Alaska LNG

DOCKET NO. PF14-21-000

DRAFT RESOURCE REPORT NO. 3

FISH, WILDLIFE, AND VEGETATION RESOURCES

PUBLIC VERSION

Document Number: USAKE-PT-SRREG-00-0003

RESOURCE REPORT NO. 3

SUMMARY OF FILING REQUIREMENTS[1]

Filing Requirement	Found in Section
1. Classify the fishery type of each surface waterbody that would be crossed, including fisheries of special concern. (18 C.F.R. § 380.12(e)(1))[2] • This includes commercial and sport fisheries as well as coldwater and warmwater fishery designations and associated significant habitat.	3.2
2. Describe terrestrial and wetland wildlife and habitats that would be affected by the project. (18 C.F.R. § 380.12(e)(2)) • Describe typical species with commercial, recreational or aesthetic value.	3.4 Resource Report No. 2 for wetlands
3. Describe the major vegetative cover types that would be crossed and provide the acreage of each vegetative cover type that would be affected by construction. (18 C.F.R. § 380.12(e)(3)) • Include unique species or individuals and species of special concern. • Include nearshore habitats of concern.	Section 3.3
4. Describe the effects of construction and operation procedures on the fishery resources and proposed mitigation measures. (18 C.F.R. § 380.12(e)(4)) • Be sure to include offshore effects, as needed.	Section 3.2.8 Appendix F
5. Evaluate the potential for short-term, long-term and permanent impact on the wildlife resources and state-listed endangered or threatened species caused by construction and operation of the project and proposed mitigation measures. (18 C.F.R. § 380 .12(e)(4))	3.4.10, 3.4.11, 3.5.3, Appendix F
6. Identify all federally listed or proposed endangered or threatened species that potentially occur in the vicinity of the project and discuss the results of the consultations with other agencies. Include survey reports as specified in (18 C.F.R. § 380.12(e)(5)). • See 18 C.F.R. § 380.13(b) for consultation requirements. Any surveys required through 18 C.F.R. § 380.13(b)(5)(I) must have been conducted and the results included in the application.	3.5
7. Identify all federally listed essential fish habitat (EFH) that potentially occurs in the vicinity of the project and the results of abbreviated consultations with the National Marine Fisheries Service (NMFS), and any resulting EFH assessment. (18 C.F.R. § 380.12(e)(6))	3.2.7, Appendix D
8. Describe any significant biological resources that would be affected. Describe impact and any mitigation proposed to avoid or minimize that impact. (18 C.F.R. § 380.12(e)(4&7)) • For offshore species be sure to include effects of sedimentation, changes to substrate, effects of blasting, etc. This information is needed on a mile-by-mile basis and will require completion of geophysical and other surveys before filing.	3.2, 3.3, 3.4, 3.5 Appendix F

[2] FERC Guidance Manual for Environmental Report Preparation (August 2002), available online at http://www.ferc.gov/industries/gas/enviro/erpman.pdf.

RESOURCE REPORT NO. 3

SUMMARY OF FILING REQUIREMENTS[1]

Filing Requirement	Found in Section
Additional Information Often Missing and Resulting in Data Requests	
Provide copies of correspondence from federal and state fish and wildlife agencies along with responses to their recommendations to avoid or limit impact on wildlife, fisheries, and vegetation.	Will file as received
Provide a list of significant wildlife habitats crossed by the project. Specify locations by milepost, and include length and width of crossing at each significant wildlife habitat.	See Appendices A and B and figures in text and other appendices

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ACRONYMS AND ABBREVIATIONS

ABBREVIATION	DEFINITION
Abbreviations for Units of Measurement	
°C	degrees Celsius
°F	degrees Fahrenheit
BSCF/D	billion standard cubic feet per day
cfs	cubic feet per second
cm	centimeters
dB	decibels
dBA	A-weighted decibels
ft	feet
g	grams
gpm	gallons per minute
ha	hectare
hp	horsepower
Hz	hertz
in	inches
kg	kilogram
kHz	kilohertz
kW	kilowatts
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
L_{max}	maximum sound level
m^3	cubic meters
Ma	mega-annum (millions of years)
mg	milligrams
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MGD	million gallons per day
mm	millimeters
MMBtu/hr	million British thermal units per hour
MMSCF/D	million standard cubic feet per day
MPH	miles per hour
MMTA	million metric tons per annum
ng	nanograms
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
ppmv	parts per million by volume
Psig	pounds per square inch gauge
rms	root mean square
SPL	sound pressure level
tpy	tons per year

ABBREVIATION	DEFINITION
µg	microgram
µg/kg	micrograms per kilogram
µPa	micropascals
Other Abbreviations	
§	section or paragraph
AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
ACC	Alaska Conservation Corps
ACEC	Areas of Critical Environmental Concern
ACP	Arctic Coastal Plain
ACRC	Alaska Climate Research Center
ACS	U.S. Census, American Community Survey
AD	aggregate dock
ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADGGS	Alaska Division of Geological and Geophysical Surveys
ADM	average daily membership
ADNR	Alaska Department of Natural Resources
ADOLWD	Alaska Department of Labor and Workforce Development
ADOT&PF	Alaska Department of Transportation and Public Facilities
AEIC	Alaska Earthquake Information Center
AES	Arctic Slope Regional Corporation Energy Service
AGDC	Alaska Gasline Development Corporation
AGPPT	Alaska Gas Producers Pipeline Team
AHPA	Alaska Historic Preservation Act
AHRS	Alaska Heritage Resources Survey
AIDEA	Alaska Industrial Development and Export Authority
AKNHP	Alaska Natural Heritage Program
AMP	approximate mile post
ANCSA	Alaska Native Claims Settlement Act
ANGPA	Alaska Natural Gas Pipeline Act
ANGTS	Alaska Natural Gas Transportation System
ANILCA	Alaska National Interest Lands Conservation Act
ANIMIDA	Arctic Nearshore Impact Monitoring in the Development Area
ANS Task Force	Aquatic Nuisance Species Task Force
ANVSA	Alaska Native Village Statistical Area
AOGCC	Alaska Oil and Gas Conservation Commission
AOI	Area of Interest
APCI	Air Products and Chemicals Inc.
APDES	Alaska Pollutant Discharge Elimination System
APE	Area of Potential Effect
API	American Petroleum Institute
APP	Alaska Pipeline Project

ABBREVIATION	DEFINITION
Applicants	ExxonMobil Alaska LNG LLC, ConocoPhillips Alaska LNG Company, BP Alaska LNG LLC, TransCanada Alaska Midstream LP, and Alaska Gasline Development Corporation
APSC	Alyeska Pipeline Service Company
AQRV	Air Quality Related Value
Arctic NWR	Arctic National Wildlife Refuge
ARD	acid rock drainage
ARDF	Alaska Resource Data File
ARPA	Archaeological Resources Protection Act of 1979
ARRC	Alaska Railroad Corporation
AS	Alaska Statute
ASAP	Alaska Stand Alone Pipeline
ASME	American Society of Mechanical Engineers
ASOS	Automated Surface Observation System
ASRC	Arctic Slope Regional Corporation
ATC	Allakaket Tribal Council
ATWS	additional temporary workspace
AWOS	Automated Weather Observing System
B.C.	British Columbia
BACT	Best Available Control Technology
BGEPA	Bald and Golden Eagle Protection Act
BIA	U.S. Department of the Interior, Bureau of Indian Affairs
BLM	U.S. Department of the Interior, Bureau of Land Management
BMP	best management practices
BOD_5	biochemical oxygen demand
BOEM	U.S. Department of the Interior, Bureau of Ocean Energy Management
BOG	boil-off gas
BP	Before Present
C.F.R.	Code of Federal Regulations
CAA	Clean Air Act
CAMA	Central Arctic Management Area
CCP	Comprehensive Conservation Plans
CDP	Census Designated Place
CEA	Chugach Electric Association
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGF	Central Gas Facility
CGP	Construction General Permit
CH_4	methane
CHA	Critical Habitat Area
CIRCAC	Cook Inlet Regional Citizens Advisory Council
CIRI	Cook Inlet Region Inc.
CLG	Certified Local Government
CO	carbon monoxide

ABBREVIATION	DEFINITION
CO_2	carbon dioxide
CO_2e	total greenhouse gas emissions, in CO_2-equivalent global warming potential
COC	Certificate of Compliance
CONUS	Continental U.S.
COOP	National Weather Service, Cooperative Observer Program
CPCN	Certificate of Public Convenience and Necessity
CRA	Certificate of Reasonable Assurance
CSD	Contaminated Sites Database
CSP	Contaminated Sites Program
CSU	conservation system units
CV	coefficient of variation
CWA	Clean Water Act
DB	Denali Borough
DEM	Digital Elevation Model
DGGS	ADNR Division of Geological and Geophysical Surveys
DH	dock head
DHSS	Alaska Department of Health and Social Services
DMLW	Alaska Department of Natural Resources, Division of Mining, Land, and Water
DPS	Distinct Population Segment
DWPP	Drinking Water Protection Program
EDA	U.S. Department of Commerce, Economic Development Administration
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRP	Emergency Preparedness and Response Plan
ERL	Environmental, Regulatory and Lands
ERMA	Extended Recreation Management Areas
ESA	Endangered Species Act
ESD	Emergency Shut Down
ESU	Evolutionary Significant Unit
FAA	U.S. Department of Transportation, Federal Aviation Administration
FCC	Federal Communications Commission
FE	U.S. Department of Energy, Office of Fossil Energy
FEED	front-end engineering design
FEIS	Final Environmental Impact Statement
FEMA	U.S. Department of Homeland Security, Federal Emergency Management Agency
FERC	U.S. Department of Energy, Federal Energy Regulatory Commission
FERC Plan	FERC Erosion Control, Revegetation, and Maintenance Plan
FERC Procedures	FERC Wetland and Waterbody Construction and Mitigation Procedures
FLPMA	Federal Land Policy and Management Act (of 1976) BLM
FMP	Fisheries Management Plan

ABBREVIATION	DEFINITION
FNSB	Fairbanks North Star Borough
FR	Federal Regulation
GDP	Gross Domestic Product
GHG	greenhouse gases
GIS	geographic information system
GMU	Game Management Units
GP	General Permit
GRI	Gas Research Institute
GTP	gas treatment plant
GWP	Global Warming Potential
H_2S	hydrogen sulfide
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HAP	Hazardous Air Pollutant
HAPC	Habitat Areas of Particular Concern
HCA	High Consequence Area
HDD	horizontal directional drill
HDMS	Hazard Detection and Mitigation System
HGM	hydrogeomorphic
HLV	heavy lift vessel
HMR	Hazardous Materials Regulations
HRS	Hazard Ranking System
IBA	Important Bird Areas
ICS	Incident Command System
IHA	Incidental Harassment Authorization
IHLC	Inupiat History, Language, and Culture
ILI	In-line Inspection
IMP	Integrity Management Plan
IP	Individual Permit
ISO	International Organization for Standardization
JPO	State and Federal Joint Pipeline Office
kbpd	thousand barrels per day
KCC	Kuparuk Construction Camp
KOP	key observation points
KPB	Kenai Peninsula Borough
KTC	Kuparuk Transportation Company
LiDAR	light detection and ranging
Liquefaction Facility	natural gas liquefaction
LLC	Limited Liability Company
LNG	liquefied natural gas
LNGC	liquefied natural gas carrier
LOA	Letter of Authorization
LOD	Limits of Distribution

ABBREVIATION	DEFINITION
LP	Limited Partnership
LPG	liquefied petroleum gas
LUP	Land Use Permit
LUST	Leaking Underground Storage Tanks
MACT	maximum achievable control technology
Mainline	An approximately 800-mile-long, large-diameter gas pipeline
MAOP	maximum allowable operating pressure
MARPOL	Marine Pollution Protocol
MBTA	Migratory Bird Treaty Act
MCD	marine construction dock
MHHW	mean higher high water
MHW	mean high water
ML&P	Anchorage Municipal Light and Power
MLA	Mineral Leasing Act
MLBV	Mainline block valve
MLLW	mean lower low water
MLW	mean low water
MMPA	Marine Mammal Protection Act
MMS	Mainline Meter Station
MOE	margin of error
MOF	material offloading facility
MP	Mainline milepost
MPRSA	Marine Protection Research and Sanctuaries Act of 1972
MSB	Matanuska-Susitna Borough
MSCFD	Thousand standard cubic feet per day
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAS	nonindigenous aquatic species
NCC	national certification corporation
NCDC	National Climatic Data Center
NDE	non-destructive examination
NEP	non-essential experimental population
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NGA	Natural Gas Act
NHPA	National Historic Preservation Act of 1996, as amended
NID	Negligible Impact Determination
NLURA	Northern Land Use Research Alaska, LLC
NMFS	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NOAA	National Oceanographic and Atmospheric Administration

ABBREVIATION	DEFINITION
NOI	Notice of Intent
North Slope	Alaska North Slope
NPDES	National Pollutant Discharge Elimination Systems
NPL	National Priority List
NPP	National Park and Preserve
NPR-A	National Petroleum Reserve – Alaska
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	Noise-Sensitive Areas
NSB	North Slope Borough
NSPS	New Source Performance Standards
NTC	national training center
NTP	Notice to Proceed
NVIC	Navigation and Vessel Inspection Circular
NWA	Northwest Alaska Pipeline
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O_3	Ozone
OC	open-cut
OCS	Outer Continental Shelf
OD	outside diameter
OEP	FERC, Office of Energy Projects
OHA	ADNR Division of Parks and Outdoor Recreation, Office of History and Archaeology
ONA	Outstanding Natural Area
OPMP	ADNR, Office of Project Management and Permitting
OU	Operating unit
PAC	potentially affected community
Pb	the element lead
PBTL	Prudhoe Bay Gas Transmission Line
PBU	Prudhoe Bay Unit
PCB	polychlorinated biphenyl
PHMSA	Pipeline and Hazardous Materials Safety Administration
$PM_{2.5}$	particulate matter having an aerodynamic diameter of 2.5 microns or less
PM_{10}	particulate matter having an aerodynamic diameter of 10 microns or less
PMP	Point Thomson Gas Transmission Line milepost
POC	Plan of Cooperation
POD	Plan of Development
Project	Alaska LNG Project
PRPA	Paleontological Resources Preservation Act
PSD	Prevention of Significant Deterioration
PTTL	Point Thomson Gas Transmission Line
PTU	Point Thomson Unit

ABBREVIATION	DEFINITION
PWS	public water supply
Q&A	question and answer
RCA	Regulatory Commission of Alaska
RCRA	Resource Conservation and Recovery Act
RNA	Research Natural Area
ROD	Record of Decision
ROE	right-of-entry
ROW	right-of-way
RR	Resource Report
SCC	Deadhorse Airport
SDWA	Safe Drinking Water Act
SEIS	Supplemental Environmental Impact Statement
SGR	State Game Refuge
SHPO	State Historic Preservation Office(r)
SIP	State Implementation Plan
SMA	Special Management Areas
SRMA	Special Recreation Management Areas
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasure Plan
SPCO	State Pipeline Coordinator's Office
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
SPMT	self-propelled module transporters
SRA	State Recreation Area
SRR	State Recreation River
STATSGO	State Soil Geographic
STATSGO2	State Soil Geographic2 – General Soils Map of Alaska & Soils Data (2011)
SWAPA	Southwest Alaska Pilots Association
SWPPP	Stormwater Pollution Prevention Plan
TAHC	total aliphatic hydrocarbons
TAPS	Trans-Alaska Pipeline System
TBD	To be determined
TCC	Tanana Chiefs Conference
The Applicants' Plan	Applicants' Upland Erosion Control, Revegetation, and Maintenance Plan
The Applicants' Procedures	Applicants' Wetland and Waterbody Construction, and Mitigation Procedures
TPAH	total polycyclic aromatic hydrocarbons
TSA	Transportation Security Administration
TSCA	Toxic Substances Control Act
TSD	tug support dock
TSS	total suspended solids
UCIDA	United Cook Inlet Drift Association
UIC	Underground Injection Control
U.S.	United States
U.S.C.	U.S. Code

ABBREVIATION	DEFINITION
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDHHS	U.S. Department of Health and Human Services
USDOE	U.S. Department of Energy
USDOI	U.S. Department of the Interior
USDOT	U.S. Department of Transportation
USDW	underground sources of drinking water
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VPSO	Village Public Safety Officer
VRM	Visual Resource Management Methodology
VSM	Vertical Support Members
WELTS	Well Log Tracking System
WRCC	Western Regional Climate Center
WSA	Waterway Suitability Assessment
WSR	Wild and Scenic Rivers

Information in this draft Resource Report, including maps, is preliminary and may change during Project pre-filing. Updated information will be provided in the subsequent draft and final versions of the Resource Reports.

3.0 RESOURCE REPORT NO. 3 – FISH, WILDLIFE, AND VEGETATION RESOURCES

3.1 PROJECT DESCRIPTION

The Alaska Gasline Development Corporation, BP Alaska LNG LLC, ConocoPhillips Alaska LNG Company, ExxonMobil Alaska LNG LLC, and TransCanada Alaska Midstream LP (Applicants) plan to construct one integrated LNG Project (Project) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and opportunity for in-state deliveries of natural gas.

The Natural Gas Act (NGA), 15 U.S.C. § 717a(11) (2006), and FERC regulations, 18 C.F.R. § 153.2(d) (2014), define "LNG terminal" to include "all natural gas facilities located onshore or in State waters that are used to receive, unload, load, store, transport, gasify, liquefy, or process natural gas that is ... exported to a foreign country from the United States." With respect to this Project, the "LNG terminal" includes the following: a liquefaction facility (Liquefaction Facility) in Southcentral Alaska; an approximately 800-mile, large diameter gas pipeline (Mainline); a gas treatment plant (GTP) on the North Slope; a gas transmission line connecting the GTP to the PTU gas production facility (PTU Gas Transmission Line or PTTL); and a gas transmission line connecting the GTP to the PBU gas production facility (PBU Gas Transmission Line or PBTL). All of these facilities are essential to export natural gas in foreign commerce.

These components are shown in Resource Report No. 1, Figure 1.1-1, and their current basis for design is described below.

The new Liquefaction Facility will be constructed on the eastern shore of Cook Inlet in the Nikiski area of the Kenai Peninsula. The Liquefaction Facility will include the structures, equipment, underlying access rights and all other associated systems for pre-processing (other than that performed by the GTP) and liquefaction of natural gas, as well as storage and loading of LNG, including terminal facilities (dock) and auxiliary marine vessels used to support marine terminal operations (excluding LNG carriers). The Liquefaction Facility will include three liquefaction trains combining to process up to approximately 20 million metric tons per annum (MMTPA) of LNG. Three 160,000 cubic meter (m^3) tanks will be constructed to store the LNG. The Liquefaction Facility will be capable of accommodating two LNG carriers. The size range of LNG carriers that the Liquefaction Facility will accommodate will be determined through further engineering study and consultation with the United States Coast Guard (USCG) as part of the Waterway Suitability Assessment (WSA) process.

In addition to the Liquefaction Facility, the LNG Terminal will include the following interdependent facilities:

- Mainline: A new large-diameter natural gas pipeline approximately 800 miles in length will extend from the Liquefaction Facility to the GTP on the North Slope, including the structures, equipment, and all other associated systems. The diameter of the pipeline has not been

finalized but for the purpose of these resource reports a 42-inch diameter pipeline is assumed. The Mainline will include compressor stations, heater stations, meter stations, and various mainline block valves; pig launcher and receiver facilities; and associated ancillary and auxiliary facilities. Ancillary and auxiliary facilities will include additional temporary work spaces, access roads, helipads, construction camps, pipe storage areas, contractor yards, material extraction sites, and material disposal sites. Along the Mainline route, there will be at least five off-take interconnection points to allow for the opportunity for future in-state deliveries of natural gas. The size and location of such interconnection points are unknown at this time. None of the potential third-party facilities used to condition, if required, or move natural gas away from these off-take points will be part of the Project.

- GTP: A new GTP and associated facilities in the Prudhoe Bay area will receive natural gas from the PBU Gas Transmission Line and the PTU Gas Transmission Line. The GTP will treat/process the natural gas for delivery into the Mainline. The Project also includes a new pipeline that will deliver natural gas processing byproducts from the GTP to the PBU.

- PBU Gas Transmission Line: A new natural gas transmission line will extend approximately one mile from the inlet flange of the GTP to the outlet flange of the PBU gas production facility.

- PTU Gas Transmission Line: A new natural gas transmission line will extend approximately 60 miles from the inlet flange of the GTP to the outlet flange of the PTU gas production facility.

- Ancillary Facilities: Existing State of Alaska transportation infrastructure will be used during the construction of these new facilities including ports, airports, roads, and airstrips (potentially including previously abandoned airstrips). The potential need for new infrastructure and modifications or additions to these existing in-state facilities is under evaluation. The Liquefaction Facility, Mainline, and GTP will require the construction of material offloading facilities.

Draft Resource Report No. 1, Appendices A and B contain general maps of the Project footprint. Detailed plot plans will be developed during the pre-front-end engineering and design (Pre-FEED) process and will be provided to the Commission in a subsequent draft of Resource Report No. 1. An update to the current list of affected landowners is being filed under separate cover as privileged and confidential information.

