridges or culverts would be placed in known drainage locations and, at a minimum, culverts or bridges if water flow justifies it, will be placed at approximately every 500 ft along roads. The Clover site will be rehabilitated (see the rehabilitation plan in Appendix O of the FEIS), including interim reclamation.	Minimum gravel road thickness of 5 ft, maintains the permafrost condition by insulating the tundra and offsetting the loss of insulating effect caused by suppression of the vegetated tundra below the gravel. Cleared snow is placed in designated areas. Stormwater is managed from all facility gravel pads to ensure no contaminants are released during spring thaw. Attaching power line cables to pipeline and VSMs reduces the disturbance to vegetation (no power poles installed). Ice roads are a minimum of 6 inches thick. Ice pads are built during construction to stage vehicles and equipment. Ice roads are routed to avoid shrub areas and large areas of tussock tundra as much as is practicable. Stream crossings are minimized where possible and the most direct route is taken to minimize the surface area of the disturbance. Off-road vehicle operators are trained to avoid tight turns on tundra. CPAI collects environmental baseline data prior to developments and monitors various environmental media as applicable during construction and operations. Revegetation studies to monitor vegetation impacts.
Fish	A-2 through A-7, A-11, A-12, B-1, B-2, C-3, C-4, C-5, E-1, E-2, E-4, E-6, E-8, E-14, K-1, K-2, L-1	CPAI will perform fish surveys and hydrologic modeling for water bodies at proposed bridge and culvert sites. The results of these surveys and modeling will be incorporated into the designs of bridges and culverts. Based on the surveys and modeling, CPAI will install bridges or culverts in roadbeds in low lying areas to ensure fish passage during high-water conditions. The fish surveys and hydrologic modeling will continue until BLM determines that further surveys and modeling are unnecessary. CPAI will continue fish monitoring studies in the Plan Area to ensure that the health of regional and locally important fish stocks is maintained. On a schedule to be approved by the BLM, CPAI will monitor all culverts to ensure that they are properly maintained and are providing access by fish to critical summer spawning and rearing grounds. CPAI will promptly repair any culverts that are not meeting these intended fish passage goals.	Pad and road construction is scheduled to occur in winter in low-diversity areas sparsely inhabited by large fish and not during times when migratory fish are moving to and from freshwater habitats. Installation of bridges rather than culverts across major waterways to ensure fish passage and minimize disturbance to riparian habitat.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Fish (Continued)	A-2 through A-7, A-11, A-12, B-1, B-2, C-3, C-4, C-5, E-1, E-2, E-4, E-6, E-8, E-14, K-1, K-2, L-1	CPAI will develop a mitigation plan that includes remedial measures to be taken should monitoring detect adverse impacts from the project. Intake structures specially designed to eliminate the potential for fish being impinged, entrained, or entrapped during withdrawal of water shall be used at all water sources. These structures must meet the standards developed by Alaska Department of Fish and Game. Monitoring of water withdrawals from lakes.	
Birds	A-1 through A-7, A-11 and 12, B-2, E-2, 4, 8, 9, 10, 11, 12, 16 and 18, F-1, I-1, L-1	If deemed necessary by BLM, the Authorized Officer may require vehicle traffic restrictions during brood rearing of specific species. The Authorized Officer will determine the time-frame that the traffic restrictions will be in place and what the reduced speed and amount of allowable traffic will be. Permittee shall utilize best available technology to prevent facilities from providing nesting, denning, or shelter sites for gulls, ravens, raptors, and foxes. The permittee shall provide the Authorized Officer with an annual report on the use of oil and gas facilities by gulls, ravens, raptors, and foxes as nesting, denning, and shelter sites. Powerlines will be placed on cable trays between CD6 (GMT1) and CD7 (GMT2) rather than on separate power poles. Artificial exterior lighting on structures over 20 ft tall would be controlled. Except for required safety lighting as may be required by FAA and OSHA, illumination of taller structures would be designed to direct artificial exterior lighting inward and downward, rather than upward and outward.	Gravel hauling is restricted during most of spring and summer to avoid interference with waterfowl nesting habitats. Attach power line cables to pipeline and VSMs. Exposed wellheads (primarily exploration wells) are wrapped with tarps to prevent raven nesting. Ongoing ecological studies (e.g., birds, vegetation, hydrology) for project planning to mitigate potential impacts.
Mammals	A-1 through A-7, A-8, A-11, A-12, C-1, E-7, E-8, E-12, E-19, F-1, I-1, L-1, M-1, M-4	The permittee will develop and implement a monitoring plan for caribou movement and vehicle traffic on the roads leading to CD6 (GMT1) and CD7 (GMT2). CPAI will then develop and apply adaptive management approved by the BLM that is aimed at minimizing traffic impacts to caribou based on what is learned. Elevate pipe a minimum of 7 ft above the tundra, as measured at the VSMs.	ADF&G is consulted for grizzly bear dens and for assistance with limiting human to bear interaction. New pipelines constructed so the bottom of pipe is at least 7 ft above the tundra, and in some places more. New pipeline VSMs for sections parallel to existing pipelines are aligned to match existing VSMs where possible, to avoid a picket-fence effect. New pipelines are designed with a muted (non-shiny) coating to avoid bright flashes from sunlight that may frighten caribou.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Mammals (Continued)	A-1 through A-7, A-8, A-11, A-12, C-1, E-7, E-8, E-12, E-19, F-1, I-1, L-1, M-1, M-4		Predator-proof dumpster bins are used for accumulation of food wastes. Workers are trained regarding the problems associated with feeding wildlife. Zip-lock and other containers are provided for meals-on-the-go to conceal food odors to lessen chances of attracting wildlife. CPAI prepared a Wildlife Avoidance and Interaction Plan, has training in place on waste management practices, and has project specific training on waste management for any new project to provide guidance to employees and contractors for managing predators. Through ACS, CPAI assists with quick response to wildlife impacts during an incident. ACS has a wildlife rehabilitation trailer where they stabilize the wildlife before sending offsite for treatment (most applies to birds and always in consultation with qualified veterinarians and agency personnel). CPAI maintains safe speed limits on all North Slope roads.
ESA Species	A-1 through A-7, A-11, A-12, C-1, E-4, E-8, E-10, E-11, E-18, F-1, I-1, J	To minimize the likelihood that migrating spectacled eiders will strike structures associated with drilling activities, BLM, cooperating agencies and the Service will cooperatively develop a lighting/operating protocol to be used on all drill rigs and associated production infrastructure. The Service and BLM will work together to identify when and where the protocol should be applied. Any protocol developed will be in compliance with Federal Aviation Administration (FAA) regulations. The lighting protocol shall ensure that radiation of light outward from all drill rigs and associated infrastructure will be minimized. This will be achieved by shading and/or light fixture placement to direct light inward and downward to living and work surfaces while minimizing light radiating upward and outward. Temporary impacts to spectacled eider productivity due to disturbance and direct habitat impacts must be minimized by ensuring protection of females with nests. Ground-level activity (by vehicle or on foot) within 200 meters of occupied spectacled eider nests, from June 1 through August 1, will be restricted to existing thoroughfares. This includes “working” gravel on existing fill (pads and roads). Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 200 meters of occupied spectacled eider nests will be prohibited. In instances where minimal summer support/construction activity must occur off existing thoroughfares, Service-approved nest surveys must be conducted	CPAI coordinates with USFWS to locate polar bear dens so the dens can be avoided. Gravel pads and facilities are oriented to minimize wind-drifted snow accumulations that could potentially serve as polar bear habitat.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