Outside the scope of the Project, but in support of, or related to, the Project, additional facilities or expansion/modification of existing facilities will be needed or may be constructed. These other projects may include:

- Modifications/new facilities at the PTU;

- Modifications/new facilities at the PBU;

- Relocation of the Kenai Spur Highway; and

- Third-party pipelines and associated infrastructure to transport natural gas from the off-take interconnection points to markets in Alaska.

3.1.1 Purpose of Resource Report

As required by 18 C.F.R. § 380.12, Alaska LNG Applicants (Applicants) have prepared Resource Report No. 3 in support of its applications under Section 3 of the NGA to construct and operate the Project facilities. The purpose of this draft Resource Report is as follows:

- Describe the existing fish, wildlife, and vegetation resources in the Project area;
- Assess the potential adverse effects to these resources resulting from Project construction and operation; and
- Identify potential general mitigation measures to avoid or minimize potential adverse effects to fish, wildlife, and vegetation resources in the Project area.

The Project Applicants will prepare a draft Biological Assessment (BA) as required under Section 7(c) of the Endangered Species Act (ESA) of 1973 as amended ((PL 93-205; 16 U.S.C. §§ 1531-1544) to address listed species or their critical habitat that may be present in the Project area. A Draft BA will be included as Appendix C in a subsequent draft of this Resource Report.

The Project Applicants have prepared a draft Essential Fish Habitat (EFH) Assessment Report to identify federally listed EFH that potentially occurs in the vicinity of the Project and the results of consultations with the National Marine Fisheries Service (NMFS) as required under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and 18 CFR Part 380.12(e)(6). An outline of the draft EFH Assessment is included in Appendix D. An updated EFH will be provided in a subsequent draft of this Resource Report as the facility site locations are further defined and input is received from the agencies and FERC staff. An outline for an Avian Protection Plan (APP) is contained in Appendix E. Following discussions with the U.S. Fish and Wildlife Service and FERC, a draft APP will be provided in a subsequent draft of this Resource Report.

The data for this Resource Report were compiled based on a review of the following:

- Preliminary Pre-FEED engineering design and proposed construction plans;
- USGS topographic maps;
- National landcover maps;
- Recent aerial photography;
- Field survey data;
- Scientific literature;
- Recent EIS and permits issued in Alaska for projects in the Project area;

- Other proposed LNG Project Environmental Reports filed on the FERC Docket; and
- Geographic Information System (GIS) data from federal and state agencies.

The Project area is defined generally throughout this report to describe the regions and watersheds within which Project components would be constructed.

3.1.2 Agency and Organization Consultations

This section describes consultations that have been conducted to date with agencies and other parties interested in the Project. As Project details are refined in the Pre-FEED process currently underway, additional consultations will be conducted.

3.1.2.1 Federal Agencies

Applicable Consultations/Permits/Clearances

The Project Applicants' representatives have held discussions with several federal agencies regarding various Project details, some of which are contained in this Resource Report. A summary of these meetings with a synopsis of key issues discussed will be presented in a subsequent draft of this Resource Report. A list of the required federal permits for the Project is provided in Resource Report No. 1, Appendix C. A summary of Public, agency, and stakeholder engagement conducted by Alaska LNG Project Participants is provided in Resource Report No. 1, Appendix C and will be updated in subsequent report versions as additional input is solicited.

3.1.2.2 State Agencies

Applicable Consultations/Permits/Clearances

The Project Applicants' representatives have had discussions with several State of Alaska representatives regarding the Project details contained in this Resource Report. A summary of these meetings with a synopsis of key issues discussed will be presented in a subsequent draft of this Resource Report. A list of the required federal permits for the Project is provided in Resource Report No. 1, Appendix C. A summary of Public, Agency, and Stakeholder Engagement is provided in Resource Report No. 1, Appendix C and will be updated in subsequent report versions as additional input is solicited.

3.2 FISHERIES AND AQUATIC RESOURCES

Fisheries in Alaska include subsistence, commercial, sport, personal use, aquatic shellfish farms, and hatcheries. Most commercial fisheries in Alaska occur in marine or estuarine waters, with the exception of the Kuskokwim and the Yukon in-river commercial salmon fisheries. Commercial fisheries are not currently authorized in the Arctic Management Area. Sport, subsistence and personal use fisheries may occur in fresh or marine waters. Aquatic shellfish farms occur in coastal areas; while commercial and state-run hatcheries are used primarily to support salmon fisheries (commercial, sport, and personal use). There are currently no aquatic farms or hatcheries operating in the Project area in Upper Cook Inlet.

Commercial fisheries in Cook Inlet include: Pacific salmon, halibut, groundfish, shellfish, smelt and herring. The Upper Cook Inlet commercial salmon fishery uses set and drift gill nets. Groundfish, principally Pacific cod and sable fish, are harvested using jigs, pots or longline gear; while commercial halibut are harvested using longline gear. Within the Project area, the primary commercial fisheries are the Upper Cook Inlet set gill net fishery near the Mainline route across Cook Inlet and near the Marine Terminal; and the Upper Cook Inlet drift gill net fishery near the Marine Terminal and shipping lanes. These fisheries intercept all five Pacific salmon, primarily from the Kenai and Susitna rivers.

Sport fishing is significant throughout Cook Inlet and Interior Alaska, with fisheries for salmon, halibut, rockfish, lingcod, and Pacific cod. The most highly sought fish are halibut and Chinook, sockeye, and coho salmon. The Kenai and Susitna rivers support the bulk of freshwater salmon fishing in Cook Inlet. Harvesting of shellfish, such as shrimp, tanner, Dungeness, and king crab, razor clams, and other hardshell clams occurs south of the Project area. Personal use is a regulatory category of fishery defined as the taking, fishing for, or possession of finfish, shellfish, or other fishery resources, by Alaska residents for personal use and not for sale or barter, with gill or dip net, seine, fish wheel, long line, or other means. Personal use fisheries for salmon, eulachon, herring, shrimp, crab and clams occur in Cook Inlet. The most significant personal use fisheries near the Project area are Kenai River and Kasilof River dip net salmon fisheries.

Primary information sources used to compile descriptions of fish habitat and usage include documents from Alaska Department of Fish and Game (ADF&G, 1985, 1986a, b; 2014a-c), Bureau of Land Management (BLM, 1987a, b), Alyeska Pipeline Service Company (APSC, 1993, 2002), APSC Fish Stream Database (APSC, undated), and R2 Resource Consultants (2013). The APSC database includes information on fish species in many of the streams along the pipeline corridor north of Livengood. A list of freshwater fishes expected to be present in waters that may be affected by the Project is provided in Table 3.2-1. Many fish species are widely distributed throughout Alaska and within the Project corridor. Because changes in biotic conditions across Alaska are reflected and previously described based on ecoregions, this discussion is organized by ecoregions. Where possible specific fisheries and aquatic resources associated with the Liquefaction Facility and Interdependent Facilities are described. In keeping with the presentation throughout the remainder of this Resource Report, North Slope is roughly equivalent to the Arctic Tundra Ecoregion; Interior is roughly equivalent to the Intermontane Boreal Ecoregion; and Southcentral is roughly equivalent to the Alaska Range Transition Ecoregion. Fisheries discussions are based primarily on river drainages within these ecoregions and the Project area is defined generally throughout this report to describe the regions and watersheds within which Project components would be constructed. A primary difference is that the headwaters and portions of the Chandalar-Christian Rivers and Koyukuk River drainages originate in the Arctic Tundra Ecoregion and some headwaters and portions of the Tanana River drainage orginate in the Alaska Range Transition Ecoregion.

TABLE 3.2-1

Freshwater Fishes Occurring with the Project Area

Species		Region			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
Alaska blackfish	*Dallia pectoralis*	X	X	Introduced	Distributed throughout central Alaska lowlands, including Yukon and Tanana River systems and drainages from the Colville River west on the North Slope. Occurs in wetlands and ponds with abundant vegetation, vegetated streams, rivers, and lakes. Typically migrates to deeper areas of rivers and larger lakes before freezing in winter.
Arctic char	*Salvelinus alpinus*	X			Freshwater. Found in lakes along the northern foothills of the Brooks Range, also in a few scattered coastal plain lakes west of the Colville River.
Arctic cisco	*Coregonus autumnalis*	X			Anadromous. One of the most abundant and valued subsistence species along Alaska's North Slope. Produced in the Mackenzie River system of Canada and transported, as juveniles, to Alaskan waters by strong westerly currents. Occurs mainly in the Colville River area, with limited distributions in the Sagavanirktok and Putuligayuk rivers and drainages west to Dease Inlet.
Arctic grayling	*Thymallus arcticus*	X	X	X	Freshwater. Widespread in lakes, rivers and streams throughout most of Alaska. Spawns in spring during and immediately following breakup. Migrates between spawning and feeding areas in the spring and overwintering areas in deeper portions of lakes and rivers during the winter
Arctic lamprey	*Lampetra japonica*	X	X	X	Two forms - parasitic anadromous and nonparasitic freshwater forms. Spawn in fast-flowing stretches of clear large streams. Parasitic adults prey upon some commercially important species such as salmon, lake trout, and lake whitefish. Occurs along Pacific Coast of Alaska, in the Mackenzie River system of the Northwest and Yukon Territories, and on the North Slope.
Bering cisco	*Coregonus laurettae*	X	X	X	Anadromous. Occurs in Yukon and Susitna drainages. Bering cisco migrate long distances and spawning occurs as far as 1,200 miles up the Yukon River. Spawning migration in the Susitna River is a more modest 80 miles. Spawns during the fall in natal rivers.
Broad whitefish	*Coregonus nasus*	X	X		Anadromous. Occurs mostly in rivers, but sometimes in lakes. On the North Slope and In Yukon River, broad whitefish are an important subsistence harvest. Spawning and overwintering populations exist in Sagavanirktok River and Yukon River drainages, and in drainages from the Colville River west to the Meade River.
Burbot	*Lota lota*	X	X	X	Freshwater. A valuable subsistence and recreational fish that occupies most large rivers and many lakes throughout Alaska. Burbot spawn under the ice in late winter.

TABLE 3.2-1

Freshwater Fishes Occurring with the Project Area

Species		Region			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
Chinook salmon	*Oncorhynchus tshawytscha*	X	X	X	Anadromous. Adults return to spawn in natal streams, especially in areas that have subsurface water flow through the spawning gravel. Abundant from the Southeastern panhandle to Yukon River. Major populations return to the Yukon, Susitna, and Kenai rivers and important runs also occur in many smaller streams. Chinook populations in the Susitna and Kenai rivers support major sport fisheries, as well as contributing to the commercial harvest. Chinook from the Susitna River also support the Tyonek subsistence fishery.
Chum salmon	*Oncorhynchus keta*	X	X	X	Anadromous. The most abundant commercially harvested salmon species in arctic, northwestern, and Interior Alaska, but relatively less important in other areas of the state. Most of those taken in Cook Inlet fisheries originate from the Susitna River. Spawns in side channels and other areas of large rivers with upwelling springs, small streams, and intertidal zones. In arctic, western, and Interior Alaska, chum salmon are an important subsistence resource.
Coho salmon	*Oncorhynchus kisutch*		X	X	Anadromous. Found in coastal waters of Alaska from southeast to Point Hope on the Chukchi Sea and in Yukon River to Alaska-Yukon border. Occurs in nearly all accessible bodies of fresh water. Congregate in central Gulf of Alaska in June, later migrating along the coast until they reach their stream of origin. Spawning occurs primarily in October and November. Stocks from the Susitna, Kenai, and a variety of smaller rivers support an important sport fishery in Cook Inlet.
Dolly Varden	*Salvelinus malma*	X	X	X	Anadromous and resident populations occur in the Project area. Locally abundant in all coastal waters of Alaska. Dolly Varden spawn in streams, usually from mid-August to November. One of Alaska's more important and sought-after sport fish, also an important subsistence resource on the North Slope.
Eulachon	*Thaleichthys pacificus*		X	X	Anadromous. Generally spawn during spring over any gravel bottoms in the lower reaches of streams and rivers. Known to migrate and spawn in the Susitna River, where a large population exists.
Humpback whitefish[a]	*Coregonus pidschian*	X	X	X	Distributed throughout drainages of the North Slope from the Colville River westward, in Interior streams north of the Alaska Range, as well as in the Copper and Susitna rivers, Bristol Bay drainages, and isolated river systems farther south. Upstream migration starts during the summer and fall and spawning occurs in the upper reaches of rivers in October, usually over a gravel bottom. Important as subsistence and

TABLE 3.2-1

Freshwater Fishes Occurring with the Project Area

Species		Region			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
					commercial resource.
Inconnu	*Stenodus leucichthys*		X		Most abundant in Kuskokwim and Yukon river drainages. Upper Yukon River populations are anadromous, while lower Yukon populations overwinter in the delta. Migrates upstream from overwintering areas during ice breakup to feeding or spawning areas. Important as both a subsistence and sport resource.
Lake chub	*Couesius plumbeus*		X		Prefers cooler waters of lakes, streams, and rivers. Spawns during summer when water temperatures are greater than 50 degrees Fahrenheit (°F), sometimes migrating to tributary streams.
Lake trout	*Salvelinus namaycush*	X	X	X	Alaska's largest freshwater fish. Inhabits deeper lakes along the central and western Arctic Coastal Plain, as well as waters in the Brooks Range and Alaska Range. Also occurs in Interior lakes, including Summit Lake and Paxson Lake. Spawning occurs over clean, rocky lake bottoms from September through November.
Least cisco	*Coregonus sardinella*	X	X		Anadromous; resident populations also present. Annual migrations from winter habitats in freshwater to summer feeding habitats in brackish coastal water. Least cisco from anadromous populations migrate upstream in early October to spawn in clear streams with gravel bottoms north of the Alaska Range. A sport fishery exists for least cisco in the upper Chatanika River. Harvested for subsistence in much of its range.
Longfin smelt	*Spirinchus thaleichthys*			X	Anadromous and landlocked populations exist. Spawn in fall in the lower sections of rivers. Occur in many Cook Inlet river systems.
Longnose sucker	*Catostomus catostomus*	X	X	X	Widely distributed in clear, cold streams and rivers of Alaska, occasionally entering brackish waters in the Arctic region. Spawns during late spring and early summer
Ninespine stickleback	*Pungitius pungitius*	X	X	X	Mostly occurs in lakes, ponds, slow-moving streams, and estuaries containing emergent vegetation. Spawns in freshwater during summer months.
Northern pike	*Esox lucius*	X	X	Introduced	Occurs in a wide variety of habitats, including rivers and lakes. Spawns after ice melts in late spring or early summer. Mostly occurs in freshwater, but occasionally enters brackish water. Widely distributed in the Yukon River drainage in Alaska and in drainages west of the Colville River on the North Slope. Introduced into the Susitna drainage in Cook Inlet.
Pink salmon	*Oncorhynchus gorbuscha*	X		X	Anadromous, occurs in most coastal streams of Alaska. Important to commercial fisheries, sport fisheries, and subsistence users. Adults enter

TABLE 3.2-1

Freshwater Fishes Occurring with the Project Area

Species		Region			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
					spawning streams between late June and mid-October. Most spawn within a few miles of the coast, and spawning within the intertidal zone or the mouth of streams is common. After entering clear salt water, juveniles feed along the beaches in dense schools near the surface and then move into the ocean feeding grounds in the Gulf of Alaska and Aleutian Islands. In more turbid waters, such as northern Cook Inlet, juveniles are widely dispersed near the surface as they move seaward.
Pond smelt	*Hypomesus olidus*			X	Freshwater species that occupies lakes and streams. Spawns between April and June.
Pygmy whitefish	*Prosopium coulteri*			X	Occurs in some lakes of southwestern Alaska. Spawning occurs in autumn or early winter in lakes or streams
Rainbow smelt	*Osmerus mordax*	X	X		Anadromous and landlocked populations exist. Spawn in early spring, often during or following ice breakup. Occur in many North Slope and western Alaska river systems and in some Interior lakes.
Rainbow trout	*Oncorhynchus mykiss*		X	X	Freshwater. Found in the Susitna River and other northern Cook Inlet drainages and associated lakes. Not anadromous in this portion of the range. Spawning is from mid-April through early June.
Round whitefish	*Prosopium cylindraceum*	X	X	X	Widely distributed in shallow water along the pipeline corridor. Spawning occurs along lake and stream shorelines in autumn over gravel shoals of lakes or at river mouths.
Slimy sculpin	*Cottus cognatus*	X	X	X	Most widespread sculpin in Alaska and the only sculpin in Interior Alaska. Occupies streams and lakes.
Sockeye salmon	*Oncorhynchus nerka*	X	X	X	Anadromous; occurs along coast and in coastal streams from southeastern Alaska to western Alaska and in the Bering Sea. Limited numbers occur in the Beaufort Sea. Important subsistence resource and major commercial fishery in Cook Inlet, with the Kenai River supporting the largest population, followed by the Susitna River.
Threespine stickleback	*Gasterosteus aculeatus*	X	X	X	Anadromous and resident populations are present. Numerous in Cook Inlet drainages but extend north into Beaufort Sea drainages.

Sources: ADF&G (1985, 1986a, b, 2014a-c); BLM (1987a, b); APSC (1993, 2002); Hebert and Wearing-Wilde (2002); Armstrong (1996); Moulton (1997); R2 Resource Consultants (2013).

[a] Humpback whitefish complex as described here may also include lake whitefish (*Coregonus clupeaformis*) and Alaska whitefish (*C. nelsonii*) (Brown, 2006).

3.2.1 Coldwater Anadromous Fisheries

Alaska Statute (AS) 16.05.871(a) requires the ADF&G to specify those waters important for spawning, rearing, or migration of anadromous fishes. The Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes (Catalog) and its companion Atlas are adopted by reference in the Alaska Administrative Code (AAC) at 5 AAC 95.011(a) to identify such waters. The Catalog and Atlas are divided into six volumes corresponding to Alaska's six fish and game resource management regions. The volumes that encompass Project-associated areas are for the Arctic (ADF&G, 2014a), Interior (ADF&G, 2014b), and Southcentral regions (ADF&G, 2014c). The Catalog lists waterbodies documented as used by anadromous fish. It also lists US Geological Survey (USGS) quadrangle map, latitude, longitude, and legal description of the mouth and upper known extent of anadromous fish use for each specified waterbody. The Atlas is a compilation of topographic maps that show locations of specified anadromous fish- bearing waters, species using these waters, and, to the extent known, fish life history phases for which the waters are used. Not all streams have been thoroughly surveyed; thus, streams that are not designated as anadromous fish streams in the Catalog may still contain or be used by anadromous fish. A list of anadromous fish species expected to be present in waters that may be affected by the Project is provided in Table 3.2.1-1.

TABLE 3.2.1-1

Coldwater Anadromous Fish Occurring in the Project Area by Drainage

	Major Drainage Basins[b]									
	North Slope Arctic Tundra Ecoregion		**Interior Intermontane Boreal Ecoregion**				**Southcentral Alaska Range Ecoregion**			
Anadromous Fishes	**Prudhoe Bay**	**Colville River[c]**	**Chandalar-Christian Rivers**	**Koyukuk River**	**Beaver Creek - Yukon River**	**Tanana River**	**Susitna River**	**West Cook Inlet**	**Kenai Peninsula**	**Knik Arm**
Arctic cisco	X	X								
Arctic lamprey	X	X	X		X	X	X	X	X	X
Bering cisco	X	X			X		X	X		X
Broad whitefish[a]	X	X	X	X	X	X				
Chinook salmon			X	X	X	X	X	X	X	X
Chum salmon	X	X	X	X	X	X	X	X	X	X
Coho salmon				X	X	X	X	X	X	X
Dolly Varden[a]	X	X	X	X	X	X	X	X	X	X
Humpback whitefish	X	X								
Least cisco	X	X	X	X	X	X				
Pacific lamprey							X	X	X	X
Pink salmon	X	X					X	X	X	X
Rainbow smelt	X	X								
Sockeye salmon							X	X	X	X
Steelhead[a]							X	X	X	X

TABLE 3.2.1-1

Coldwater Anadromous Fish Occurring in the Project Area by Drainage

	Major Drainage Basins[b]									
	North Slope Arctic Tundra Ecoregion		Interior Intermontane Boreal Ecoregion				Southcentral Alaska Range Ecoregion			
Anadromous Fishes	Prudhoe Bay	Colville River[c]	Chandalar-Christian Rivers	Koyukuk River	Beaver Creek - Yukon River	Tanana River	Susitna River	West Cook Inlet	Kenai Peninsula	Knik Arm

Sources: ADF&G 2014a, b, c.

[a] May occur as anadromous and resident populations within the same drainage system. Steelhead or rainbow trout.

[b] The project would affect no streams in the Eastern Arctic Basin.

[c] The Mainline crosses through a small portion of the Colville Basin in the Brooks Range Foothills.

Not all fish species listed in in Table 3.2.1-1 are expected to be present based upon finalization of the Project footprint. Fish streams crossed by the Project are identified in Appendix A and seasonal distribution is discussed in Section 3.2.3. Appendix A will be updated in subsequent reports based upon additional information and refinement of the Project's footprint. Identification of sensitive habitat was based, in part, on listings in BLM documents (BLM, 1987a,b), which present official federal Authorized Officer's list of key fish and wildlife areas on federally administered lands along the Project corridor. BLM (1987a) classifies waterbodies along the Project corridor as either not sensitive, sensitive, or critically sensitive for fish species inhabiting those waterbodies and identifies sensitive periods of the year. These definitions were originally established by BLM on the basis of an overview of spawning, migration, and rearing activities of important fish species and assemblages.

3.2.1.1 Liquefaction Facility

Southcentral Alaskan Region

The Liquefaction Facility will be located within the Kenai Peninsula drainage in the Alaska Range Transition ecoregion (Figure 3.2.1-1). Around 23 species of fish occur within this region (Table 3.2-1 and Table 3.2.1-1). All five species of Pacific salmon are found in the drainage, with sockeye, coho, and Chinook salmon being dominant (ADF&G, 1985). Other anadromous species within the Kenai Peninsula drainage include Dolly Varden, steelhead, eulachon and longfin smelt. There are no cataloged anadromous waters in the immediate vicinity of the proposed Liquefaction Facility, although the mouth of the Kenai River (244-30-10010) is located about 9.5 miles south of the Liquefaction Facility (ADF&G, 2014c). Parsons Lake (247-90-10030-0030) and the upper reaches of Bishop Creek (247-90-10030), east of the Liquefaction Facility, support coho salmon, sockeye salmon, and Dolly Varden (ADF&G, 2014c). Bishop Creek drains to the northeast into upper Cook Inlet on the north side of the East Forelands (ADF&G, 2014c).

3.2.1.2 Interdependent Facilities

North Slope Alaskan Region

The Project area within the North Slope region runs west from Point Thomson to the GTP immediately west of the Putuligayuk River near Prudhoe Bay, then south along or near the Sagavanirktok River and its side channels and tributaries (Figure 3.2.1-1). The Mainline corridor also crosses the headwaters of the Kuparuk River. Fifteen species of fish have been reported in the Project area in the North Slope region, with the most common anadromous species being Dolly Varden, broad whitefish, and arctic cisco. The presence of chum salmon, least cisco, and humpback whitefish is less common or incidental and those species do not represent large spawning stocks (Craig, 1984).

Compared with other in-state sport fisheries, effort and harvest is low in the portions of rivers and streams near the Project area. Dolly Varden (both anadromous and resident populations), is the species most often targeted by anglers, although some fishing for pink salmon occurs in the Sagavanirktok River when they are abundant. No subsistence or commercial fisheries have been identified along the Sagavanirktok River itself, although juvenile arctic cisco that overwinter in the lower reaches and delta of the river may eventually be recruited to stocks harvested by fisheries in the Colville River. In addition, some anadromous Dolly Varden from the Sagavanirktok River may be taken in subsistence fisheries along the coast during summer (Craig, 1989).

The GTP is located next to the Putuligayuk River, which is classified as an anadromous fish stream in its lower reaches because of its use by arctic cisco, broad whitefish, and least cisco during summer. After leaving GTP, the Mainline corridor parallels the Sagavanirktok River, crossing numerous side channels. The river and smaller channels are classified as anadromous fish habitat along this entire length, primarily because of the presence of anadromous Dolly Varden. Side channels also contain broad whitefish and are considered sensitive during the May-to-October open-water season. The main channel of the Sagavanirktok River is considered sensitive year-round because it provides rearing and overwintering areas for many fish species. The main river is considered critically sensitive from August through October because of anadromous Dolly Varden migration and spawning.

Many streams that are within the Mainline corridor north of Oksrukuyik Creek are classified as sensitive from May to October because they provide summer foraging habitat for a number of species, including Dolly Varden. Because of spawning by anadromous Dolly Varden, these tributaries are considered critically sensitive in spring and fall. As in the lower reaches, the portion of the Sagavanirktok River into which these tributaries empty is considered sensitive year-round and critically sensitive in spring (May-June) and fall (August-October). Other streams within the Mainline corridor from Vanish Creek through the Atigun River floodplain are considered sensitive during summer, providing habitat for anadromous Dolly Varden.

Although the portion of the Kuparuk River in the vicinity of the Mainline corridor is not designated as anadromous fish habitat, designated anadromous fish habitats occur farther downstream (ADF&G, 2014a). In addition, the Mainline corridor crosses the Atigun River and several streams that enter Tee Lake, which contain anadromous Dolly Varden and are considered critically sensitive from May to October. They also provide overwintering habitat for some species and are considered sensitive from November through December.

Interior Alaskan Region

After crossing Atigun Pass in the Brooks Range, the Mainline corridor enters Interior Alaska. Within this region, the corridor crosses or runs along several major streams and rivers, most of which are in the Yukon River drainage. At least 19 species of fish occur in the Yukon River drainage, with anadromous and resident Dolly Varden; and chum, coho, and Chinook salmon being the most important.

South of the Brooks Range, the Mainline corridor follows the course of the Dietrich River and the Middle Fork of the Koyukuk River. Although none of the waterbodies within the Dietrich River system are classified as anadromous, the Dietrich flows into the Middle Fork of the Koyukuk River, which is classified as an anadromous fish stream. The Middle Fork of the Koyukuk River and several of its tributaries support stocks of anadromous Dolly Varden, chum and Chinook salmon. The Middle Fork of the Koyukuk River is considered critically sensitive rearing habitat year-round, and most of the tributaries and sloughs associated with it are considered sensitive from April through October.

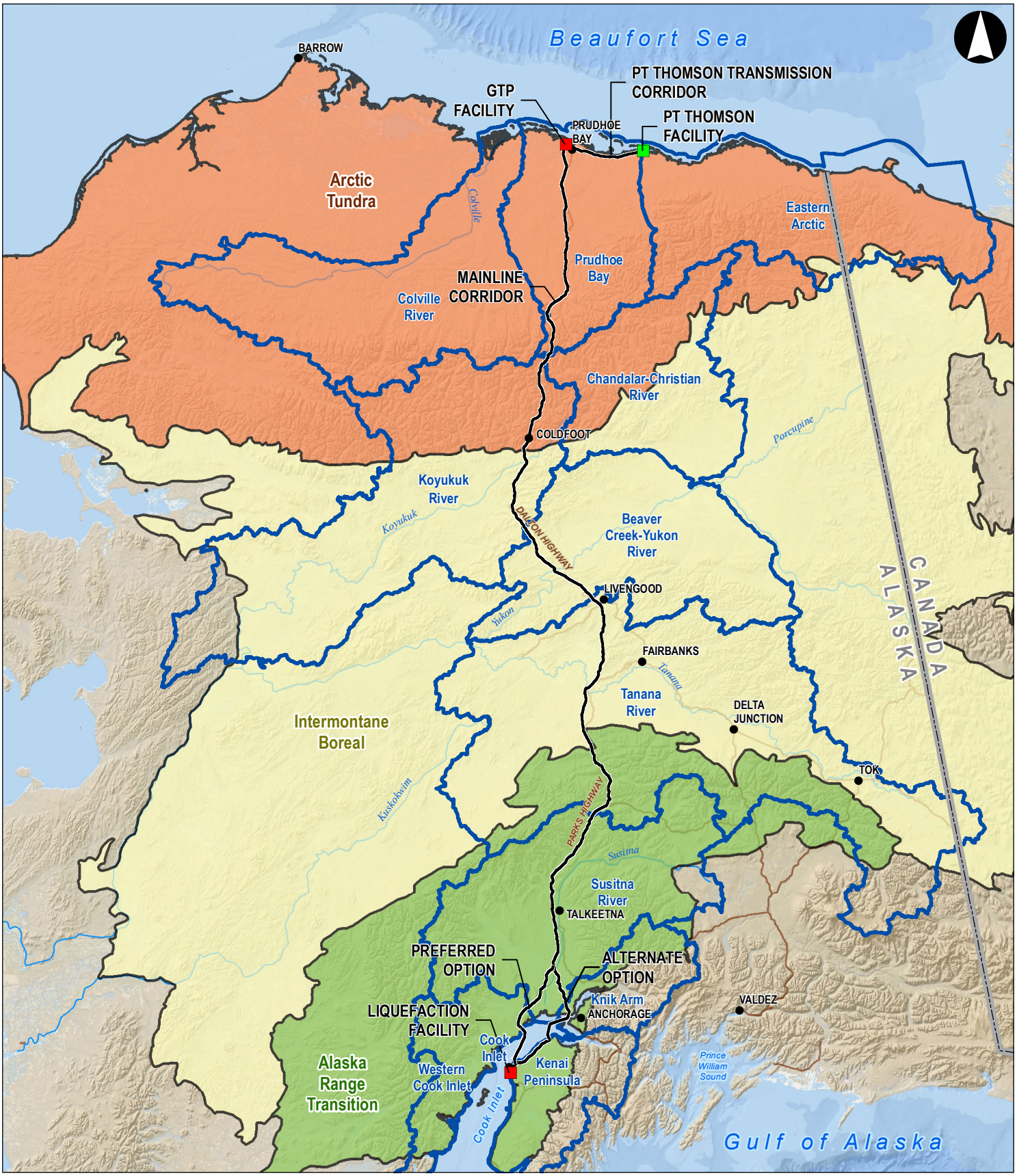
The Mainline corridor, south of the Dietrich River and the Middle Fork of the Koyukuk River, crosses several streams that provide habitat for chum and/or Chinook salmon, including Minnie Creek, Marion Creek, the South Fork of the Koyukuk River, Jim River, Douglas Creek, Prospect Creek, and the Yukon River. These streams are considered critically sensitive throughout the year. Although few anadromous fish streams exist between Prospect Creek and the Yukon River, Bonanza Creek and Fish Creek empty into the South Fork of the Koyukuk River, which is an anadromous fish stream. Chum salmon occur in Bonanza Creek downstream from the Mainline corridor crossing, and the Kanuti River provides anadromous-fish habitat near its mouth.

Few anadromous fish streams occur along the Mainline corridor between the Yukon and the West Fork of the Tolovana rivers; chum salmon have been reported in Hess Creek and the Tolovana River (Appendix A). Most streams in this area support arctic grayling and numerous other species, including whitefishes, slimy sculpin, longnose sucker, northern pike, and burbot. These waterbodies are considered sensitive from May through October. The Tolovana River supports anadromous fish about 25 miles downstream of the Project corridor (ADF&G, 2014b).

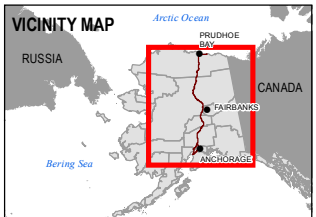
South of the Tolovana River, the Mainline corridor diverges from the TAPS corridor and information on fish distribution and habitat use is less detailed. The Chatanika, Tanana and Nenana rivers are all anadromous fish streams supporting populations of Chinook, coho and chum salmon. June Creek supports coho and chum salmon, while Panguingue Creek contains coho salmon.

Southcentral Alaskan Region

South of the Alaska Range, the Mainline corridor crosses streams and rivers that are primarily within the Susitna River drainage (Figure 3.2.1-1). Approximately 23 species of fish occur within this region (Table 3.2-1 and Table 3.2.1-1). All five species of Pacific salmon are found in the drainages, with sockeye, coho, and Chinook salmon being dominant (ADF&G, 1985). From the Chulitna River south to Cook Inlet, most of the streams support spawning and/or rearing by one or more of the salmon species. The Susitna River is a major producer of sockeye, Chinook, coho, and chum salmon in the Cook Inlet region. Other anadromous species within the drainage include Dolly Varden, Bering cisco, humpback whitefish, eulachon, and longfin smelt.



VICINITY MAP



LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- River Basins

Ecoregions

- Arctic Tundra
- Intermontane Boreal
- Alaska Range Transition

0 25 50 100 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_2_1-1 River Basins Associated with the Alaska LNG Project.mxd

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SCALE:	1:6,000,000		
DATE:	2015-01-08	SHEET:	1 of 1

RIVER BASINS ASSOCIATED WITH THE ALASKA LNG PROJECT

FIGURE 3.2.1-1

Alaska LNG

3.2.2 Coldwater Resident Fisheries

Many species of freshwater resident fish also occupy aquatic habitats within the Project area (Table 3.2.2-1). Arctic grayling are the most visible freshwater fish along the pipeline corridor, occurring in many of the small, clearwater tributaries along the entire route. Other commonly encountered freshwater species include burbot, northern pike, round whitefish, slimy sculpin and ninespine stickleback. Arctic grayling are the species most often targeted by anglers, with northern pike and burbot often targeted in Interior waters.

TABLE 3.2.2-1

Coldwater Resident Fishes Occurring in the Project Area by Drainage

	Major Drainage Basins[b]									
	North Slope Arctic Tundra Ecoregion		**Interior Intermontane Boreal Ecoregion**				**Southcentral Alaska Range Ecoregion**			
Resident Fishes	**Prudhoe Bay**	**Colville River**	**Chandalar-Christian Rivers**	**Koyukuk River**	**Beaver Creek-Yukon River**	**Tanana River**	**Susitna River**	**West Cook Inlet**	**Kenai Peninsula**	**Knik Arm**
Alaska blackfish		X			X	X				I
Alaskan brook lamprey						X			X	
Arctic char	X	X	X						X	
Arctic grayling	X	X	X	X	X	X	X	X	I	X
Broad whitefish	X	X	X	X	X	X				
Burbot	X		X	X	X	X	X	X	X	X
Dolly Varden[a]	X	X	X	X	X	X	X	X	X	X
Humpback whitefish				X	X	X				
Inconnu/Sheefish				X	X	X				
Lake chub			X	X	X	X				
Lake trout	X	X	X	X	X	X	X	X	X	X
Least cisco[a]	X	X	X	X	X	X				
Longnose sucker	X	X	X	X	X	X	X	X	X	X
Ninespine stickleback	X	X	X	X	X	X	X	X	X	X
Northern pike	X	X	X	X	X	X	I		I	
Pond smelt	X	X					X	X	X	X
Rainbow trout[a]						S	X	X	X/S	X
Round whitefish	X	X	X	X	X	X	X	X	X	X
Slimy sculpin	X	X	X	X	X	X	X	X	X	X

Sources: Mecklenburg et al., 2002

[a] May occur as anadromous and resident populations within the same drainage system.

[b] The project would affect no streams in the Eastern Arctic Basin.

I = Introduced, S = Stocked

3.2.2.1 Liquefaction Facility

Within the Kenai Peninsula drainage on the north Kenai Peninsula, fisheries for resident freshwater fish include rainbow trout, Dolly Varden, lake trout, and arctic grayling (Begich and Pawluk, 2010). Rainbow trout, as with arctic grayling, spawn in spring; thus, streams used for spawning by this species are sensitive during the April to June spawning and incubation period. Several lakes in the Nikiski Area are stocked with rainbow trout. Arctic grayling are not considered native to the Kenai Peninsula, but were stocked in several lakes and have become self-sustaining in several drainages (ADF&G, 1985). Other notable resident species in this region include round whitefish, longnose sucker and slimy sculpin.

3.2.2.2 Interdependent Facilities

North Slope Region

Within the North Slope region, the Sagavanirktok River and its side channels support arctic grayling, ninespine stickleback, round whitefish, and slimy sculpin and are considered sensitive during the May-to-October open-water season. As mentioned above, the main channel of the Sagavanirktok River is considered sensitive year-round because it provides rearing and overwintering areas for many fish species. The main river is considered critically sensitive from May through June because of arctic grayling spawning.

Many of the tundra streams that are crossed are classified as sensitive from May to October because they provide summer foraging habitat for a number of species, including arctic grayling and Dolly Varden. Because of spawning by arctic grayling, these tributaries are considered critically sensitive in the spring. As in the lower reaches, the portion of the Sagavanirktok River into which these tributaries empty is considered sensitive year-round for arctic grayling, burbot, slimy sculpin, and round whitefish and critically sensitive in spring (May-June) for spawning arctic grayling.

Interior Alaska Region

Within Interior Alaska, arctic grayling, resident Dolly Varden, burbot, northern pike, least cisco, and humpback whitefish are the most noticeable freshwater species, with slimy sculpin and longnose sucker among other abundant species. Arctic grayling and slimy sculpin use the North Fork of the Chandalar River. The North Fork of the Chandalar River is considered sensitive habitat during summer from May through October and critically sensitive in spring and fall because of spawning by arctic grayling and possibly Dolly Varden. South of the Brooks Range, the Mainline corridor follows the course of the Dietrich River and the Middle Fork of the Koyukuk River. Resident Dolly Varden, arctic grayling, burbot, round whitefish, longnose sucker, and slimy sculpin inhabit the Dietrich River drainage. Known overwintering areas occur intermittently along the Dietrich River and are considered critically sensitive year round. The river's tributaries are considered sensitive habitat during periods of open water (typically May-October). Streams along the Interior Alaska portion of the corridor that support overwintering habitat are also considered sensitive.

Southcentral Alaska Region

Within Southcentral Alaska, arctic grayling, resident Dolly Varden, and burbot are abundant within streams, and rainbow trout are also present in many tributaries of the Susitna River. Rainbow trout, like arctic grayling, spawn in spring; thus, streams used for spawning by this species are sensitive during the

April to June spawning and incubation period. Other notable resident species in this region include round whitefish, longnose sucker, and slimy sculpin.

3.2.3 Seasonal Fish Distribution

Seasonal coldwater resident fish distribution within the Project area varies by species and region. For example, within the Susitna River drainage, which has been extensively studied because of ongoing hydroelectric evaluations, life stages of all five Pacific salmon species are present year-round (Table 3.2.3-1). However, a typical seasonal pattern for the salmon species present is as follows:

- Movement to summer feeding areas following breakup;
- Movement within feeding areas during summer, with movements sometimes extensive; and
- Late summer movement to wintering areas.

Within this basic movement pattern will be movements to appropriate spawning areas, which can be in spring (arctic grayling, rainbow trout, eulachon), summer (Pacific salmon), fall (Dolly Varden, ciscoes, whitefish), and winter (burbot, sculpins).

3.2.4 Sensitive Fish Species

3.2.4.1 Pacific Salmon

Pacific salmon are considered the most sensitive fish species that may be influenced by the Project because of their importance to subsistence, commercial, and sport fisheries throughout the state of Alaska, and their use of a wide variety of aquatic habitats during all seasons.

The Alaska Board of Fisheries in consultation with ADF&G, may designate, amend, or discontinue Salmon Stocks of Concern identified by the ADF&G as required under the Management of Sustainable Salmon Fisheries Policy (SSFP; 5 AAC 39.222). Designations are based on stock status reports and recommendations from ADF&G. The SSFP defines three levels of concern (Yield, Management, and Conservation) with yield being the lowest level of concern and conservation the highest level of concern.

Seven Chinook and one sockeye salmon stock in Cook Inlet have been designated as stocks of concern at the yield or management level (Table 3.2.4-1). Juveniles and adults from these stocks are likely to occur in marine waters in upper Cook Inlet. The freshwaters supporting spawning for these stocks are shown in Figure 3.2.4-1).

TABLE 3.2.3-1
Seasonality of juvenile salmon presence in the Susitna River
Light gray indicates total duration of residence in the middle Susitna River and dark gray represents periods of peak use.