ESA Species (Continued)	A-1 through A-7, A-11, A-12, C-1, E-4, E-8, E-10, E-11, E-18, F-1, I-1, J	during mid-June of each year in which activities take place between June 1 and August 1. BLM and cooperating agencies will also work with the Service to schedule oil spill response training in riverine, marine and inter-tidal areas that occurs within 200 meters of shore, outside sensitive nesting/ broodrearing periods or conduct nest surveys. The protocol and timing of nest surveys for spectacled eiders will be determined in cooperation with the Service, and must be approved by the Service. Surveys should be supervised by biologists who have previous experience with spectacled eider nest surveys.	
SOCIOECONOMIC ENVIRONMENT			
Community Health	A-1, A-2. A-4, A-10, A-11, A-12, I-1		
Cultural and Archaeological	C-2, E-13, I-1	Before construction of ice roads, CPAI will evaluate and assess possible cultural resources in the immediate areas of the proposed ice roads.	Cultural/archaeological resource surveys are conducted prior to ground-disturbing activity. CPAI routes ice roads to avoid archaeological sites where possible.
Economics			CPAI strives to hires qualified Nuiqsut residents for jobs in the oil fields. CPAI has an internship program (Career Quest) to introduce Nuiqsut high school students to jobs in the oil fields and in their community. CPAI's philanthropy program from the Alpine field provide income and other benefits to residents of Nuiqsut.
Environmental Justice	H-1 – see Subsistence		
Subsistence	A-4 through A-7, A-11, A-12, B-1, B-2, C-3, 4, and 5, E-1, 2, 6, 7, and 19, F-1, H-1, H-3, I-1, K-1, K-2, M-1	Roads will be available for subsistence use	CPAI employees and contractors receive cultural awareness training. Hunting and fishing by non-local employees and contractors is prohibited. CPAI consults with the Kuukpik Subsistence Oversight Panel (KSOP), the Native Village of Nuiqsut, and Kuukpik Corporation to ensure operations do not adversely affect subsistence activities, and holds public community meetings frequently and well in advance of future projects. Projects have been rescheduled or travel has been rerouted to avoid subsistence use and hunting areas during seasonal periods. Subsistence hunters are allowed access to CPAI's oil fields subject to safety policies. CPAI provides the community of Nuiqsut with clear and concise policies regarding use of the roads associated with the project and hunting prohibitions, if any, along the roads and near project components. Ensure that these policies are disseminated throughout the community. The policies should also be provided to BLM for their records.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Subsistence (Continued)	A-4 through A-7, A-11, A-12, B-1, B-2, C-3, 4, and 5, E-1, 2, 6, 7, and 19, F-1, H-1, H-3, I-1, K-1, K-2, M-1		CPAI consults with the local community (Nuiqsut) on locations of road and pipelines. CPAI consults with Nuiqsut residents regarding the potential benefit (or impacts) of a boat launch on the Ublutuoch River that allows residents to access the Ting/Ublutuoch River and Fish Creek without having to travel to the Beaufort Sea. Topics for consultation should include the usefulness of the boat launch to Nuiqsut residents, the potential for creating new impacts on subsistence, and navigability of the Ublutuoch River to its confluence with Fish Creek. The consultation results should be documented, distributed to BLM and other stakeholders, and clearly identify actions to be implemented based on the consultation. CPAI implements a multi-year monitoring program in Nuiqsut to document the impacts of GMT1 on Nuiqsut subsistence harvesting activities. CPAI identifies areas of high snow drifting along the pipeline after construction and implement a snow drifting management program that clears drifts and creates access points in areas where drifts accumulate for a long distance along the pipeline. Consult with Nuiqsut residents as to an appropriate distance for cleared access areas as well as the depth of snow drifts that impede access under the pipeline. The consultation results should be documented, distributed to BLM and other stakeholders, and clearly identify actions to be implemented based on the consultation. In consultation with local hunters and local organizations, continue to facilitate, improve, and expand communication protocols to inform subsistence users of daily flight patterns and identify potential conflict areas during peak hunting times. This consultation should include efforts to advertise these communication protocols so that a majority of Nuiqsut subsistence harvesters are aware of them and confirmation that existing minimum altitude requirements are adequate. The consultation results should be documented, distributed to BLM and other stakeholders, and clearly identify actions to be implemented based on the consultation. During community consultation provide ample opportunities for input from various local entities (e.g., Kuukpik Subsistence Oversight Panel, Native Village of Nuiqsut, City of Nuiqsut, Kuukpik Corporation) in addition to knowledgeable subsistence users. CPAI will periodically document the level of local entities' participation in and satisfaction with community consultation.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Subsistence (Continued)	A-4 through A-7, A-11, A-12, B-1, B-2, C-3, 4, and 5, E-1, 2, 6, 7, and 19, F-1, H-1, H-3, I-1, K-1, K-2, M-1		CPAI should inform local residents of company subsistence leave policies and ensure that leave policies are flexible to account for annual variation in the timing and length of subsistence activities. CPAI should employ subsistence representatives who receive daily communications on project activities and report potential conflicts with subsistence users. Subsistence representatives should be local and knowledgeable residents and be included in field activities that the community believes have a high potential for conflicting with subsistence uses (e.g., helicopter surveys). CPAI will provide subsistence representatives with regular project updates and clear communication protocols and training on how to report potential conflicts with subsistence users. Except in the case of emergencies, prohibit the use of airboats on rivers that have been previously documented as boat subsistence use areas for Nuiqsut residents. Through consultation with local residents, identify key boating areas that should be avoided.
Land Use	A-1, A-3, A-4, A-5, A-10, C-2, C-3, E-1, E-5, E-8, F-1, I-1, K-1e, K-1g		
Recreation	A-1, A-5, C-2, C-3, C-4, E-5, E-6, E-7, F-1, H-3, E-17, I-1, M-2		
Visual	A-1, A-3, A-4, A-5, A-6, C-2, C-3, E-5, E-17, F-1, I-1, M-2	All permanent painted structures, including emergency spill containers located along watercourses, will be painted to blend with the natural environment. All colors will be pre-approved by the Authorized Officer. BLM will use computer generated colors and on-site testing to determine the color for structures that will blend in best with the background colors of the natural landscape. Self-weathering steel, non-specular surfaces, or BMPs shall be used on all metal structures not otherwise painted. Use a non-reflective finish on all pipelines.	
Wilderness	A-1, A-4, A-5, A-6, C-2, C-3, E-5, F-1, I-1, M-2		