Species	Life Stage (age)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0+)												
	Rearing (1+)												
	Juvenile Migration (0+)												
	Juvenile Migration (1+)												
Sockeye Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0+)												
	Rearing (1+)												
	Juvenile Migration (0+)												
	Juvenile Migration (1+)												
Coho Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0+)												
	Rearing (1+)												
	Rearing (2+)												
	Juvenile Migration (0+)												
	Juvenile Migration (1+)												
	Juvenile Migration (2+)												
Chum Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0+)												
	Juvenile Migration (0+)												
Pink Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Juvenile Migration (0+)												

Source: R2 Resource Consultants (2013)

= Peak Use
= Off-peak Use

TABLE 3.2.4-1

Salmon Stocks of Concern within the Project Area

System	Common Name	Area	Year Designated	Level of Concern	Year Last Reviewed
Susitna (Yentna) River	Sockeye salmon	Cook Inlet	2007	Yield	2010
Chuitna River	Chinook salmon	Cook Inlet	2010	Management	2010
Theodore River	Chinook salmon	Cook Inlet	2010	Management	2010
Lewis River	Chinook salmon	Cook Inlet	2010	Management	2010
Alexander Creek	Chinook salmon	Cook Inlet	2010	Management	2010
Willow Creek	Chinook salmon	Cook Inlet	2010	Yield	2010
Goose Creek	Chinook salmon	Cook Inlet	2010	Management	2013
Sheep Creek	Chinook salmon	Cook Inlet	2013	Management	2013

Source: ADF&G 2014e

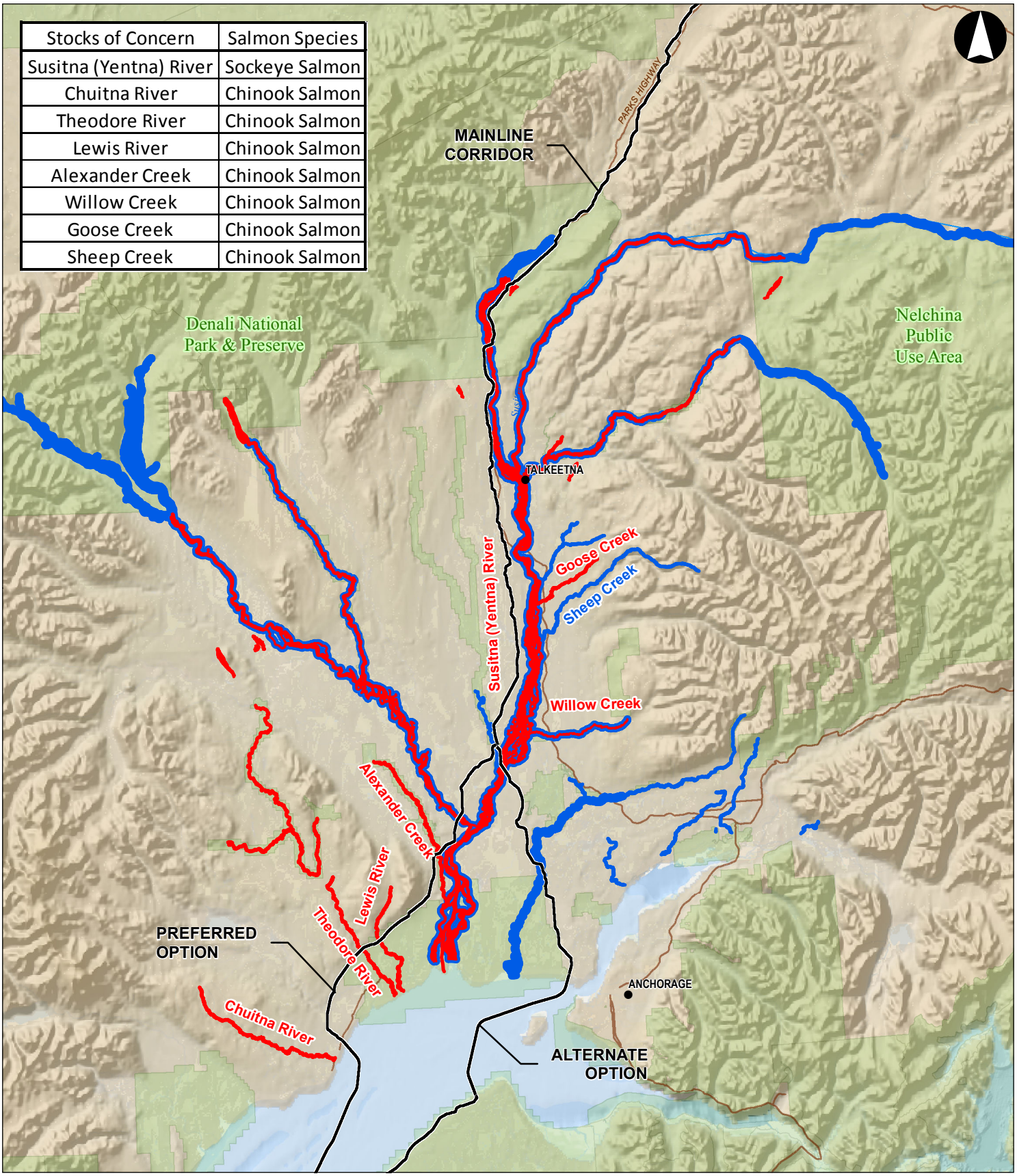
Liquefaction Facility

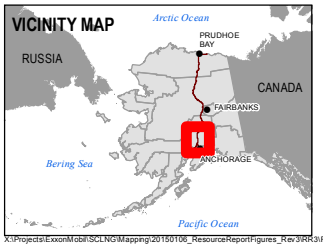
All five species of Pacific salmon use marine waters in the vicinity of the Project area near Nikiski and use rivers or streams on the northern Kenai Peninsula for migration, spawning, and rearing. Most notable is the Kenai River (244-30-10010) which is located approximately 9.5 miles south of the Liquefaction Facility (ADF&G, 2014c). There are no cataloged anadromous waters in the immediate vicinity of the Liquefaction Facility (ADF&G, 2014c). Parsons Lake (247-90-10030-0030) and the upper reaches of Bishop Creek (247-90-10030), east of the Liquefaction Facility, support coho and sockeye salmon (ADF&G, 2014c). A brief synopsis of the five Pacific salmon is provided below.

Chinook Salmon. Chinook salmon spawn in rivers throughout Interior and Southcentral Alaska, including the Yukon River and its tributaries, and the Susitna, Little Susitna, Beluga, Theodore, and Chuit rivers in Upper Cook Inlet. Females may deposit 2,000 to 17,000 eggs in gravel beds. Chinook fry hatch in spring and most juvenile Chinook remain in freshwater until the following spring when they begin to move toward marine habitats.

In the Cook Inlet region, Chinook juveniles normally leave freshwater and enter marine waters during the summer of their second or third year. Information from the Susitna River indicates Chinook salmon leave that system as both age-0 and age -1 fish (Roth and Stratton, 1985). Age-0 outmigrants leave the system from mid-June to late August at mean lengths of 43 to 75 millimeters (mm), while age-1 smolts leave the river from late May to mid-June at 80 to 89 mm. Chinook smolts feed on plankton and insects in freshwater. After migrating to sea, young Chinook salmon initially feed in shallow nearshore areas along the coast. As they grow, they gradually move offshore and into deeper water. Chinook remain within the coastal area throughout their marine phase. Prey initially include a variety of marine plankton, including copepods, amphipods, euphausiids, and small fishes. With increasing size, fish become the dominant food item, with Pacific herring (*Clupea pallasii*) and Pacific sandlance (*Ammodytes hexapterus*), as well as squid and crustaceans, providing a high percent of the diet. Chinook salmon enter tributaries on the western side of the Susitna River in May and June, continuing until August, with peak recreational harvests occurring at the mouth of Alexander Creek during the first week of June, and at the mouth of the Deshka River during mid-June (Ivey and Sweet, 2004). Catches from commercial set nets along the western side of northern Cook Inlet, between 2001 and 2005, indicate that 90 percent of the catch occurs between May 25th and June 18th.

Stocks of Concern	Salmon Species
Susitna (Yentna) River	Sockeye Salmon
Chuitna River	Chinook Salmon
Theodore River	Chinook Salmon
Lewis River	Chinook Salmon
Alexander Creek	Chinook Salmon
Willow Creek	Chinook Salmon
Goose Creek	Chinook Salmon
Sheep Creek	Chinook Salmon





LEGEND

- Alaska Place Names
- Project Corridor
- Salmon Stocks of Concern
- Major Salmon Producing Waters
- Major Highways
- State and Federal Conservation Lands

0 5 10 20 Miles

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DATE:	2015-01-09	SHEET:	1 of 1

SALMON STOCKS OF CONCERN ASSOCIATED WITH THE ALASKA LNG PROJECT

FIGURE 3.2.4-1

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_2_4-1 Salmon Stocks of Concern Associated with the Alaska LNG Project.mxd

Moulton (1997) captured juvenile Chinook salmon smolts along the northwestern shore of Upper Cook Inlet in the Susitna, Tyonek, and Trading Bay regions. Catch rates peaked in mid-June and mid-July, and no Chinook smolts were caught in September. Chinook smolts captured in June were primarily age-1, while those captured in July were ages-0 and -1. Small numbers of age-2 and -3 juvenile Chinook were also caught. In Knik Arm, Chinook salmon comprised 25.6 percent of all juvenile salmon captured from April to July 2005 (Houghton et al., 2005a). Peak abundance occurred in June and no significant difference in the catch per unit effort occurred among stations throughout the Knik Arm. In April, most of the Chinook were age-0 fish from 30 to 40 mm (1.2 to 1.6 inches) in length. Beginning in May, fish greater than 61 mm (2.4 inches) dominated the catch, many of which appeared to be of hatchery origin. Multiple cohorts were also present in tow net samples collected in May. Chinook smolt abundance declined in Knik Arm in mid- to late summer.

Sockeye Salmon. Sockeye salmon is an important commercial, sport, and subsistence fish throughout Cook Inlet, with major runs to the Kenai, Susitna, and other rivers in the region. Sockeye typically spawn in lakes or rivers associated with lake systems, although they can occur in river systems without lakes. Female sockeye salmon deposit 2,000 to 4,500 eggs in gravel nests. When lakes are available, sockeye fry may spend 1 to 3 years in freshwater before entering the ocean. In systems without lakes, sockeye generally spend less time in fresh water (ADF&G, 2014d). Some sockeye salmon populations are landlocked (i.e., kokanee) and spend their entire life in freshwater.

Adult sockeye salmon are present from June to October in Upper Cook Inlet waters (ADF&G, 2014d) with a historic peak return to the southern boundary of Upper Cook Inlet marine waters around July 15th (Shields and Willette, 2005). Approximately 50 percent of Susitna River sockeye are thought to be produced in the Yentna River tributary (Ivey and Sweet, 2004). Catches from commercial set nets along the western side of northern Cook Inlet between 2001 and 2005 indicate that 90 percent of the catch occurs between July 1 and 31, although they are present from early June into early August.

Juvenile sockeye salmon were caught in Upper Cook Inlet in June and July, but in limited numbers (Moulton, 1997). During June, juvenile sockeye were caught throughout the study area in Upper Cook Inlet; in July, they were caught mostly in the eastern and middle portions of Moulton's (1997) study area. Age-1 (one winter in freshwater) was dominant in the June tows, but ages-0 and -1 were caught in equal numbers in July. No juvenile sockeye salmon were caught in September.

Sockeye juveniles normally leave freshwater and enter marine waters during the summer of their second or third year. In the Susitna River, sockeye were observed to leave the system at age-0 and -1 (Roth and Stratton, 1985). Age-0 sockeye outmigrated from the Susitna River in mid-May to late August at mean lengths of 40-53 mm. Age-1 sockeye from the Susitna River show a more typical outmigration, with 90 percent outmigrating from mid-May to mid-June at mean lengths of 71-78 mm in 1984 and 80 mm in 1985.

In Knik Arm in 2004, juvenile sockeye were the most frequently caught salmon during beach seining from July to November (Houghton et al., 2005a, b). Catches peaked in August 2004. In 2005, juvenile sockeye catches were low in April and May, peaked in June, and continued in July. Based on length measurements, two cohorts of sockeye (ages-0 and -1) were present in Knik Arm during both years. Juvenile sockeye in Knik Arm appeared to have substantial body growth from July through September 2004.

Coho Salmon. Coho salmon is a popular commercial and sport fish, occurring in most river systems within Cook Inlet. Coho salmon spawn in many types of freshwater habitats and are known to migrate up the Yukon River to the Alaska/Canada border. Adult coho salmon return to spawn later than other species and may be found in spawning streams from July through November. The timing of spawning runs may vary depending on environmental conditions, and barriers in small headwater streams they often spawn in. Females deposit 2,000 to 4,500 eggs into gravel beds.

Juvenile coho salmon usually rear from 1 to 3 winters in freshwater (ADF&G, 2014d). Juvenile coho salmon can establish winter territories in freshwater pools and lakes, and may move between brackish estuarine water during spring and summer for feeding and move back to freshwater in fall (ADF&G, 2014d).

Adult coho salmon are well represented throughout Upper Cook Inlet with runs beginning in July and continuing into October. The peak of the run in the west-side Susitna area, an early-run stock, is generally in the last week of July (Ivey and Sweet, 2004). The Little Susitna River has proven to be a good indicator of coho run strength throughout the region, and the Susitna River drainage supports the largest coho stock in Upper Cook Inlet. The greatest recreational harvest of coho salmon generally occurs in the Knik and Eastside Susitna Management Units, followed closely by the Westside Susitna Unit (Ivey and Sweet, 2004). Lake Creek is the greatest contributor to sport fish catches in the Westside Unit. Catches from commercial set nets along the western side of northern Cook Inlet between 2001 and 2005 indicate that 90 percent of the catch occurs between July 12 and August 15, although they are present from early July into late August.

Juvenile coho in northern Cook Inlet streams spend from 1 to 3 years in the freshwater streams. In the Susitna and Little Susitna rivers, most of the returning adults have spent either 1 or 2 summers in freshwater, migrating out as smolts the following summer. Neither age group appears to be consistently dominant (ADF&G, 1983; Barrett et al., 1984, 1985; Bartlett, 1992; Waltemyer, 1991). Migration of smolts out of the Susitna River to marine waters occurs from mid-May to September. Age 0 smolts left the river in late July through August in both 1984 and 1985. In 1984, ages-1 and -2 showed a similar outmigration pattern, while in 1985, the older smolts outmigrated in June and early July. Age-1 smolts left at mean lengths of 85-113 mm in 1984 and 89-108 mm in 1985, while age-2 smolts were 126-141 mm in 1984 and averaged 132 mm in 1985. Upon entry into the marine waters, coho tend to remain near shorelines where they feed on planktonic crustaceans, pink and chum salmon fry, and juveniles and larvae of other fishes. As they grow, they move into deeper, offshore waters and are eventually distributed across the North Pacific Ocean and into the Bering Sea. As the coho grow, their diet shifts to larger pelagic prey.

In Knik Arm, juvenile coho salmon was the second most abundant juvenile salmon species captured in beach seines in 2004, and the most abundant species in 2005 (Houghton et al., 2005a). Coho salmon smolts were captured as early as April and were present in Knik Arm into late November. In both 2004 and 2005, catches of juvenile coho peaked in July, but continued into August. In 2005, coho salmon were distributed throughout Knik Arm but were more abundant on the western side (Houghton et al., 2005a). Several cohorts were present throughout the study period and a relatively high frequency of 101 to 140 mm coho captured in June 2005 may have resulted from the smolt release from Ship Creek hatcheries. Houghton et al. (2005a) reported that adult coho comprised 0.9 percent of the total beach seine catch and that most adult coho were captured in July with smaller numbers in August. In northern Cook Inlet, catch rates of juvenile coho salmon were highest in mid-June and mid-July, and the greatest numbers were

caught near the Susitna River delta (Moulton, 1997). Juvenile coho were the only salmon caught in September.

Pink Salmon. Pink salmon are the smallest of the Pacific salmon, with a maximum length of 76 centimeters (cm) (30 inches) and weight of 6.4 kilograms (14 pounds; Mecklenburg et al., 2002). Adult pink salmon return to rivers and streams throughout Upper Cook Inlet. They are harvested in commercial and subsistence fisheries, but usually in the course of effort directed at other species. Females may deposit as many as 1,500 to 2,000 eggs in a gravel nest in freshwater or occasionally in intertidal areas. The eggs hatch during winter and the developing fish, or alevins, remain in the gravel using their yolk sacs for nourishment. Fry emerge from the gravel in late winter or early spring and immediately move downstream to marine waters.

In the ocean, juvenile pink salmon smolt feed on plankton and larval fish, and may reach 4 to 6 inches in length by their first winter. They spend the next year in the open ocean, returning the following fall to spawn in their natal streams. This life cycle of the Pacific salmon is generally the shortest (2 years from hatching to spawning).

Because pink salmon spawn at 2 years of age, two separate lines of unrelated fish develop in alternating odd and even year cycles. In some locations one line may be dominant over the other in abundance. In the Cook Inlet region, larger pink salmon runs occur during even years.

Adult pink salmon probably feed relatively little in Cook Inlet because they are close to entering their natal stream. Based on the diets of juvenile pinks in Prince William Sound and the northern Gulf of Alaska, pink salmon are known to feed on a mixture gastropods, cladocerans, copepods, and bivalves early on, ranging to larger prey such pteropods, larvaceans, amphipods and euphausiids later in summer (Bolt and Haldorson, 2003).

Adult pink salmon return to Upper Cook Inlet from early July to mid-August, with Westside Susitna drainages having peak runs in July. Upper Cook Inlet pink salmon runs are even-year dominated, with the 2000 and 2002 returns being characterized as strong or very strong, as opposed to diminished returns since the mid-1980s. However, harvest levels of pink salmon have been low, owing to restrictions in place to ensure sockeye salmon escapement. Pink salmon returns in 2004 were deemed average to above average (Fox and Shields, 2005). Catches from commercial set nets along the western side of northern Cook Inlet between 2001 and 2005 indicate that the adult return timing is quite similar to that of sockeye salmon, with 90 percent of the catch occurs between July 1 and 31, although they are present from mid-June into early August.

Pink salmon emerge from gravel substrate in April and May, and immediately migrate downstream to the estuary. The time spent in freshwater varies, depending on the distance the juveniles must travel, and average stream velocities they encounter along the way. Freshwater residence of a few hours to a few days is typical. Feeding does not normally occur during this downstream migration. During 1985, pink salmon left the Susitna River throughout June, with the outmigration essentially finished by the first week in July (Roth et al., 1986). Outmigrating pink salmon averaged 37 mm, with a maximum of 48 mm.

Juvenile pink salmon were the most abundant salmon reported by Moulton (1997) during tow net sampling in Upper Cook Inlet in June and July of 1993, comprising 16.5 percent of the total catch. Pink salmon were caught in 92 percent of the tows in June, comprising approximately 25 percent of the total catch. Pink salmon numbers decreased in July, when they occurred in only 70 percent of the tows. Pink salmon were abundant throughout the study area from the East and West Forelands to Fire Island near Anchorage, but were most abundant in mid-June near the mouth of the Susitna River. However, a large number of pink salmon was also caught in a single mid-channel tow in mid-July in the eastern portion of the study area.

Houghton et al. (2005a) did not capture any pink salmon smolt in Knik Arm during beach seine sampling in 2004, although few were expected. The larger even-year pink runs in Cook Inlet produce a larger number of odd-year outmigrants, and the numbers of pink salmon smolt expected in even years are much lower. In 2005, Houghton et al. (2005a) captured 33 pink salmon by beach seine, which was 1.9 percent of all juvenile salmonids. Most pink salmon were captured in May and were young-of-the-year outmigrants between 31 and 40 mm (1.2 to 1.6 inches) in length. Houghton et al. (2005a) also captured pink salmon smolt during tow net sampling in Knik Arm. Pink salmon smolt were most abundant in May and numbers declined in June and July.

Pink salmon juveniles entering marine habitats begin feeding on small invertebrates, particularly calanoid and harpacticoid copepods (Cooney et al., 1981; Sturdevant et a1., 1993). Other important foods are often decapod larvae, fish larvae, invertebrate eggs and insects (Heard, 1991). As they grow, the juveniles move away from estuaries, but usually remain close to shorelines for several weeks. In Prince William Sound, pink salmon fry enter the marine area at lengths of around 35 mm in late April to early May and have reached mean lengths of 40 to 45 millimeters by early June, depending on growing conditions (Celewycz and Wertheimer, 1993). By late summer, the juveniles have grown to a length of about 60-80 mm and they begin moving offshore. Pink salmon from northern Cook Inlet likely move to the Gulf of Alaska during the late summer and early fall.

Chum Salmon. Chum salmon in Upper Cook Inlet are most abundant in the Susitna River, although they occur in other rivers as well. Chum salmon spawn in coastal streams and intertidal areas, but may also travel great distances inland. Some chum salmon are known to migrate up the Yukon River to the Yukon Territory to spawn, a distance of over 2,000 miles. Females may lay up to 4,000 eggs.

Chum fry move toward marine waters soon after hatching, usually shortly after ice breaks up from their natal rivers. Chum may not feed before reaching saltwater, thus making marine food resources of special importance. Juvenile chum in Cook Inlet are thought to enter marine water from late May through July. By their first winter, Cook Inlet chum salmon have moved into the Gulf of Alaska and spend 3 to 4 years in the ocean before returning to natal streams (ADF&G, 2008).

Adult chum salmon are not well represented in Westside Susitna drainages of the Upper Cook Inlet. Their peak run timing is mid-July through mid-August; however, their run continues into September (ADF&G, 2008). Upper Cook Inlet chum stocks are only monitored at one location, Clearwater Creek, with an escapement index generated by peak run time aerial survey counts (Hasbrouck and Edmundson, 2005). Chum production in the Susitna River declined in the mid-1980s to the mid-1990s but a steady increase in production has been observed in Upper Cook Inlet since the mid-1990s (Fox and Shields, 2005). Catches from commercial set nets along the western side of northern Cook Inlet between 2001 and 2005 indicate that the return of adult chum salmon falls between that of sockeye and coho, with 90 percent of the catch occurring between July 8 and August 7, although they are present from early July into late August.

Juvenile chum salmon emerge from the streambed in spring and immediately begin moving downstream to the sea. The duration of this migration depends on the total distance traveled, and water velocities encountered. In most cases, the downstream migration takes a few hours to a few days. Little or no feeding occurs in streams where the downstream migration is completed in a small time after emergence. In the Susitna River, chum leave during June through early July at a mean size of 42 to 43 mm. In both 1984 and 1985, chum salmon between 50 and 60 mm were caught in the river, which was interpreted to indicate growth prior to outmigration.

Chum salmon smolts were the second most abundant salmon reported by Moulton (1997) in Upper Cook Inlet and comprised 10.2 percent of the total catch. Chum salmon showed a steady increase in size through the study period with mean lengths ranging from 43.6 mm (1.7 inches) in early June to 57.7 mm (2.3 inches) in mid-July. The growth rate of chum smolt appeared to be greater in July than in June and may have been related to warmer temperatures or to a decrease in the numbers of smolt emigrating from freshwater (Moulton, 1997).

During beach seine sampling in Knik Arm, Houghton et al. (2005a) captured only five juvenile chum in 2004 and concluded that most chum had probably migrated out of the area before sampling began in late July. Sampling in 2005 began earlier than in 2004 and small numbers of juvenile chum were captured in April with significant increases in May and June. As in 2004, no chum smolts were captured with beach seines in July 2005. Chum salmon smolts were the most abundant salmon captured in tow net sampling in Knik Arm (Houghton et al., 2005a). Chum smolt were most abundant in May and numbers declined in June and July. Houghton et al. (2005a) reported that adult chum salmon composed 0.1 percent of the total beach seine catch.

Once in the estuary, juveniles form schools and normally remain close to shorelines for several months to feed and grow prior to moving onto the high seas. Salo (1991) describes chum salmon juveniles as depending on a detritus-based food web in the estuarine habitat. Fish larvae and insects were important components of juvenile chum diet in northern Cook Inlet during June, while insects became dominant in July (Moulton, 1997). Prey studies often describe harpacticoid copepods as dominant food item. By late summer, juvenile chum salmon move to offshore waters.

Interdependent Facilities

All five species of Pacific salmon use streams along the Project corridor for migration, spawning, and rearing. A brief synopsis of each species within the Project area is provided in Section 3.2.4.1 above.

3.2.4.2 BLM-Sensitive and "Watch" List Fish

In implementing its obligations under the Federal Land Policy Management Act (FLPMA), 43 U.S.C. § 1701 et seq. (1976), the BLM designates sensitive species and implements measures to conserve certain species and their habitats on BLM land. All federally designated candidate species, proposed species, and delisted species in the five years following their delisting are conserved as BLM-sensitive species. BLM is not obligated to conserve federally designated critical habitat once the proposal to be de-listed becomes final or the habitat is no longer proposed for listing.

Liquefaction Facility

One of the BLM sensitive or "watch" list fish in Alaska may occur in streams near the Liquefaction Facility on the Kenai Peninsula, the Alaskan brook lamprey (*Lampetra alaskense*). The Alaskan brook lamprey is a separate species from the American brook lamprey (*L. appendix*). It is found in a few areas of Alaska, including the Alaska and Kenai peninsulas. The Alaska brook lamprey is a nonparasitic, freshwater species. This fish is gray-brown on the back and white underneath with a dark blotch on the second dorsal fin and a dark tail. Alaskan brook lampreys have blunt teeth and measure five to seven inches as adults. They spawn in spring and summer in shallow areas of streams and sometimes lakes. After spending four years as ammocoetes, these lampreys metamorphose to adults in the fall and spawn the following spring.

Interdependent Facilities

One BLM sensitive or "watch" list fish may occur in the Project area, the Alaskan brook lamprey. Its distribution includes the Chatanika and Chena rivers and the Alaska Peninsula and Kenai Peninsula. A brief synopsis of this species is provided above.

3.2.5 Aquatic Nuisance Species

Nonindigenous species can cause great harm to ecological systems by upsetting natural balances and suppressing resident species. Invasive species can also upset commercial industries when they impact fisheries. To combat the spread of invasive species and limit their disturbance on Alaska's ecosystems, ADF&G has developed an Aquatic Nuisance Species (ANS) Plan, which focuses on nonindigenous species that have or could still be introduced into Alaskan waters. The plan was developed in 2002 to provide for interdivision and interagency coordination for the prevention and detection of the spread of invasive species (ADF&G, 2002). The approval of ADF&G's ANS plan allowed for limited federal funding from the Aquatic Nuisance Species Task Force (ANSTF), which is an intergovernmental organization composed of 13 federal agency representatives and 12 ex-officio members and is co-chaired by the USFWS and NOAA.

The ADF&G has identified several ANS of concern, identifying them as High Priority Threats. The designation as a Priority Species means that the ANS is considered a significant threat to Alaskan waters and requires immediate or continued management action to minimize the impact on existing ecosystems. A summary of ANS species that could be within the Project area is provided in Table 3.2.5-1.

TABLE 3.2.5-1

Alaska ANS Plan High Priority Threat Species[a]

Type	Common Name	Scientific Name	Present in Project Area[b]
Fish	Atlantic salmon	*Salmo salar*	No
Fish	Brook Trout	*Salvelinus fontinalis*	No
Fish	Northern pike	*Esox Lucius*	Yes
Fish	Oscar	*Astronotus ocellatus*	No
Fish	Yellow perch	*Perca flavescens*	Yes
Crustacean	Chinese mitten crab	*Eriocheir sinensis*	No
Crustacean	Green crab	*Carcinus maenas*	No
Crustacean	Signal crayfish	*Pacifastacus leniusculus*	No

TABLE 3.2.5-1

Alaska ANS Plan High Priority Threat Species[a]

Type	Common Name	Scientific Name	Present in Project Area[b]
Mollusks	New Zealand mudsnail	*Potamopyrgus antipodarum*	No
Mollusks	Zebra mussel	*Dreissema polymorpha*	No

Notes:
[a] Based on Appendix I of the ADF&G Aquatic Nuisance Species Management Plan (ADF&G, 2002)
[b] Based on query of USGS NAS mapped occurrences: http://nas.er.usgs.gov/queries/SpSimpleSearch.aspx (USGS, 2013)

In addition to the state program, the USGS also established a database to track and record the presence of Nonindigenous Aquatic Species (NAS) throughout the U.S. to support the efforts of the federal ANSTF. The species listed in Table 3.2.5-2 are identified as having some presence in Alaska, which may or may not include presence in the Project area. Some of these species occur naturally within portions of the Project area, but they may have been legally [stocked] or illegally introduced into portions of the Project area where they did not naturally occur.

TABLE 3.2.5-2

USGS Nonindigenous Aquatic Species in Alaska[a]

Type	Common Name	Scientific Name	Present in Project Area[b]
Amphibian	Northern Pacific Treefrog	*Pseudacris regilla*	No
Amphibian	Northern Red-legged Frog	*Rana aurora*	No
Amphibian	Rough-skinned Newt	*Taricha granulosa*	No
Crustacean	Signal crayfish	*Pacifastacus leniusculus*	No
Crustacean	Red swamp crayfish	*Procambarus clarkii*	Yes (Kenai Peninsula)
Fish	Unidentified pacu	*Colossoma or Piaractus sp.*	No
Fish	Oscar	*Astronotus ocellatus*	No
Fish	American Shad	*Alosa sapidissima*	Yes (Cook Inlet)
Fish	Goldfish	*Carassius auratus*	No
Fish	Northern pike	*Esox Lucius*	Yes (Cook Inlet)
Fish	Yellow perch	*Perca flavescens*	Yes (Kenai Peninsula)
Fish	Western mosquitofish	*Gambusia affinis*	No
Fish	Rainbow trout	*Oncorhynchus mykiss*	Yes (Interior)
Fish	Atlantic salmon	*Salmo salar*	Yes (Cook Inlet)
Fish	Brook trout	*Salvelinus fontinalis*	No
Fish	Arctic grayling	*Thymallus arcticus*	Yes (Kenai Peninsula)
Fish	Alaska blackfish	*Dallia pectoralis*	No

Notes:
[a] Based on query of USGS website for Alaska: http://nas.er.usgs.gov/queries/SpeciesList.aspx?Group=&Sortby=1&state=AK
[b] Based on query of USGS NAS mapped occurrences: http://nas.er.usgs.gov/queries/SpSimpleSearch.aspx (USGS, 2013)

3.2.5.1 Liquefaction Facility

The most notable ANS near the Liquefaction Facility on the northern Kenai Peninsula is northern pike, which was illegally introduced into Derks Lake, a tributary to Soldotna Creek in the 1970s, and has spread through Soldotna Creek drainage, including East and West Mackey Lakes; Soldotna Creek; and Soldotna (Sevena) Lake and Stormy Lake in the Swanson River drainage (Begich and Pawluk, 2011). Northern pike also use the Kenai River as a migration corridor (Begich and Pawluk, 2011). Introduced northern pike are thought to be a leading cause in the decline of rainbow trout and Dolly Varden in Soldotna Lake (Begich and Pawluk, 2011). ADF&G has used sport fishing, including spear fisheries, gill-net removal, and rotenone poisoning, to remove northern pike from specific waters on the northern Kenai Peninsula (Begich and Pawluk, 2011).

Yellow perch were illegally introduced into a 14-acre lake on the northern Kenai Peninsula more than 3 miles northeast of the Liquefaction Facility off Bastien Drive (Table 3.2.5-1). This introduction resulted in an established population of yellow perch in the lake which was eradicated with rotenone in 2000 (ADF&G, 2014f).

3.2.5.2 Interdependent Facilities

The most notable ANS in the Project area is northern pike, which was introduced into the Susitna River drainage in the 1950s, and has spread into 70 drainages and over 100 lakes within the Susitna basin (Rutz, 1999; Sepulveda et al., 2013). Introduced northern pike are thought to be a leading cause in the decline of salmonid species in the lower Susitna drainage and have drastically reduced the number of returning Chinook salmon adults and distribution of spawning in Alexander Creek. Pike were introduced to Alexander Lake in the late 1960s, although no harvest record of pike prior to 1985 exists (Mills, 1986). Today, pike are widespread throughout the system. Pike are hypothesized to be primary drivers of declines in multiple fish species beginning in the late 1990s including Chinook, coho, chum and sockeye salmon, rainbow trout, and arctic grayling (Rutz, 1999).

3.2.6 Marine Fisheries

The Alaskan coastline is highly irregular, composed of a variety of sheltered coves, bays, exposed river deltas, and mudflats. In general, the rivers that run through the low-lying coastal areas are braided and can form depositional deltas that extend into the open ocean (NOAA, 2010). The northern Alaskan coast is also protected by several barrier islands located at various distances off shore.

3.2.6.1 Liquefaction Facility

The Liquefaction Facility is located along Upper Cook Inlet. Within Cook Inlet there are numerous protected marsh bays located along the rocky shoreline. Due to its proximity to Anchorage and abundance of charismatic species, Cook Inlet is highly utilized for recreational fishing. Marine fisheries within Cook Inlet include flatfish such as halibut, flounder, and sole; rockfish; pollock, and some members of the cod family; and others. Some marine species that are normally found in deep water as adults move into shallower water to spawn.

The marine fish discussed below are some of the species that have been reported from Upper Cook Inlet, or are species that have been considered as prey for Cook Inlet beluga whales.

Pacific Cod

Pacific cod (*Gadus microcephalus*) in the eastern Pacific Ocean are found from central California to the Bering Sea with unconfirmed reports to the Chukchi Sea. Pacific cod are distributed throughout Southcentral Alaska and are found primarily in benthic habitats in water depths ranging from 15 to 550 meters (49 to 1,804 feet). Pacific cod was one of the most abundant species captured during sampling in Kachemak Bay (Abookire et al., 2001). Pacific cod feed on other fish including walleye pollock (*Theragra chalcogramma*), flatfishes, Pacific sandlance, and Pacific herring, as well as on crabs and shrimp. They may reach 120 cm in length but the average length in trawl catches is 70 to 75 cm (27.5 to 29.5 inches; Mecklenburg et al., 2002). Pacific cod usually spawn in relatively deep water during the winter and move to shallower waters to feed. Males become sexually mature at age-2 and females at age-3. Breeding occurs annually and fecundity increases with increasing size of female fish. Eggs develop on the ocean floor and development is affected by temperature. Optimal temperatures for egg development are around 3.5 to 4 degrees Celsius (38.3 to 39.2°F). Larvae are moved by ocean currents and have been found in Cook Inlet from May to July. Larvae feed on copepods and other plankton. Young Pacific cod are often found in shallow coastal waters and move to deeper water with age. Pacific cod were not reported from tow net sampling in northern Cook Inlet during 1993 (Moulton, 1997), nor from sampling by beach seine and tow net during 2004-2005 studies in Knik Arm (Houghton et al., 2005a, b).

Sculpins

Sculpins (family Cottidae) spawn in the winter, and some species have internal fertilization. Eggs are typically laid in rocks, where they are guarded by males. Larvae often have diel migration (near the surface at night) and may be present year-round. Juveniles are abundant nearshore and gradually move offshore as they grow. Studies in Knik Arm caught only Pacific staghorn sculpin (*Leptocottus armatus*) (Houghton et al., 2005a, b). Staghorn sculpin are a euryhaline species that is common in the nearshore region and ascends the lower reaches of river deltas (Hart, 1973). They typically co-occur with starry flounder.

Starry Flounder

Starry flounder (*Platichthys stellatus*) occur from the Beaufort and Chukchi seas to southern California and Korea. Starry flounder reach a length of 91 cm (36 inches) and a weight of 9.1 kilograms (20 pounds). They are found on soft bottoms from intertidal areas to a depth of 375 meters (1,230 feet), but are usually found in areas of less than 100 meters (328 feet). In nearshore areas, they are found in estuaries and up rivers to the limit of tidal influence, as well as in marshes and coastal lakes (Mecklenburg et al., 2002). Starry flounder have been reported in small numbers in Knik Arm (Houghton et al., 2005a, b), Upper Cook Inlet (Moulton, 1997), and the Chisik Island area of Lower Cook Inlet (Fechhelm et al., 1999; Robards et al., 1999).

Walleye Pollock

Walleye pollock is an abundant species in the Bering Sea and the Gulf of Alaska, and is also found in Cook Inlet. Pollock range from the Chukchi Sea south through the Bering Sea and Pacific Ocean to central California and Japan. Pollock reach 91 cm (36 inches) in length and are an important species in commercial fisheries. Walleye pollock are demersal and may occur at depths to 950 meters (3,117 feet), but are also pelagic and occur in schools near the surface and in mid-water habitats (Mecklenburg et al., 2002). Small pollock feed on copepods and other zooplankton and larger pollock feed on fish. Although

walleye pollock is grouped with groundfish, young pollock are the dominant forage fish consumed by larger fish, including adult pollock, and many marine bird and mammal species (Schumacher et al., 2003). Walleye pollock consistently spawn in the Shelikof Strait area and were the second most abundant groundfish species captured during small-mesh trawl sampling in Kachemak Bay in 2000 (Gustafson and Bechtol, 2005). Walleye pollock are scarce in the upper portions of Cook Inlet.

3.2.6.2 Interdependent Facilities

Prudhoe Bay is located at the Project's northern terminus and consists of largely open bays with limited barrier island protection. Prudhoe Bay abuts the Beaufort Sea, which is nominally covered by ice for approximately 9 months of the year between late summer and the following July. During the summer months, ice on the Beaufort Sea will retreat from 10 kilometers to 100 kilometers offshore (NOAA, 2010). Due to the combination of meltwater from the sea ice and overland flow from the rivers, a stratified water column can develop with more saline waters below a layer of fresher water. As summer progresses, the waters can become less stratified and more well mixed, returning to marine conditions (URS, 1999). Although gravel makes up the substrate around the bases of several of the barrier islands, the overlying sediment covering most of Prudhoe Bay and nearby coastal waters consists primarily of fine silt and fine sand (Busdosh et al., 1985).

Fish populations of the nearshore region of the Beaufort Sea provide an important subsistence resource for local residents (Craig, 1989) and support commercial and sport harvests (Bureau of Land Management [BLM], 1998, 2004, 2014; Howe et al., 1998). Fish populations near existing and planned developments related to oil exploration and extraction, and the effects of these developments on fishes and fish habitat, have been extensively investigated since the mid-1970s. Summaries of those studies are included in reviews and other documents, including USACE (1980, 1984), ARCO Alaska et al. (1997), BLM (1998), Truett and Johnson (2000), Logerwell et al. (2010), Williams and Burril (2011), and Fechhelm et al. (2011).

Marine species commonly encountered include arctic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), arctic flounder (*Pleuronectes glacialis*), and fourhorn sculpin (*Myoxocephalus quadricornis*) (Fechhelm et al., 2011). Anadromous fish commonly occurring in the Beaufort Sea in the vicinity of oil production areas include Dolly Varden, arctic cisco, least cisco, humpback whitefish, broad whitefish, and rainbow smelt. Although these anadromous species occur in the Beaufort Sea, they can include both anadromous and freshwater populations.

The marine fish discussed below are some of the species that are expected to occur in the Project area.

Arctic Cod

As summarized in Fechhelm et al. (2011), arctic cod have a circumpolar distribution and are ubiquitous in marine waters throughout the Beaufort Sea. Arctic cod are an important food item in the diets of marine mammals, birds, and fish, and are considered to be a primary component of the arctic marine food chain. Arctic cod is one of the most abundant fish species collected in coastal waters and is typically associated with highly productive transition layers that separate cold marine bottom water and warm brackish surface water. The onshore movement of such layers is an important factor in coastal aggregations of fish. Arctic cod do not actively move into freshwater or low-salinity habitats. The movement of large schools into coastal areas can be dramatic and can be either short-lived or sustained. The occurrence of arctic cod schools in any particular area is both unpredictable and ephemeral.

Saffron Cod

Saffron cod are found in brackish and marine waters of the Beaufort Sea east to Bathurst Inlet in Canada (Fechhelm et al., 2011). They frequently enter rivers and may go considerable distances upstream. Saffron cod may be found both nearshore and offshore during summer. Saffron cod have been reported from studies throughout the Beaufort Sea, but it is the least abundant of the marine species that move shore during summer. Saffron cod have been reported from studies throughout the Beaufort Sea, but it is the least abundant of the marine species that are regularly caught by fyke nets in the Prudhoe Bay region during summer.

Arctic Flounder

Arctic flounder are typically found in shallow coastal waters during summer and are circumpolar in distribution (Fechhelm et al., 2011). They are not found offshore and they often move upriver. They are common and widely distributed along the Beaufort Sea coast during summer. Arctic flounder catch rates increased in 1990s from levels reported in the 1980s and remained elevated through the 2010s, contributing about 9 percent of the catch during 2011 fyke net sampling (Fechhelm et al., 2011).

Arctic Cisco

Nearly all of the studies conducted in the Beaufort Sea nearshore zone in the summer found substantial numbers of large arctic cisco present (Craig and Mann, 1974; Griffiths et al., 1975, 1977; West and Wiswar, 1985; Wiswar and West, 1987; Griffiths, 1983; Fruge et al., 1989; Underwood et al., 1995). Arctic ciscos found in the Alaskan Beaufort Sea originate from spawning grounds in the Mackenzie River system of Canada (Gallaway et al., 1983, 1989). In the spring, newly hatched young-of-the-year (age-0) are flushed downriver into ice-free coastal waters adjacent to the Mackenzie Delta. Some young-of-the-year are transported west to Alaska by wind-driven coastal currents (Gallaway et al., 1983; Fechhelm and Fissel, 1988; Moulton, 1989; Fechhelm and Griffiths, 1990; Schmidt et al., 1991; Underwood et al., 1995; Colonell and Gallaway, 1997). In summers with strong and persistent eastern winds, enhanced westward transport can carry fish to the Colville River, where they take up winter residence. They continue to winter within the Colville River until the onset of sexual maturity at about age 7, at which point they migrate back to the Mackenzie River to spawn (Gallaway et al., 1983).

The meteorologically driven recruitment process plays a major role in determining the age structure of Arctic cisco populations in Alaska. Summers with strong, persistent eastern winds are associated with strong year classes in the Colville/Sagavanirktok region (Cannon et al., 1987; Moulton, 1989; Glass et al., 1990; Reub et al., 1991; LGL Alaska, 1992, 1994a; Griffiths et al., 1996). These year classes maintain a presence in the region that can be tracked as fish grow to ages harvested by the commercial and subsistence fisheries operating in the Colville River (Moulton et al., 1992; Moulton and Field, 1988, 1991, 1994; Moulton, 1994, 1995).

Dolly Varden

Dolly Varden are discussed above, under anadromous fish. Dolly Varden migrate considerable distances along the coast during summer, where extensive alongshore and open-water migrations have been reported, suggesting that they may be tolerant of marine water conditions (Fechhelm et al., 2011). They have been taken as far as 15 km offshore in the Alaskan Beaufort Sea. There is dietary evidence that Dolly Varden may feed offshore among ice floes in mid and late summer (Fechhelm et al., 2011).

Fourhorn Sculpin

Fourhorn sculpin are circumpolar in distribution in brackish and moderately saline waters (Fechhelm et al., 2011). They are one of the most common fish in coastal waters of the Beaufort Sea during summer, moving offshore to overwinter when nearshore shallow waters freeze in the fall. They spawn in mid-winter, are not found far offshore. When coastal ice dissipates in the spring they move back into coastal waters and may travel considerable distances up river (Fechhelm et al., 2011).