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Spill Prevention	A-2 through A-5	Install pipeline valves on either side of the Tingmiaqsigvik (Ublutuoch) River and place spill containment equipment below each valve. Pipeline monitoring and surveillance program. Locate roads near to and parallel the pipelines, facilitating leak detection and spill response. Valves will be placed in the produced fluids pipeline on both sides of the Tingmiaqsigvik (Ublutuoch) River and spill containment equipment will be installed below each valve.	CPAI uses an improved weld pack design. CPAI has an ice road liner and spill kit policy. CPAI's practice is to immediately and completely clean up spills, recovering 100% of the spilled product for recycling when possible. Fuel Transfer SOP in place. Mutual Aid agreement among N.S. operators to supply manpower and equipment for spill response. Spill drills to ensure response readiness and awareness are scheduled each year and involve Production, Drilling and Pipeline scenarios. Well cellars are designed to catch drips and leaks. Alpine Spill Response Team (SRT) and Hazardous Materials Response Team (HMRT) - trained, volunteer spill and hazardous materials response personnel on-site at Alpine. Pipelines are inspected and maintained regularly using pigs (where possible) and other standard operating procedures including the Twin Otter-mounted FLIR technology. Pipelines in the Colville delta are designed to withstand a 200 year (Q200) return flood event plus 3 ft of freeboard. Pipelines are designed to American Society of Mechanical Engineers (ASME) Codes B31.4 (oil and water) and B31.8 (gas). In the Colville Delta, pipelines are designed to be placed downstream from roads so the roads would help protect the pipeline from ice; elsewhere pipelines are designed to be upstream from roads so that roads would serve as a containment barrier in the event of a pipeline spill. Fluids in pipelines are treated periodically with chemicals to limit the potential of corrosion. CPAI has an extensive corrosion inspection program. Pipelines undergo hydrostatic testing prior to operation. Petroleum storage tanks have secondary containment and spill prevention and detection technology as required by regulations. These tanks are inspected regularly in accordance with industry standards.

Table 4.7-1. Mitigation Associated with the GMT1 Development Project (Continued)

Resource	2013 ROD BMPS	2004 ASDP ROD	CPAI Design Features and Other Agency Permit Requirements
Spill Prevention (Continued)	A-2 through A-5		"Target Zero" Spill prevention program designed to raise awareness around spill prevention and pass on lessons learned. CPAI has an Incident Investigation Program. CPAI audits contractors' HSE performance. Pipelines are constructed above ground.
General		All research and monitoring activities by the permittee will follow protocols described by the Authorized Officer that will be designed to minimize disturbance and mortality. CPAI will do the required monitoring and studies, though to enhance cooperation among research and monitoring entities and to avoid duplication, the Authorized Officer may waive this requirement of CPAI if the monitoring or study is being done by another entity. Substantial infrastructure would be removed from the Fish Creek 3-mile setback. (Consistent with the exception clause provision of the IAP/EIS, CD6 (GMT1) and some infrastructure would be allowed to be located as requested by CPAI within the setback.	CPAI audits each field on a scheduled basis to ensure compliance with all environmental laws, regulations and local requirements, company policies and procedures and other regulations regarding safety, fire codes, etc. CPAI employs Field Environmental Coordinators to monitor compliance with permits and other requirements. The Green Star program encourages field personnel to reduce, reuse and recycle materials. Cuttings from borings may be hauled to gravel source locations and deposited there as part of the reclamation plan, or may be used as fill for another project. CPAI recycles hydrocarbons to the extent possible.