Least Cisco

Least cisco have both migratory and freshwater resident populations on the Arctic Coastal Plain. Migratory populations have a discontinuous distribution in the coastal Beaufort Sea (Craig and McCart, 1974; Craig, 1984, 1989). Western populations are associated with the Colville River and smaller rivers to the west, while eastern populations are associated mainly with the Mackenzie River. The large distance between these freshwater systems apparently isolates the migratory populations from each other.

The eastward dispersal of juvenile least cisco during summer appears to be a function of wind-driven coastal currents (Fechhelm et al., 1994). Western winds in early summer (primarily July) create easterly flowing currents in Simpson Lagoon that enhance the eastward dispersal of small fish. In summers of substantial western winds (about 1 out of every 2 years), large numbers of juvenile least cisco are collected in the Prudhoe Bay/Sagavanirktok Delta region (Griffiths et al., 1983; Moulton et al., 1986; LGL Alaska, 1992, 1993). In years lacking substantial July western wind events, few small least cisco reach the eastern end of Simpson Lagoon (Cannon et al., 1987; Glass et al., 1990; Reub et al., 1991; Fechhelm et al., 1994; LGL Alaska, 1994b; Griffiths et al., 1996).

Rainbow Smelt

Rainbow smelt are an anadromous pelagic fish found throughout the Beaufort Sea. They spawn in spring, and are known to spawn in the Colville and Chipp rivers (Fechhelm et al., 2011; Moulton et al., 2011). As with arctic flounder, catch rates for rainbow smelt increased in the 1990s, but rainbow smelt catch rates gradually declined back to 1980s levels by the end of the decade (Fechhelm et al., 2011). They contributed approximately 1 percent of the catch during 2011 fyke net sampling (Fechhelm et al., 2011).

Whitefish

As with least cisco, anadromous broad whitefish and humpback whitefish have two population centers in the Beaufort Sea region, the Colville River and westward, and the Mackenzie River drainage. Unlike the situation with least cisco and Arctic cisco, however, the Sagavanirktok River supports a spawning and overwintering population of broad whitefish. Humpback whitefish do not spawn or overwinter in the Sagavanirktok River drainage (Fechhelm et al., 2011). Like broad whitefish, humpback whitefish are intolerant of high salinities and remain in brackish nearshore waters and river deltas throughout summer (Fechhelm et al., 2011).

Broad whitefish use a variety of habitats throughout their life cycle. Spawning occurs in deep portions of large rivers in fall. In the Mackenzie River, they spawn in the lower river, just upstream of the marine influence. The anadromous population in the Colville River appears to show a similar pattern, with spawning in the main river upstream of the delta. Bendock and Burr (1986) identified a pre-spawning

migration in August, but did not know if the fish were freshwater residents or part of the anadromous population.

During spring flood, subadult broad whitefish enter a variety of available habitats, including seasonally flooded lakes, lakes connected to stream systems, river channels, and coastal areas. Fish using perched lakes remain in the lake until they reach maturity, and then return to the river in the spring of the year they will spawn. Broad whitefish that do not enter perched lakes either enter the coastal region and adjacent small drainages to feed, thus assuming an anadromous pattern, or remain in the river system and feed in low-velocity channels, tapped lakes, or drainage lakes. In fall, they leave the shallow feeding areas and return to deep wintering areas in the main river or in lakes. Maturity is first reached at age 9, with most maturing at age 10 to 12 (Bendock and Burr, 1984, 1986).

3.2.7 Essential Fish Habitat

The 1996 Sustainable Fisheries Act reauthorized the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq.) (Magnuson-Stevens Act). The Sustainable Fisheries Act introduced new requirements for the description and identification of Essential Fish Habitat (EFH) in fishery management plans, minimizing adverse impacts on EFH, and proposing actions to conserve and enhance EFH. EFH guidelines were set forth by the NMFS to help Fisheries Management Councils fulfill requirements of the Magnuson-Stevens Act. Consultation between federal permitting or action agencies and NMFS Habitat Conservation Division is required by the Magnuson-Stevens Act when an action may adversely affect designated EFH. The Magnuson-Stevens Act also requires that the federal permitting or action agency respond to comments made by NMFS.

EFH is defined as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (50 C.F.R. Part 600). For the purposes of this definition, "waters" means aquatic areas and their associated physical, chemical, and biological properties; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and healthy ecosystem; and "spawning, feeding, and breeding" is meant to encompass the complete life cycle of a species (50 C.F.R. Part 600).

EFH is designated based on best available scientific information (NMFS, 2005). Information levels used to describe the level of understanding are defined by the Magnuson-Stevens Act: Level 1 corresponds to distribution; Level 2 to density or relative abundance; Level 3 to growth, reproduction, or survival rates; and Level 4 to production rates (NMFS, 2005). Arctic cod EFH is designated based on Level 1 information for only adults and late juveniles; insufficient information is available to designate EFH for eggs, larvae, and early juveniles (NPFMC, 2009). Pacific salmon EFH in Alaska is designated based on Level 1 information for all species and life stages (NMFS, 2005).

Freshwater and Marine EFH potentially occurring in the Project area is provided in Table 3.2.7-1 and Table 3.2.7-2, respectively.

TABLE 3.2.7-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
LIQUEFACTION FACILITY				
LNG Plant	None	NA	NA	
Marine Terminal	None	NA	NA	
PIPELINES				
Mainline	Bettles River	334-40-11000-2125-3912-4260	CHUMp	
	Middle Fork Koyukuk River	334-40-11000-2125-3912	CHUMp, CHINp	
	Middle Fork Koyukuk River	334-40-11000-2125-3912	CHUMp, CHINp	
	Minnie Creek	334-40-11000-2125-3912-4128	CHINr	
	Marion Creek	334-40-11000-2125-3912-4112	CHUMs; CHINr	
	Slate Creek	334-40-11000-2125-3912-4100	CHUMp; CHINp	
	No Name	334-40-11000-2125-3912-4076	CHINr	
	South Fork Koyukuk River	334-40-11000-2125-3740	CHUMp; CHINp; COHOp	
	Jim River	334-40-11000-2125-3740-4080	CHUMs; CHINs; COHOp	
	Douglas Creek	334-40-11000-2125-3740-4080-5062	CHINr	
	Prospect Creek	334-40-11000-2125-3740-4080-5030	CHINs,r	
	Yukon River	334-40-11000	CHUMp, CHINp; COHOp; PINKp; SOCKp	
	Hess Creek		CHUM	
	Chatanika River	334-40-11000-2490-3151-4020	CHUMp; CHINp; COHOp	
	Tanana River	334-40-11000-2490	CHINp; CHUMp;COHOp	
	Nenana River	334-40-11000-2490-3200	CHINp; CHUMp; COHOp	
	Nenana River	334-40-11000-2490-3200	CHINp; CHUMp; COHOp	
	Trib to June Creek	334-40-11000-2490-3200-4220-5005-6016	CHUMs, COHOs	
	June Creek	334-40-11000-2490-3200-4220-5005	CHUMs, COHOs	
	Panguingue Creek	334-40-11000-2490-3200-4075	COHOs, r	
	Chulitna River	247-41-10200-2381	CHINp; SOCKp; CHUMs; COHOp; PINKp	

TABLE 3.2.7-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
	East Fork Chulitna River	247-41-10200-2381-3260	CHINs; COHOp; SOCKp	
	Honolulu Creek	247-41-10200-2381-3240	CHINs; COHOp, r	
	Pass Creek	247-41-10200-2381-3236	CHINp; SOCKp; CHUMp; COHOp; PINKp	
	Horseshoe Creek	247-41-10200-2381-3220	CHINp; SOCKp; CHUMp; COHOp; PINKp	
	Byers Creek	247-41-10200-2381-3180	CHINs; SOCKp; CHUMs; COHOs	
	Troublesome Creek	247-41-10200-2381-3130	CHINs; PINKs; CHUMs; COHOs	
	Chulitna River	247-41-10200-2381	CHINp; SOCKp; CHUMs; COHOp; PINKp	
	Trib Chulitna River	247-41-10200-2381-3060	COHOp	
	Trib Chulitna River	247-41-10200-2381-3051	COHOp	
	Trib Chulitna River	247-41-10200-2381-3007	COHOp	
	Trib Chulitna River	247-41-10200-2381-3007-4029	COHOp	
	Trib Chulitna River	247-41-10200-2381-3007-4017	COHOp	
	Trapper Creek	247-41-10200-2341	CHINr; COHOs, r	
	Trib to Rabideux Creek	247-41-10200-2291-3049	COHOs, r	
	Sawmill Creek	247-41-10200-2291-3041	COHOs, r	
	Trib to Sawmill Creek	247-41-10200-2291-3041-4002	COHOp	
	Queer Creek	247-41-10200-2291-3011	COHOr	
	Trib to Kroto Creek	247-41-10200-2081-3030	COHOp	
	Deshka River/Kroto Creek	247-41-10200-2081	CHINp,r; SOCKp,r; CHUMs; COHOs,r; PINKp	
	Fish Creek	247-41-10200-2053-3020-4015	CHINp,r; COHOr; SOCKp	
	Yentna River	247-41-10200-2053	CHINp,r; SOCKp,r; CHUMs; COHOs,r; PINKp	
	Anderson Creek	247-41-10200-2043	COHOp; PINKp	
	Alexander Creek	247-41-10200-2015	CHINp; SOCKp; CHUMp; COHOr; PINKp	
	Granite Creek	247-41-10200-2015-3017	COHOs,r; SOCKr	
	Lewis River	247-30-10070	CHINs,r; COHOr; PINKp	
	Theodore River	247-30-10080	CHINs,r; CHUMp; COHOr; PINKp	
	Pretty Creek	247-30-10090-2010	CHINr; COHOr; PINKs;	

TABLE 3.2.7-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
			SOCKr	
	Trib to Pretty Creek	247-30-10090-2010-3015	CHINs,r; COHOp; PINKs; SOCKp	
	Trib to Pretty Creek	247-30-10090-2010-3015-4015	CHINp; COHOp; PINKs; SOCKp	
	Olson Creek	247-30-10090-2020	CHINs,r; COHOs,r; PINKp	
	Beluga River	247-30-10090	CHINp,r; COHOp,r; PINKp; SOCKp,r	
	Threemile Creek	247-20-10002	CHINp,r; CHUMp; COHOs,r; PINKs; SOCKp	
PTTL	Shaviovik River	330-00-10310	PINKs	
	Sagavanirktok River	330-00-10360	CHUMp; PINKs	
	West Channel Sagavanirktok River	330-00-10361	CHUMp; PINKp	
PBTL	TBD			
PIPELINE ABOVEGROUND FACILITIES				
Compressor Stations	TBD			
Heater Stations	TBD			
PTU Meter Station	TBD			
Prudhoe Bay Meter Station	TBD			
Mainline Meter Station	TBD			
LNG Terminal Meter Station	TBD			
MLBVs (not on Compressor sites)	TBD			
PIPELINE ASSOCIATED INFRASTRUCTURE				
Access roads	TBD			
ATWS	TBD			
Contractor yards	TBD			
Pipe yards	TBD			
Construction camps	TBD			
Disposal sites	TBD			
Material sites	TBD			
GTP				
GTP	None	NA	NA	
ASSOCIATED GTP INFRASTRUCTURE				
Module Staging	None	NA	NA	

TABLE 3.2.7-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
Area				
Offshore West Dock	None	NA	NA	
Access Roads	None	NA	NA	
Construction Camp	None	NA	NA	
Material Sites	None	NA	NA	
Water Reservoir, Pump Facilities, Transfer Line	None	NA	NA	

Notes: Several waterbodies are identified by a proper name and others that share a proper name with a different waterbody; therefore, the Alaska anadromous Catalog and Atlas number have been included in the table. NA = Not Applicable

Species Codes:

CHIN – Chinook salmon	PINK – Pink salmon		
CHUM – Chum salmon	SOCK – Sockeye salmon		
COHO – Coho salmon			
Life-stage Codes:	m-migration	p-present	r-rearing
	s-spawning		
Source Codes:			
1 – Alaska LNG Project survey data	2 – ADF&G Anadromous Waters Catalog (ADF&G, 2014a-c)		

OC - Open-cut conventional method; HDD - Horizontal directional drill; ISOLATED - Isolated open-cut method; AERIAL - Aerial crossing method

TABLE 3.2.7-2

Marine Essential Fish Habitat Occurring in the Project Area

Facility/Milepost	Waterbody Name	Fisheries Management Plan	Fishes	Potential Source / Season
LIQUEFACTION FACILITY				
LNG Plant	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[1] – marine stages Groundfish[2]; Forage fish[3]	Marine Discharge Potential for Spills/year-round
Marine Terminal	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[1] – marine stages; Groundfish[2]; Forage fish[3]	Habitat modification Potential for Spills Ballast Water/year-round
PIPELINES				
PBTL	NA	NA	NA	NA
PTTL	NA	NA	NA	NA
Mainline	Cook Inlet	Alaska EEZ Salmon FMP;	Salmon[1] – marine stages; Groundfish[2]; Forage fish[3] –	HDD, In-water construction / TBD

TABLE 3.2.7-2

Marine Essential Fish Habitat Occurring in the Project Area

Facility/Milepost	Waterbody Name	Fisheries Management Plan	Fishes	Potential Source / Season
		Gulf of Alaska Groundfish FMP	egg larvae	
PIPELINE ABOVEGROUND FACILITIES				
Compressor Stations	NA	NA	NA	NA
Heater Stations	NA	NA	NA	NA
PTU Meter Station	NA	NA	NA	NA
Prudhoe Bay Meter Station	NA	NA	NA	NA
Mainline Meter Station	NA	NA	NA	NA
LNG Terminal Meter Station	NA	NA	NA	NA
MLBVs (not on Compressor sites)	NA	NA	NA	NA
PIPELINE ASSOCIATED INFRASTRUCTURE				
Access roads	NA	NA	NA	NA
ATWS	NA	NA	NA	NA
Contractor yards	NA	NA	NA	NA
Pipe yards	NA	NA	NA	NA
Construction camps	NA	NA	NA	NA
Disposal sites	NA	NA	NA	NA
Material sites	NA	NA	NA	NA
GTP				
GTP	NA	NA	NA	NA
ASSOCIATED GTP INFRASTRUCTURE				
Offshore West Dock Dredging	Beaufort Sea	Arctic FMP Alaska EEZ Salmon FMP	Arctic cod, saffron cod Salmon[1] – marine stages	Offshore West Dock Modifications / TBD
Module Staging Area	NA	NA	NA	NA
Access Roads	NA	NA	NA	NA
Construction Camp	NA	NA	NA	NA
Material Sites	NA	NA	NA	NA
Water Reservoir, Pump Facilities, Transfer Line	NA	NA	NA	NA

[1] **Alaska EEZ Salmon FMP**	[2] **GOA Groundfish FMP**		[3] **Forage Fish Complex**
Chinook Salmon	Walleye Pollock	Dusky Rockfish	Osmeridae (smelt)
Chum Salmon	Pacific Cod	Thornyhead Rockfish	Myctophidae (lanterfish)
Coho Salmon	Sablefish	Atka Mackerel	Bathylagidae (deep-sea smelt)
Pink Salmon	Yellowfin Sole	Squids	Ammodytidae (sand lance)
Sockeye Salmon	Arrowtooth Flounder	Sculpins	Trichodontidae (sand fish)
	Northern Rock Sole	Skates	Pholidae (gunnels)
	Alaska Plaice	Sharks	Stichaeidae (pricklebacks)
	Rex Sole	Octopuses	Gonostomatidae (bristlemouths)

TABLE 3.2.7-2

Marine Essential Fish Habitat Occurring in the Project Area

Facility/Milepost	Waterbody Name	Fisheries Management Plan	Fishes	Potential Source / Season
		Dover Sole	Southern Rock Sole	Euphausiacea (krill)
		Flathead Sole	Yelloweye Rockfish	
		Pacific Ocean Perch		
		Northern Rockfish		
		Shortraker Rockfish		
		Blackspotted / Rougheye Rockfish		

Sources: RR1; NPFMC, 2009, 2014; NPFMC et al., 2012

3.2.7.1 Liquefaction Facility

EFH consultation for the Cook Inlet region is expected to focus on species managed under the:

- Fisheries Management Plan (FMP) for the Salmon Fisheries in the EEZ off the Coast of Alaska (Salmon FMP); and
- FMP for Groundfish of the Gulf of Alaska.

No designated Habitat Areas of Particular Concern (HAPC's) are located in the Project area.

Salmon FMP

Salmon populations within the Project area are all in the West Management Area, which is the area of the U.S. Exclusive Economic Zone west of Cape Suckling in the Gulf of Alaska to Demarcation Point in the Beaufort Sea, with the exception of three excluded areas in northern Gulf of Alaska. Pacific salmon EFH in Alaska is designated based on Level 1 information (NMFS, 2005). The Salmon FMP (NPFMC et al., 2012) identifies EFH for each species' life stage and in most cases is based on either the general distribution of the life stage, or the general distribution of the life stage in waters identified by the ADF&G Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (ADF&G, 2014a, b, c).

Pacific salmon are anticipated to be the species of interest near the Liquefaction Facility and any fishery based on these species could potentially be affected by Project activities. Mitigation aimed at avoiding or reducing impacts to salmon will likely be beneficial to other marine species in the area.

Groundfish FMP

Marine species expected to occur in the Project area include forage fish species, such as walleye pollock, saffron cod, Pacific herring, eulachon, longfin smelt, capelin, Pacific sandfish (*Trichodon trichodon*), Pacific sandlance, snake prickleback (*Lumpenus sagitta*), Pacific staghorn sculpin, and starry flounder (Moulton, 1997; Houghton et al., 2005a, b). Of these species, pollock and flounder are considered target species of the FMP for Groundfish of the Gulf of Alaska (NPFMC, 2014).

3.2.7.2 Interdependent Facilities

EFH consultation for the Interdependent Facilities located in the Prudhoe Bay and Beaufort Sea region is expected to focus on species of the:

- FMP for the Fish Resources of the Arctic Management Area; and
- Salmon FMP.

No HAPC's are located in the Project area.

FMP for the Fish Resources of the Arctic Management Area

The FMP for the Fish Resources of the Arctic Management Area (NPFMC, 2009; 74 C.F.R. 56734) manages three target species: (1) arctic cod, (2) saffron cod (*Eleginus gracilis*), and (3) snow crab (*Chionoecetes opilio*). Of these three target species, snow crab are more associated with deep water (Logerwell et al., 2010), and are not expected to be found within the Project area. Arctic cod EFH is designated based on Level 1 information for only adults and late juveniles; insufficient information is available to designate EFH for eggs, larvae, and early juveniles (NPFMC, 2009).

The general summer distribution of saffron cod and arctic cod extends across Prudhoe Bay into the Point Thomson portion of the Project area, with saffron cod and arctic cod being documented in summer study programs within the area (NMFS, 2005; Williams and Burril, 2011). During winter, arctic cod are the primary species in the Prudhoe Bay region, although in low densities (Tarbox and Thorne, 1979).

Salmon FMP

The Salmon FMP, discussed above in Section 3.2.7.1 includes the Beaufort Sea. The general summer distribution of all five species of Pacific salmon extends across Prudhoe Bay into the Point Thomson portion of the Project area, with pink and chum salmon being documented in summer study programs within the area (NMFS, 2005; Williams and Burril, 2011).

Within the Project area, freshwater EFH consultation is anticipated to be primarily focused on the five species of Pacific salmon, which are covered under the Salmon FMP (NPFMC et al., 2012).

3.2.8 Potential Construction Impacts and Mitigation Measures

A general summary of potential impacts to fisheries resources from construction of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report will identify site-specific impacts to fisheries resources crossed by the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed plans and measures, including any site-specific measures.

3.2.9 Potential Operational Impacts and Mitigation Measures

A general summary of potential impacts to fisheries resources from operation of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as

examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report will identify site-specific impacts to fisheries resources crossed, or in the vicinity of, the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed mitigation measures, including site-specific measures.

3.3 VEGETATION

This section describes the various ecoregions and terrestrial vegetation communities associated with the Project components, including the Liquefaction Facility, approximately 800 miles of underground pipeline, and the GTP. Many vegetation communities are widely distributed throughout the Project areas and within the Project corridor. Because changes in biotic conditions across the project are reflected and previously described based on ecoregions, this discussion is organized by ecoregions. Where possible, specific vegetation resources associated with the Liquefaction Facility and Interdependent Facilities are described.

3.3.1 General Description of Vegetation Resources

The Project crosses a diverse array of vegetation communities extending from the Arctic Coastal Plain across Interior Alaska to the Cook Inlet Basin in Southcentral Alaska (see Appendix B). The description of vegetation communities within the Project area follows ecoregions based on a unified interagency effort to delineate ecoregion boundaries in Alaska (Nowacki et al., 2001) (Figure 3.3.1-1). The Project will cross the primary ecoregions: Arctic Tundra, Intermontane Boreal, and Alaska Range Transition. Within the Arctic Tundra Ecoregion the Project crosses three subregions: Beaufort Coastal Plain (Arctic Coastal Plain), Brooks Foothills, and Brooks Range. Within the Intermontane Boreal Ecoregion the Project crosses four subregions: Kobuk Ridges and Valleys, Ray Mountains, Yukon-Tanana Uplands, and Tanana-Kuskokwim Lowlands. Within the Alaska Range Transition Ecoregion the Project crosses two subregions: Alaska Range and Cook Inlet Basin. The U.S. Environmental Protection Agency (EPA) Level III Ecoregions for Alaska (EPA, 2010) have generally similar boundaries as the Nowacki et al. (2001) subregions and are based on Gallant et al. (1995).