4.8 Unavoidable Adverse Impacts

Adverse effects from oil and gas activities, resulting from construction, operation, and abandonment of the proposed project and alternatives were described in BLM (2004, § 4H.1) and in BLM (2012, § 4.9). Many adverse impacts could be lessened by mitigation, but would not be completely eliminated or reduced to negligible levels. Some are short-term effects, while others may be long term effects. These have been described for each resource in Section 4.2 through 4.5. Depending on the preferred alternative and adopted mitigation, these effects potentially include:

- Loss of soil productivity and sand and gravel resources largely from construction of roads and pads and gravel mine development;
- Loss of petroleum resources;
- Change in surface drainage due to construction of roads and pads;
- Increased air emissions, including fugitive dust, pollutants, and GHG;
- Loss of wetlands and associated functions largely from construction of roads and pads and gravel mine development;
- Loss or fragmentation of wildlife habitat;
- Continued change in access to and availability of subsistence resources; and
- Increased risk of spills.

To assist with abandonment and reclamation, BLM has a bonding process in place for leases which are issued within NPR-A. The bond is held by BLM, and certifies that the company will cover the full cost of reclamation. This bond provides monetary assurance to BLM that the company will reclaim the pads, wells, and any associated surface disturbance to the standards of the BLM authorized officer. This is determined at the time of reclamation, thus allowing BLM to take an adaptive management approach. Upon abandonment, BLM will consider current data, technologies available, and the current resource situation in its determinations on specific reclamation. Additionally, BLM retains the ability to increase the bond amount at any time during the lease based on a recalculation of liability (ie, increased number of wells, or a history of non-compliance with BLM's operational standards).

Bonding for the right-of-way grant would be very similar to what is done for BLM leases. When BLM processes a ROW application, BLM determines if a bond is necessary and the amount of the bond. BLM discusses potential bond amounts with clients, and estimates the amount based on how much it would cost the BLM to remove all infrastructure associated with the ROW grant, including roads. When BLM requires a bond, it is connected to a particular stipulation, of which the requirement for reclamation would be an example. The ROW bond for the current project wouldn't cover reclamation of the portion of road that is on Kuukpik land or the small portion of the road that is located on CPAI's lease.

4.9 Relationship between Local Short-Term Uses and Long-Term Productivity

The short term uses of the study area for hydrocarbon development and production activities versus the maintenance and enhancement of potential long-term productivity of environmental resources of the area were discussed in BLM (2004, § 4H.2) and in BLM (2012, § 4.10). In this SEIS, "short-term refers to the duration of hydrocarbon development and production activities at GMT1; "long-term" refers to an unspecified period beyond hydrocarbon production at GMT1. Long term productivity is the capability of the land to provide natural resources indefinitely.

The proposed GMT1 project is consistent with terms of federal oil and gas lease AA-081798. Hydrocarbons developed from the GMTU would help offset declines in production from the Alaskan North Slope and maintain throughput of the Alpine Sales Pipeline and ultimately, TAPS. Hydrocarbon production would help meet the U.S. domestic energy demand. At some future date, the GMT1 project will be abandoned, and elements of lost productivity may be restored.

4.10 Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources were described in Section 4H.3 of the ASDP EIS (BLM 2004) and in BLM (2012, § 4.11). An irreversible or irretrievable commitment of resources refers to the consumption, commitment or loss of resources due to project development. These distinctions refer primarily to non-renewable resources. No irreversible or irretrievable effects are expected on air quality, water quality, or noise. Depending on the final abandonment plan, irreversible and irretrievable commitments of gravel resources, vegetation, bird habitat, and visual resources may be reduced. Lease Stipulation G-1 includes requirements for site restoration at abandonment. There would be some irreversible or irretrievable commitments of resources. These include:

- Removal of hydrocarbons from the reservoir;
- Energy consumption associated with construction and operation of the project;
- Ground disturbance/change resulting from gravel removal;
- Surface water consumption for drilling and other industrial purposes with wastewater disposal via underground injection;
- Loss or change in vegetation and wetlands where gravel is placed, regardless of whether it is removed at abandonment;
- Increased access to resources of the NPR-A; and
- Loss or change in subsistence use of the area, depending on final abandonment plans.

CHAPTER 5: CONSULTATION AND COORDINATION

Exploration and potential development at the GMT1 site have been subject to various NEPA analyses in the past, involving a wide array of stakeholders. This section summarizes the public and agency outreach the BLM has engaged in as it has developed the Draft SEIS, including keeping the public and other federal, state and local agencies informed of the process and offering opportunities for the public and agencies to express their concerns and suggest how the BLM should proceed. The section also identifies the individuals who prepared the Draft SEIS.

Early in the process, BLM conducted public scoping to identify the range of issues and alternatives to address in the DSEIS, as described in Section 1.5.

In addition to the consultation described below, BLM-Alaska continues to seek input from the local community in a variety of ways, including the NPR-A Subsistence Advisory Panel (SAP), NPR-A Working Group, and regular contact and outreach by BLM's Arctic Field Office. The SAP is comprised of seven representatives from communities on the North Slope. The panel makes recommendations to the BLM regarding issues, concerns, and possible impacts to subsistence resources or harvesting due to oil industry activities. The SAP held its most recent meeting in September 2013. The public meeting included presentations by the BLM's Arctic Field Office on this SEIS. Another SAP meeting is scheduled for February 2014. The NPR-A Working Group, established by the BLM (2013), held its initial meeting in August 2013, which also included a presentation on the GMT1 SEIS. The Working Group's purpose is to provide BLM with information and recommendations on a range of issues in the NPR-A, including oil and gas leasing.

5.1 SEIS Consultation and Coordination

5.1.1 Coordination and Consultation with Local, State, and Federal Agencies

The BLM has consulted and coordinated with various stakeholders in setting the scope of analysis and alternatives for this Draft SEIS. Collaboration with the cooperating agencies has greatly informed the range of the alternatives and the issues analyzed in this Draft Supplemental EIS. BLM also worked closely with its Air Quality MOU Working Group which provided feedback on air quality modeling and the subsequent Air Quality Impact Analysis, and reviewed the air quality impacts language for Chapter 4 of this Draft SEIS.

Development of this SEIS has involved consultation and coordination with the following government agencies:

- U.S. Army Corps of Engineers;
- U.S. EPA;
- U.S. USFWS;
- U.S. BOEM Office of Environmental Programs;
- U.S. National Park Service;
- U.S. Forest Service;

- Alaska Department of Natural Resources;
- Alaska Department of Environmental Conservation;
- North Slope Borough Department of Inupiat History, Language, and Culture (IHLC), Department of Law, and Planning Department; and
- Native Village of Nuiqsut.