3.3.1.1 Liquefaction Facility

The Liquefaction Facility is located in the Cook Inlet Basin Ecoregion. A description of the terrain and vegetation communities within this ecoregion is provided below.

Cook Inlet Basin

Located in the Southcentral part of Alaska adjacent to the Cook Inlet, the ecoregion has one of the mildest climates in the state. The climate, the level to rolling topography and the coast proximity have attracted most of the settlement and development in Alaska. The region has a variety of vegetation communities but is dominated by stands of spruce and hardwood trees. The area is generally free from permafrost. Unlike many of the other non-montane ecoregions, the Cook Inlet Basin Ecoregion was intensely glaciated.

A variety of vegetation communities occur within the Cook Inlet Basin Ecoregion, including needleleaf, broadleaf, and mixed forests, which are the most widespread. Tall scrub communities form thickets on floodplains, along streambanks, and in drainageways. The wettest areas are colonized by tall scrub swamp, low scrub bog, and wet herbaceous vegetation (Gallant et al., 1995).

The needleleaf forests within the Cook Inlet Basin Ecoregion are dominated by white spruce (*Picea glauca*), black spruce (*Picea mariana*), and Sitka spruce (*Picea sitchensis*). Broadleaf forests are dominated by quaking aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), black cottonwood (*Populus trichocarpa*), and paper birch (*Betula papyrifera*). The mixed forest areas are codominated by both needleleaf and broadleaf species.

Floodplains and active alluvial areas support relatively pure or mixed stands of Sitka spruce, black cottonwood, balsam poplar, and paper birch. Lower shrub typically include prickly rose (*Rosa acicularis*), highbush-cranberry (*Viburnum edule*), and devilsclub (*Oplopanax horridus*). Tall scrub swamps are dominated by alder (*Alnus* spp.) or a combination of alder and willow (*Salix* spp.) with understory consisting of highbush-cranberry, currant (*Ribes* spp.), prickly rose, and Pacific red elder (*Sambucus callicarpa*). Sedges (*Carex* spp.), bluejoint (*Calamagrostis canadensis*), dwarf dogwood. (*Cornus canadensis),* and horsetail (*Equisetum* spp.) are typical herbaceous plants. Low scrub bog communities are dominated by low mixed shrub, tussock-forming sedges, and a mixture of birch, willow, and other low shrubs.

3.3.1.2 Interdependent Facilities

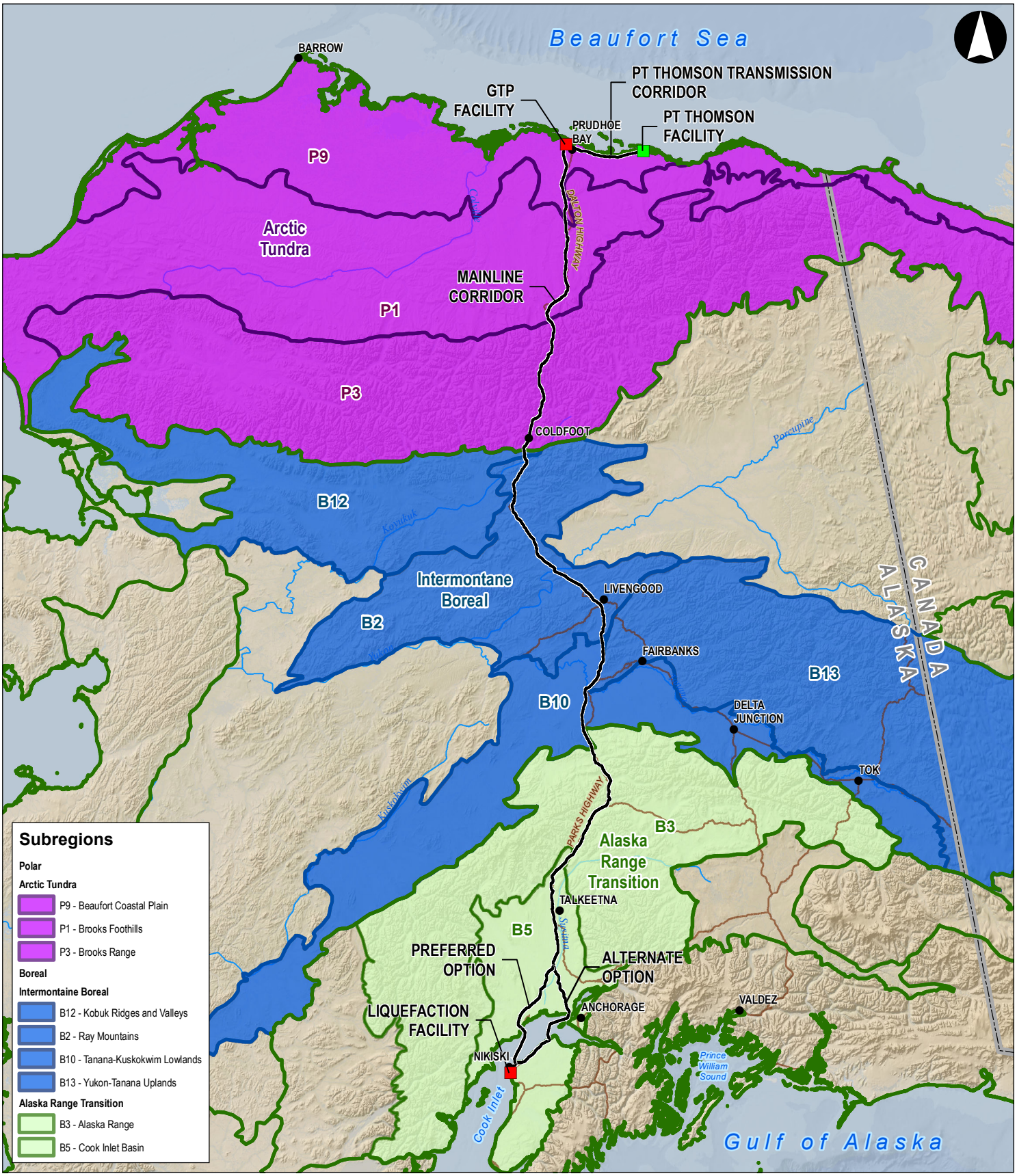
Beaufort Coastal Plain

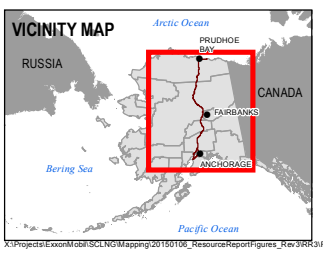
The Beaufort Coastal Plain Ecoregion occurs west of the U.S.-Canada border along the coast of the Beaufort Sea. This wind-swept plain gradually ascends from the Beaufort Sea coast southward to the foothills of the Brooks Range. The terrain is flat to undulating and is underlain by unconsolidated deposits of marine, fluvial, glaciofluvial, and eolian origin and lacks bedrock (Nowacki et al., 2001). A dry, polar climate dominates throughout the year, with short, cool summers and long, cold winters. Proximity to the Beaufort Sea and abundant sea ice contribute to the cool, frequently foggy, summers (EPA, 2010).

Due to low temperatures, permafrost is continuous across the region, except in localized areas below naturally occurring thaw bulbs under large rivers and thaw lakes (Nowacki et al., 2001). Permafrost and other frost processes result in a large variety of surface features such as pingos, ice-wedge polygons, and oriented thaw lakes. The presence of permafrost prevents the drainage of water; therefore, the soils are typically saturated and have thick organic horizons. Thaw lakes make up approximately 50 percent of the surface area and with the prevalence of saturated organic soil; most all of the region is considered wetland. Vegetation is dominated by wet sedge tundra in drained lake basins, swales, and floodplains, and by sedge-tussock tundra and sedge-*Dryas* tundra on elevated ridges. Low shrub willow thickets grow on well-drained riverbanks (Nowacki et al., 2001).

Brooks Range

The Brooks Range Ecoregion extends from the Richardson Mountains in the northern Yukon and traverses east/west through much of northern Alaska. Accreted terrains originating from the Arctic Ocean underlie most of the Books Range with the high central portion having steep angular summits of sedimentary and metamorphic rock draped with rubble and scree (Nowacki et al., 2001). The dry, polar climate along this range has short, cool summers and long, cold winters. Air temperatures decrease rapidly with rising elevation, but climate is variable due to aspect, winds, and other factors. Major mountain passes can be subject to strong outflow winds, causing severe wind chill conditions (Wiken et al., 2011).





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Ecoregion Boundary

0 35 70 140 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_3_1-1 Ecoregions Associated with the Alaska LNG Project.mxd

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ECOREGIONS ASSOCIATED WITH THE ALASKA LNG PROJECT

FIGURE 3.3.1-1

Alaska LNG

Valleys and lower mountain slopes on the northern side of the range are covered by mesic shrub and herbaceous communities of shrub-sedge tussock tundra with willow thickets along rivers and streams (Nowacki et al., 2001). Alpine tundra and barrens dominate at higher elevations along the entire crest of the range (Wiken et al., 2011). Alpine tundra vegetation consists of lichens, mountain-avens (*Dryas* spp.), and intermediate to dwarf ericaceous shrubs, sedge (*Carex* spp.), mosses, and cottongrass (*Eriophorium angustifolia*) in wetter sites. Subalpine vegetation on the southern portion of the ecoregion consists of discontinuous open stands of dwarf white spruce (*Picea glauca*) in a matrix of willow (*Salix* spp.), dwarf birch (*Betula nana*), and Labrador tea (*Ledum decumbens*) (Nowacki et al., 2001).

Kobuk Ridges and Valleys

The Kobuk Ridges and Valleys Ecoregion is a series of paralleling ridges and valleys. This diagnostic feature is created in part by high-angle reverse faults and interceding troughs. This area was overridden by past ice sheets descending from the north. Today, immense U-shaped valleys harbor large rivers that originate in the Brooks Range. The broad valleys are lined with alluvial and glacial sediments, whereas the intervening ridges are covered with rubble. Thin to moderately thick permafrost underlies most of the area. A dry continental climate prevails with long cold winters and short cool summers. Frigid conditions are reinforced during the winter as the valleys serve as cold-air drainages for the Brooks Range (Wiken et al., 2011).

Forests and woodlands dominate much of the valley bottoms and mountainsides with black spruce (*Picea mariana*) in wetland bogs, white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*) along rivers, and white spruce, paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremuloides*) on well-drained uplands. Tall and short shrublands of willow (*Salix* spp.), birch (*Betula* spp.), and alder (*Alnus* spp.) communities occur on ridges. Trees become increasingly sparse, less robust, and restricted to lower elevations in the west. (Nowacki et al., 2001)

Ray Mountains

The Ray Mountains Ecoregion is an overlapping series of compact, east-west trending ranges underlain by the Ruby terrain that includes the low hills both north and south of the Yukon River. The Ray Mountains consist of metamorphic bedrock usually covered with rubble, and soils are subsequently shallow and rocky. Permafrost is generally discontinuous and ranges from thin to moderate thickness (Nowacki et al., 2001). The climate is strongly continental with dry, cold winters and somewhat moist, warm summers. Precipitation increases with elevations (Wiken et al., 2011).

The vegetation throughout this ecoregion is dominated by black spruce woodlands and dwarf tree communities, while closed and open mixed needleleaf and deciduous forests of white spruce, paper birch (*Betula papyrifera*), and aspen (*Populus tremuloides*) usually are restricted to warm, south-facing slopes (Nowacki et al., 2001). Floodplains are dominated by white spruce, balsam poplar (*Populus balsamifera*), alders (*Alnus* spp.), and willows (Salix spp.). Forest understory varies greatly with stand density and the amount of moisture on the forest floor. Common tall shrubs found in various mixtures in white spruce forests include green alder (*Alnus crispa*) and Bebb willow (*Salix bebbiana*) and common low shrubs include Labrador tea, blueberry (*Vaccinium uliginosum*), and especially mountain cranberry (*Vaccinium vitus-idaea*). In mixed forest stands on floodplains, horsetails (*Equisetum* spp.) are a major ground cover, with feathermosses and foliose lichens prominent in the moist habitats (Nowacki et al., 2001). Shrub birch and *Dryas*-lichen tundra prevail at higher elevations. Forest fires only occasionally occur in the summer in the Ray Mountains sub regions (Nowacki et al., 2001).

Yukon-Tanana Uplands

The Yukon-Tanana Uplands Ecoregion consists of broad, rounded hills rising 500 to 1,500 feet above adjacent valleys (up to 3,000 feet total elevation) with gentle side slopes. Surficial deposits are bedrock and rubble on ridges and upper slopes, colluvium on lower slopes, and alluvium in narrow valleys. Discontinuous permafrost occurs throughout the ecoregion, particularly on north-facing slopes. The climate is continental with cold winters and warm summers.

Vegetation consists of white spruce, resin birch, and quaking aspen dominating south-facing slopes. Black spruce woodlands occur on north facing slopes and black spruce woodlands and tussock bogs cover valley floors. Low birch ericaceous shrub and *Dryas*-lichen tundra are common at upper elevations.

Tanana-Kuskokwim Lowlands

The Tanana-Kuskokwim Lowlands Ecoregion within the Project area occupies a large alluvial plain along the Tanana River and tributaries and extends through the lower-lying areas from the Little Chena River, north of Fairbanks to the Tetlin National Wildlife Refuge (NWR). The undifferentiated sediments of fluvial and glaciofluvial origin are capped by varying thicknesses of eolian silts and organic soils (Nowacki et al., 2001). Surface moisture is rather abundant due to the gentle topography, patches of impermeable permafrost, and poor soil drainage. Permafrost is thin and discontinuous, and temperatures are near the melting point. Collapse-scar bogs and fens caused by retreating permafrost are frequent (Nowacki et al., 2001). The Tanana-Kuskokwim Lowlands Ecoregion has a dry sub-Arctic, continental-influenced climate, marked by cool to mild summers and long cold winters. Summer temperatures can be relatively warm (Wiken et al., 2011).

Boreal forest communities of needleleaf, deciduous, and mixed forest occur resulting from the interplay of permafrost, surface water, fire, local elevation relief, and hill slope aspect. Lightning fires are very frequent. Black spruce woodland and dwarf tree communities occur in bogs, with tamarack in low wet areas. White spruce and balsam poplar are common along rivers. Active floodplains and river bars support tall stands of alders and willows. South-facing slopes support stands of white spruce, paper birch, and quaking aspen (*Populus tremuloides*) (Nowacki et al., 2001). The coldest, wettest areas on permafrost flats support birch-ericaceous shrubs and sedge tussocks. Wet sedge meadows and aquatic vegetation occur in sloughs and oxbow ponds. Tall willow, resin birch (*Betula glandulosa*), and green alder communities are scattered throughout (Nowacki et al., 2001).

Alaska Range

The mountains of the Alaska Range are very high and steep. The ecoregion is covered by rocky slopes, icefields, and glaciers. Much of the area is barren of vegetation. Dwarf shrub communities are common at higher elevations and on windswept sites where vegetation does exist. The Alaska Range has a continental climate regime, but due to the extreme height of the ridges and peaks, the annual precipitation at higher elevations is similar to ecoregions having a maritime climate.

Open needleleaf forests and woodlands occur on well-drained sites in some of the valleys and on lower hillslopes (Gallant, et al. 1995).Dwarf scrub communities are typically dominated by mountain-avens such as *Dryas octopetala, D. intergrifolia,* and *D. drummondii; Vaccinium* spp.; and *Cassiope tetragona*, *Arctostaphylos alpine*, and *Arctostaphylos rubra*. Other plants may include sedges (*Carex* spp.) and

alpine sweatgrass (*Anthoxanthum monticola*). Lichens, forbs, and mosses typically form the ground layer of these communities.

Low shrub communities are dominated by birch (*Betula* spp.) and willows (*Salix* spp.). Other shrubs commonly found in these communities include red-fruit bearberry (*Arctostaphylos rubra*), bog blueberry, (*Vaccinium uliginosum*), mountain-avens (*Dryas* spp.), netleaf willow (*Salix reticulate*) and arctic willow (*Salix arctica*). Common herbs are fescue grass (*Festuca altaica*), alpine sweatgrass (*Anthoxanthum monticola*), Bigelow sedge (*Carex bigelowii*), arctic sweet coltsfoot (*Petasites frigidus*), and arctic worm-wood (*Artemisia arctica*).

Tall scrub communities occur at altitudinal treeline and along streambanks, drainages, and on floodplains. These communities are dominated by willow (*Salix* spp.), alder (*Alnus* spp.), and birch (*Betula* spp.). Low shrubs, such as Alaska bog willow (*Salix fuscescens*), Beauverd spirea (*Spirea beauverdiana*), narrow leaf Labrador tea (*Ledum decumbens*), and bog blueberry (*Vaccinium uliginosum*). Understory herbs include polar grass (*Arctagrostis latifolia*), fescue grass (*Festuca altaica*), Bigelow sedge (*Carex bigelowii*), and large flowered wintergreen (*Pyrola grandiflora*).

Needleleaf forest and woodlands are dominated by white spruce (*Picea glauca*) or white spruce mixed with black spruce (*Picea mariana*). The understory typically consist of low woody vegetation, such as eightpetal mountain avens (*Dryas octopetala*), red-fruit bearberry (*Arctostaphylos rubra*), arctic willow (*Salix arctica*), crowberry (*Empetrum nigrum*), and mountain cranberry (*Vaccinium vitis-idaea*) (Gallant et al., 1995).

Cook Inlet

The Cook Inlet Basin Ecoregion is described above in Secton 3.3.1.1.

3.3.2 Terrestrial Plant Communities

Many plant communities are widely distributed throughout Alaska and within the Project area and corridor. Because changes in biotic conditions across Alaska are reflected and previously described based on ecoregions, this discussion is organized by ecoregions. Where possible specific plant resources associated with the Liquefaction Facility and Interdependent Facilities are described which are generally consistent with Level III and Level IV of Viereck's Alaska Vegetation Classification System (Viereck et al., 1992). This classification is based on dominant growth forms (tree, shrub, herb), canopy height and closure, general soil moisture and salinity, and dominant plants. A description of the vegetation communities that are within the Project area based on vegetation mapping prepared by the Alaska Natural Heritage Program (AKNHP; Boggs et al., 2012) is provided in Table 3.3.2-1. For ease in presentation and to avoid duplication Table 3.3.2-1 is organized with north to south columns running left to right: the Liquefaction Facility will be constructed in the Cook Inlet Basin Ecoregion which is in the last column of the table.

3.3.2.1 Non-native and Invasive Species

Invasive Plants

Non-native plants found in Alaska can be associated with natural processes (fluvial, animal, and fire) but are primarily correlated with anthropogenically disturbed areas (roads, trails, recreation sites, and gravel

pits). The AKNHP documented that 70 percent of recorded infestations of non-native plants were due to fill importation projects, 2.4 percent and 1.7 percent for mowing and material extraction, respectively (Nawrocki et al., 2011). Most infestations found in Alaska are relatively small (<0.01 acre) because they are associated with anthropogenic activities, which can be eradicated (Nawrocki et al., 2011).

Non-native and invasive plants potentially occurring in the Project area are listed in Table 3.3.2-2. Project construction could propagate non-native and invasive plants through several pathways. However, propagation would likely be limited to the area of disturbance, which would be mitigated. These potential pathways include:

- Transport and use of construction equipment and personnel from the continental U.S. where invasive and non-native plants are common;
- Spread of invasive and non-native plants already associated with existing rights-of-way (Alaska Railroad Corporation [ARR], Trans-Alaska Pipeline System [TAPS], and Highways) by construction equipment and personnel;
- Transport of invasive plant material from other areas within the state via: straw construction mats, machinery, footwear and clothing, hand tools, and vehicle tires; and
- Seed mixtures used to revegetate exposed soils could contain invasive and non-native seeds. However, mixtures have a maximum allowable weed seed limit.

Invasive, non-native plants thrive and establish quickly on recently disturbed soils. Invasive plants are aggressive in growth and reproduction, are generalists, and are tolerant to many environmental conditions. Thus, they outcompete and displace native plants once exposure has allowed establishment. Non-native plants with the highest ranking for invasiveness reported from the Project area include bird vetch (*Vicia cracca*), waterweed (*Elodea* sp.), white sweetclover (*Melilotus alba*), and reed canarygrass (*Phalaris arundinacea)* (Table 3.3.2-2; AKEPIC, 2014). White sweetclover has the most extensive distribution due to its adaptable properties and introduction into Alaska in the early 1900s (ADNR, 2011). The AKNHP has reported white sweetclover in the Arctic, Interior, and coastal areas of Alaska where it thrives along roadsides and disturbed areas. White sweetclover is currently found in the area of the Mainline corridor from the Alaska to Brooks Ranges (AKEPIC, 2014). White sweetclover degrades natural grasslands and is fire tolerant. Its presence alters soil characteristics and the species is highly prolific with seeds documented to be viable for up to 81 years (AKNHP, 2011).