5.1.2 Tribal Consultation

The BLM initiated the government-to-government consultation process as required by Presidential Executive Memorandums dated April 29, 1994 and November 5, 2009, and Department of the Interior Policy on Consultation with ANCSA Corporations, with letters sent on August 29, 2013, to the following tribes and ANCSA corporations whose members could be affected by the proposed development of GMT1:

- Native Village of Nuiqsut;
- Village of Anaktuvuk Pass;
- Village of Atqasuk;
- Iñupiat Community of the Arctic Slope;
- Native Village of Barrow;
- Kuukpik Corporation;
- Atqasuk Corporation;
- Ukpeagvik Inupiat Corporation;
- Arctic Slope Regional Corporation (ASRC); and
- Nunamiut Corporation.

Government-to-government consultation meetings are held on a weekly basis with the Native Village of Nuiqsut. Kuukpik Corporation and the ASRC have also engaged in government-to-government consultation with BLM-Alaska during the NEPA process.

5.1.3 Applicant Coordination

The Applicant has met with various stakeholders specifically about the proposed GMT1 development plan and schedule, as summarized in Table 5.1-1. Issues resulting from those meetings have been addressed by CPAI, with minor changes and alternatives described in this document.

Additional information meetings by the applicant with the Native Village of Nuiqsut, Kuukpik Subsistence Oversight Panel (KSOP), the City of Nuiqsut, and a public community meeting in Nuiqsut are planned in the next few months. Issues resulting from any future consultation meetings will be evaluated by CPAI and the regulatory agencies for potential changes to the proposed project, mitigation, or alternatives that should be considered.

Table 5.1-1. Summary of Applicant Coordination Meetings

Stakeholder Meetings	Date(s)
Arctic Slope Regional Corporation	10/21/2013
City of Atqasuk	11/20/2013
Community Meeting - Anaktuvuk Pass	11/19/2013
Community Meeting – Atqasuk	11/20/2013
Community Meeting – Barrow	12/2/2013
Community Meeting - Nuiqsut	1/15/2013; 2/17/2013; 11/6/2013
Community Meeting - Point Lay	11/13/2013
Community Meeting – Wainwright	12/5/2013
Cully Corporation	11/13/2013
Inupiat Community of the Arctic Slope	12/2/2013
Kuukpik Corporation Board	1/15/2013; 7/23/2013; 11/18/2013
Kuukpik Subsistence Oversight Panel	11/6/2013
Native Village of Barrow	12/3/2013
NSB Assembly	12/3/2013
NSB Planning Commission	3/28/2013; 9/26/2013
Wainwright Tri-lateral Council (Wainwright Traditional Council, City of Wainwright, Olgoonik Corporation)	12/5/2013
Agency Meetings	
Pre-Application meetings, Anchorage	7/16/2013
Pre-Application meeting, Fairbanks	7/18/2013
GMT1 SEIS Protocol Meetings	9/12/2013; 9/16/2013; 9/18/2013; 9/27/2013; 10/24/2013; 10/30/2013

5.2 List of Preparers

This SEIS was prepared by the BLM, with input from all of the cooperating agencies, the Air Quality Working Group, and technical support from a third-party contractor, SLR International Corporation (SLR). BLM employees are listed with their office, including AFO for Arctic Field Office, FDO for Fairbanks District Office, AKSO for Alaska State Office, and NOC for the National Operations Center in Denver. Technical input was provided by CPAI. In addition, numerous employees of the cooperating agencies reviewed portions the Draft SEIS and provided constructive suggestions for improvement. Following is a list of BLM Team members involved in the preparation of this DSEIS and their area of responsibility.

Name	Project Responsibility
Stewart Allen (BLM-AKSO)	Economics Sociocultural Systems
Ethan Aumann (BLM-NOC)	Air Quality Climate Change
Susan Flora (BLM-AFO)	Solid and Hazardous Wastes
Stacey Fritz (BLM-AFO)	Subsistence Sociocultural Systems Environmental Justice

Name	Project Responsibility
Eric Geisler (BLM-AKSO)	Soils Vegetation Wildland Fire
Cindy Hamfler (BLM-AFO)	Physiography GIS
Steve Hartmann (BLM-FDO)	Fairbanks District Office Manager
Lon Kelly (BLM-AFO)	Arctic Field Office Manager Wild and Scenic Rivers
Richard Kemnitz (BLM-AFO)	Water Resources Wetlands and Floodplains
Bob King (BLM-AKSO)	Paleontology Archaeology Cultural Resources
Stacie McIntosh (BLM-AFO)	Arctic Field Office Interdisciplinary Supervisor Environmental Justice Public Health
Craig Nicholls (BLM-NOC)	Air Quality Climate Change
Debbie Nigro (BLM-AFO)	Birds Threatened and Endangered Species BLM-Special Status Species ESA Section 7 Consultation
Dave Maxwell (BLM-NOC)	Air Quality Climate Change Noise
Justin Miller (BLM-AKSO)	Petroleum Resources Oil and Gas Scenario
Alan Peck (BLM-AKSO)	Climate and Meteorology Air Quality
Bridget Psarianos (BLM-AKSO)	SEIS Project Manager
Roger Sayre (BLM-AFO)	NEPA
Serena Sweet (BLM-AKSO)	Supervisory Planner
Darrel VandeWeg (BLM-AFO)	Geology and Minerals Sand and Gravel Resources
Matt Whitman (BLM-AFO)	Fish
Donna Wixon (BLM-AFO)	Land Use/Land Ownership Recreational Resources Transportation Wilderness Resources Visual Resources

Name	Project Responsibility
Dave Yokel (BLM-AFO)	Vegetation Terrestrial Mammals Threatened and Endangered Species BLM-Special Status Species

Technical support was provided by the following members of the SLR Team:

Name	Project Responsibility	Education and Experience
Brian Hoefler, PE	Principal In Charge Technical Review	MS Civil Engineering BS Civil and Environmental Engineering 22 years experience
Sandra Hamann	Project Team Co-Lead Technical Review	MS Botany / Plant Physiology BS General Science/Education 33 years experience
Pat Athey	Project Team Co-Lead Soils and Permafrost Climate Change Vegetation Fish	MS Botany BS Botany 25 years experience
Stan Flagel, PG	Water Resources Hydrology	Prof. Degree Hydrogeology MS Geology BA Geology 22 years experience
Christina Bentz	Water Resources	MS Geology BS Geosciences 9 years experience
Karen Cougan	Water Quality	BS Watershed Mgmt / Environmental Studies AAS Ecology/ Environmental Technology 27 years experience
Al Trbovich, CCM	Climate and Meteorology Air Quality	MS Meteorology BS Meteorology 30 years experience
Jessica Stark, PE	Climate and Meteorology Air Quality	BS Environmental Resources Engineering 13 years experience
Allison Erickson	Birds Terrestrial Wildlife Threatened and Endangered Species	BA Biology 16 years experience

Name	Project Responsibility	Education and Experience
Erin Donmoyer	Birds Terrestrial Mammals Marine Mammals	MS Marine Biology BS Environmental Science 6 years experience
Mark Stelljes, PhD	Community Health	PhD Environmental Toxicology / Pharmacology MS Wildlife Biology BS Zoology 23 years experience
Stephen Braund (Stephen R. Braund & Associates)	Subsistence Cultural Resources	MA Anthropology BA Northern Studies/English 36 years experience
Leah Cuyno, PhD (Northern Economics)	Economics	Ph.D. Agricultural / Applied Economics MS Agricultural Economics BS Agricultural Economics 12 years experience
Debbie Moore	Solid and Hazardous Waste Spills and Hazardous Substances	MSEL Environmental Law BS Environmental Planning 15 years experience
Jules Tileston	Recreational Resources Technical Review Transportation Visual resources Wild and Scenic Rivers Wilderness	MS Ecology / Wildlife Management BA Biology and Geology 52 years experience
Don Meares	Land Use Technical Review	BA Geography 35 years experience
Jenny Matter	Project Coordination	MAA Applied Anthropology BA Anthropology 10 years experience
Jenna Wallis	Public Participation Project Coordination NEPA Review	MEM Environmental Economics and Policy BS Environmental Conservation Studies 5 years experience

CHAPTER 6: REFERENCES

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