TABLE 3.3.2-1

Vegetation Communities Associated within the Project Area by Ecoregion

General and Subclass Designation	General Description	Common Plant Communities	Arctic Tundra[a]			Intermontane Boreal[a]				Alaska Range[a]	
			BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
FORESTED											
White Spruce or Black Spruce (Open-Closed)	Well-drained rolling hills, inactive river terraces, and mountain sideslopes up to the alpine; common on all aspects except north	• White Spruce (Open-Closed) (Upland) • Black Spruce (Open-Closed) (Mesic) • White Spruce-Sitka Spruce			X	X	X	X	X	X	X
White Spruce or Black Spruce (Woodland)	Valley bottoms and on abandoned floodplains and includes treed bogs and treed fens; flat to gently sloping terrain; permafrost is generally present	• Black Spruce (Peatland) (Woodland) • Black Spruce-Tussock (Woodland) • Black spruce (Woodland) • White Spruce (Woodland)					X	X	X	X	X
White Spruce or Black Spruce/Lichen (Woodland-Open)	Along ridge tops or on riparian benches; cool dry sites; well-drained to excessively well-drained	• White Spruce or Black Spruce/Lichen (Woodland-Open)					X			X	X
Deciduous Forest (Open-Closed)	Well-drained upland terrain on southern, western, and eastern aspects in Interior Alaska; widespread in the Cook Inlet basin	• Paper birch-Quaking aspen (Open-Closed) • Quaking aspen (Open-Closed) • Balsam poplar (Open) (Floodplain) • Balsam poplar (Open-Closed)			X	X	X	X	X	X	X
White Spruce or Black Spruce-Deciduous (Open-Closed)	Floodplains, inactive terraces, rolling hills, and mountain sideslopes and is common on all aspects except north	• White Spruce-Paper Birch-Aspen-Balsam Poplar Quaking aspen (Open-Closed) • White or Black Spruce-Paper Birch-Balsam Poplar (Open-Closed)			X	X	X	X	X	X	X

TABLE 3.3.2-1

Vegetation Communities Associated within the Project Area by Ecoregion

General and Subclass Designation	General Description	Common Plant Communities	Arctic Tundra[a]			Intermontane Boreal[a]				Alaska Range[a]	
			BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
Sitka spruce (Open-Closed)		• Sitka spruce									X
Hemlock (Open-Closed)		• Mountain Hemlock									X
SHRUB											
Tall Shrub (Open-Closed)	Mountain and hill slopes	• Alder-Willow (Open-Closed) • Alder-Willow (Floodplain)		X	X	X	X	X	X	X	X
Low Shrub	Wet and mesic mountain slopes, hillslopes, flats, and adjacent to streams	• Low Willow (Open-Closed) • Low Betula nana and Ericaceous Shrub (Mesic) • *Betula nana-Vaccinium uliginosum* (Peatland)	X	X	X	X	X	X	X	X	X
Low Shrub/Lichen	Mid to high elevations in small patches on mesic mountain slopes, hillslopes, and flats	• Low Shrub/Lichen					X			X	
Tussock Tundra (Low shrub or Herbaceous)	Common in valleys and slopes; sites are cold, poorly drained	• Low Shrub/Tussock Tundra • Herbaceous Tussock Tundra	X	X	X	X	X	X	X	X	X
Dwarf Shrub	Mountain sideslopes, low summits and ridges, floodplains, and in alpine valleys	• *Dryas* Dwarf Ericaceous Shrub • Dwarf shrub (Alpine) • Sedge-Dwarf Shrub	X	X	X	X	X		X	X	X
Dwarf Shrub-Lichen	Summits and ridges; generally exposed to the wind and do not accumulate much winter snow	• *Dryas*-Lichen • Dwarf shrub-Lichen	X	X	X		X	X	X	X	X

TABLE 3.3.2-1

Vegetation Communities Associated within the Project Area by Ecoregion

General and Subclass Designation	General Description	Common Plant Communities	Arctic Tundra[a]			Intermontane Boreal[a]				Alaska Range[a]	
			BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
HERBACEOUS											
Herbaceous (Aquatic)	Small patches in shallow water ponds and lake margins including kettles, oxbow lakes, and thaw ponds	• Herbaceous (Aquatic) • Pondlily					X			X	X
Herbaceous (Wet)	Flat to sloping in valley bottoms, basins, water tracks and adjacent to streams; also occurs in patterned wetlands such as ribbed fens	• Herbaceous (Wet) • Herbaceous (Peatland)· Sedge (Wet) • *Carex chordorrhiza-Carex aquatilis* (Peatland) • Sedge-Sphagnum (Peatland)	X	X	X	X	X	X	X	X	X
Herbaceous (Mesic)	Alpine sites north of the Alaska Range; small patches on mountain slopes, hillslopes, drained lake basins, stabilized dunes, and snowbeds	• Forb (Mesic) • Graminoid (Mesic) • Herbaceous (Mesic)	X				X			X	X
Herbaceous (Wet-Marsh) (Tidal)	Northern Alaska tidal marshes form as a narrow fringe along tidal river channels, inlets, tidal lagoons protected by barrier islands, and also on salt-killed tundra; more southerly locations tidal marshes are expansive on the sea-ward portion of deltas and tidal lagoons	• Herbaceous (Wet-Marsh)(Tidal) • Herbaceous (Tidal) • Sedge (Tidal)	X								X

TABLE 3.3.2-1

Vegetation Communities Associated within the Project Area by Ecoregion

General and Subclass Designation	General Description	Common Plant Communities	Arctic Tundra[a]			Intermontane Boreal[a]				Alaska Range[a]	
			BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
SPARSE VEGETATION											
Sparse Vegetation	Small patches, sparse canopy due to extreme exposure, exposed bedrock or unstable substrates; well-drained; windswept summits and ridges on alpine sites, cirques, recently deglaciated substrates, and floodplains	• Sparse *Dryas* • Sparse Vegetation (10-25%) • Sparse Vegetation (Floodplain)		X	X		X			X	X
NONVASCULAR											
Lichen	Slope positions include sideslopes, summits and ridges; typically acidic and mesic to dry	• Lichen • Lichen (Upland acidic) • Moss, or Lichen			X		X			X	X
OTHER											
Fire Scar	Burned areas dominated by snags or burned vegetation	• Fire Scar					X	X	X		
Urban, Agriculture, Road	At least 50 percent of the area is agriculture, urban, and/or road	• Agriculture • Urban • Urban, Agriculture, Road	X				X				X

Source: adapted from Boggs et al., 2012; Nowacki et al., 2001

[a] Ecoregion Abbreviations: BCP – Beaufort Coastal Plain; BF – Brooks Range Foothills; BR – Brooks Range; KRV – Kubuk Ridges and Valleys; RM – Ray Mountains; YTU – Yukon-Tanana Uplands; TKL – Tanana-Kuskokwim Lowlands; AR – Alaska Range; CI = Cook Inlet Basin

TABLE 3.3.2-2

Invasive Plant Occurrence by Facility and Ecoregion

Common Name	Scientific Name	Invasive Rank[c]	Liquefaction Facility	Mainline Corridor[a, b]								
				Arctic Tundra			Intermontane Boreal				Alaska Range	
			CI	BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
Alfalfa	*Medicago sativa* L. ssp. *Sativa*	59	0	0	0	0	0	3	0	0	0	0
Alsike Clover	*Trifolium hybridum* L.	57	0	0	0	0	0	13	0	0	0	2
Annual Bluegrass	*Poa annua* L.	46	0	0	0	0	0	0	0	0	1	2
Bird Vetch	*Vicia cracca* L. ssp. *Cracca*	73	0	0	0	1	0	14	0	0	0	0
Birdsfoot Trefoil	*Lotus corniculatus* L.	63	0	0	0	0	0	3	0	0	0	0
Common Chickweed	*Stellaria media* (L.) Vill.	42	0	0	0	0	0	0	0	1	0	0
Common Dandelion	*Taraxacum officinale* F.H. Wigg.	58	3	0	0	5	0	33	0	2	2	3
Common Pepperweed	*Lepidium densiflorum* Schrad.	25	0	0	0	1	0	5	0	0	0	0
Common Plantain	*Plantago major* L.	44	0	0	0	11	0	12	0	2	1	3
Foxtail Barley	*Hordeum jubatum* L.	63	0	0	0	29	0	27	0	0	3	0
Herb Sophia	*Descurainia sophia* (L.) Webb ex Prantl	41	0	0	0	0	0	1	0	0	0	0
Lambsquarters	*Chenopodium album* L.	37	0	0	0	1	0	1	0	1	1	0
Meadow Foxtail	*Alopecurus pratensis* L.	52	0	0	0	0	1	2	0	0	0	0
Narrowleaf Hawksbeard	*Crepis tectorum* L.	56	0	0	0	0	1	64	0	0	0	1
Narrowleaf Hawkweed	*Hieracium umbellatum* L.	51	0	0	0	0	0	2	0	0	0	1
Oxeye Daisy	*Leucanthemum vulgare* Lam.	61	2	0	0	2	0	1	0	0	0	0
Pineappleweed	*Matricaria discoidea* DC	32	0	0	0	5	0	14	0	2	2	2
Prostrate Knotweed	*Polygonum aviculare* L.	45	0	0	0	3	0	15	0	3	1	0
Reed Canarygrass	*Phalaris arundinacea* L.	83	1	0	0	0	0	0	0	0	0	43
Shepherd's Purse	*Capsella bursa-pastoris* (L.) Medik.	40	0	0	0	1	0	0	0	1	0	0
Smooth Brome	*Bromus inermis* Leyss.	62	0	0	0	2	1	6	0	1	1	0
Spotted Ladysthumb	*Persicaria maculosa* Gray	47	0	0	0	0	0	0	0	0	0	1

TABLE 3.3.2-2

Invasive Plant Occurrence by Facility and Ecoregion

Common Name	Scientific Name	Invasive Rank[c]	Liquefaction Facility	Mainline Corridor[a, b]								
				Arctic Tundra			Intermontane Boreal				Alaska Range	
			CI	BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
Spreading Bluegrass or Kentucky Bluegrass	*Poa pratensis* L. ssp. *irrigata* (Lindm.) H. Lindb. or *Poa pratensis* L. ssp. *Pratensis*	52	0	0	0	0	0	4	0	0	0	1
Timothy	*Phleum pratense* L.	54	0	0	0	0	0	0	0	0	2	3
Waterweed	*Elodea* Michx. sp.	79	0	0	0	0	0	0	0	0	0	3
White Clover	*Trifolium repens* L.	59	1	0	0	0	0	0	0	0	0	2
White Sweetclover	*Melilotus albus* Medik.	81	0	0	0	13	9	211	0	2	1	0
Yellow Toadflax	*Linaria vulgaris* P. Mill.	69	3	0	0	0	0	0	0	0	0	0
Number Of Occurences			10	0	0	74	12	431	0	15	15	67
Number Of Invasive Plants			5	0	0	12	4	19	0	9	10	13

Source: AKEPIC, 2014 – Alaska Exotic Plants Information Clearinghouse

[a] Within 2,000 foot corridor representing the Mainline. No invasive plant records occur in the vicinity of the GTP or PTTL on the Beaufort Coastal Plain.

[b] Ecoregion Abbreviations: BCP – Beaufort Coastal Plain; BF – Brooks Range Foothills; BR – Brooks Range; KRV – Kubuk Ridges and Valleys; RM – Ray Mountains; YTU – Yukon-Tanana Uplands; TKL – Tanana-Kuskokwim Lowlands; AR – Alaska Range; CI = Cook Inlet Basin

[c] Invasiveness rank is calculated based on a species' ecological impacts, biological attributes, distribution, and response to control measures. The ranks are scaled from 0 to 100, with 0 representing a plant that poses no threat to native ecosystems and 100 representing a plant that poses a major threat to native ecosystems.

3.3.2.1 Forest Pests and Disease

Forest pests and diseases can be spread through vegetation clearing, ground disturbance, and revegetation, or can be exacerbated by stress on trees from changes in microclimate or soil moisture caused by construction of facilities. Existing forest damage detected using aerial surveys caused by defoliating insects, diseases, and abiotic factors affected 2.7 percent of the 31.5 million acres of forest surveyed in Alaska in 2013 (Graham and Heutte, 2014). Forest damage increased by 42 percent from 2012, with much of the change due to increases in spruce mortality, and alder and birch defoliation that was facilitated by warm dry conditions throughout Alaska in 2013 (Table 3.3.2-3).

TABLE 3.3.2-3

Forest Insect and Disease Activity during 2013 in the Project Area

Damage	Hosts	Liquefaction Facility	Interdependent Facilities	Total Affected acres
Alder defoliation	Leaf roller (*Epinotia solandriana)* Striped alder sawfly (*Hemichroa crocea*)	X	X	133.1
Aspen defoliation	Aspen leaf blight (*Marssonia populi*) Aspen leaf miner (*Phyllocnistis populiella*) Large aspen tortrix (*Choristoneura conflictana*)		X	102.4
Birch defoliation	Birch aphid (*Euceraphis betulae*) Birch leaf miners (*Profenusa thomsoni*, *Heterarthrus nemoratus*, *Fenusa pumila*) Leaf roller (*Epinotia solandriana*) Spear-marked black moth (*Rheumaptera hastata*)	X	X	354.9
Cottonwood defoliation	Leaf beetles (*Chrysomela* spp., *Phratora* spp., *Macrohaltica* spp.) Leaf blotch miner (*Phyllonorycter nipigon*) Leaf roller (*Epinotia solandriana*)	X	X	19.5
Spruce mortality	Spruce beetle (*Dendroctonus rufipennis*) Northern spruce engraver (*Ips perturbatus*)	X	X	35.1
Willow defoliation	Leaf blotch miner (*Micrurapteryx salicifoliella*) Willow rust (*Melampsora epitea*)		X	28.2

Source: Holsten et al., 2008; Graham and Heutte, 2014, Map 1, Tables 1 and 2

There are no currently recognized serious exotic tree pathogens of native trees that have been introduced or have become established in Alaska (Graham and Heutte, 2014). The vastness of the state and limited transportation corridors may delay detection of invasive pathogens, however, and pathogens are often difficult to detect and identify. Potential invasive tree pathogens with potential native hosts and invasiveness rankings that could affect trees within the Project area are listed in Table 3.3.2-4. Importation and movement of live plant materials is the primary pathway for introduction of plant pathogens (Graham and Heutte, 2014).

TABLE 3.3.2-4

Potential Invasive Tree Pathogens and Diseases of Trees that Occur in the Project Area

Pathogen	Disease	Potential Alaskan Host Trees/Plants	Currently in Alaska?	Invasive Rank
Chrysomyxa abietis (Wallr.) Unger	Spruce needle rust	Spruce	No	High
Chrysomyxa ledi var. *rhododendri* (de Bary.) Savile	Rhododendron-spruce needle rust	Spruce and Rhododendron	No	Moderate
Melampsora larici-tremulae Kleb.	Poplar rust	Aspen and Larch	No	Moderate
Phytopthora ramorum Werres deCock Man in't Veld	Sudden oak death	Rhododendron, Viburnum, Salmonberry	No	Low
Phytophthora alni ssp. *unifomis* Brasier and SA Kirk	Alder phytophthora	Alder	Yes	Low[A]
Taphrina betulae (Fckl.) Johans.	Birch leaf curl	Birch	No	Low
Taphrina betulina Rostr.	Birch witches broom	Birch	No	Low
Valsa hariotii	Valsa canker	Aspen, Cottonwood, Willow	No	Low

Source: Graham and Heutte, 2014

[A] *Phytophthora alni* was detected in Alaska in 2007. High genetic diversity and lack of damage to native alder suggest that this pathogen has long been established and is not invasive.

3.3.3 Unique, Sensitive, and Protected Vegetation Communites

The BLM maintains a list of sensitive plants known to occur on BLM-managed lands in Alaska and a separate list of "watch" species, which are rare and might occur on BLM lands but have not been documented. These lists were used in conjunction with data received from the Alaska Natural Heritage Program (AKNHP), plant surveys conducted in the Project area (e.g., Carroll et al., 2003; Lipkin and Parker, 1995; Cortes-Burns et al., 2009), and Project biologists' knowledge of the Project area to develop a list of target species within the Project area. Rare plants, including BLM sensitive and "watch" species, that are tracked by the AKNHP that potentially occur in the Project area and are listed in Table 3.3.3-1.

TABLE 3.3.3-1

Rare and Sensitive Plants Potentially Occurring in the Project Area

Plants		Ecoregion			Status		
Common Name	Scientific Name	Arctic Tundra	Intermontane Boreal	Alaska Range	Global Rank	State Rank	Federal Listings
Alaska Moonwort	*Botrychium alaskense*		X	X	G4	S3	
Alaska Tall Bluebells	*Mertensia paniculata* var. *alaskana*		X		G5TNR	S3S4Q	
Alaskan Bugseed	*Corispermum ochotense*		X		G3G4	S3	BLM Watch
American Vetch	*Vicia americana*			X	G5	S2	
Artic Poppy	*Papaver gorodkovii*	X			G3	S2S3	BLM Sensitive
Athabasca Willow	*Salix athabascensis*		X		G4G5	S2	
Bebb's Sedge	*Carex bebbii*		X	X	G5	S1S2	

TABLE 3.3.3-1

Rare and Sensitive Plants Potentially Occurring in the Project Area

Plants		Ecoregion			Status		
Common Name	**Scientific Name**	**Arctic Tundra**	**Intermontane Boreal**	**Alaska Range**	**Global Rank**	**State Rank**	**Federal Listings**
Bering Sea Dock	*Rumex beringensis*			X	G3	S3	
Bluegrass	*Poa sublanata*	X			GNR		
Bluntleaf Pondweed	*Potamogeton obtusifolius*		X	X	G5	S3	
Bristleleaf Sedge	*Carex eburnea*		X		G5	S3	
Buff Fleabane	*Erigeron ochroleucus*	X			G5	S1S2	BLM Watch
Bulblet-bearing Water Hemlock	*Cicuta bulbifera* L.		X	X	G5	S3	
Clavate Bentgrass	*Agrostis clavata*		X	X	G4G5	S1S2	
Coon's Tail	*Ceratophyllum demersum* L.		X	X	G5	S3S4	
Cosmopolitan Bulrush	*Bolboschoenus maritimus* ssp. *paludosus*			X	GNRTNR	S3	
Dewey Sedge	*Carex deweyana*		X	X	G5	S2S3	
Diamondleaf Willow	*Salix planifolia*	X	X		G5T5	S2	
Drummond's Cinquefoil	*Potentilla drummondii*			X	G5	S2S3	BLM Watch
Drummonds Rockcress	*Boechera stricta*		X	X	G5		
Dunhead Sedge	*Carex phaeocephala*			X	G4	S3	
Elephanthead Lousewort	*Pedicularis groenlandica*			X	G5	S2	
Ellesmereland Whitlowgrass	*Draba subcapitata*	X			G4	S1S2	BLM Watch
Feathery False Lily of the Valley	*Maianthemum racemosum* ssp. *amplexicaule*		X		G5	S1	
Fernleaf False Candytuft	*Smelowskia media*	X			GNR	S2S3	BLM Watch
Field Locoweed	*Oxytropis tananensis*	X	X	X	GNR	S3S4Q	BLM Watch
Fowler's Knotweed	*Polygonum fowleri* ssp. *fowleri*			X	G5TNR	S3S4	
Fragile Rockbrake	*Cryptogramma stelleri*	X	X		G5	S3S4	
Grapefern	*Botrychium yaaxudakeit*		X		G3G4	S2	USFS Sensitive
Hairy Arnica	*Arnica mollis*			X	G5	S2Q	
Hudson Bay Sedge	*Carex heleonastes*			X	G4	S3	BLM Watch
Inland Sedge	*Carex interior*		X	X	G5	S3	
Kamchatka Buttercup	*Oxygraphis glacialis*		X		G4G5	S3	BLM Watch

TABLE 3.3.3-1

Rare and Sensitive Plants Potentially Occurring in the Project Area

Plants		Ecoregion			Status		
Common Name	**Scientific Name**	**Arctic Tundra**	**Intermontane Boreal**	**Alaska Range**	**Global Rank**	**State Rank**	**Federal Listings**
Lapland Sedge	*Carex lapponica*		X	X	G4G5Q	S3S4	
Largeflower Fleabane	*Erigeron porsildii*	X	X		G3G4	S3S4	BLM Watch
Longleaf Arnica	*Arnica lonchophylla ssp. lonchophylla*		X	X	G4T4	S1S2	BLM Sensitive
Longstem Sandwort	*Arenaria longipedunculata*	X	X	X	G3G4Q	S3S4	BLM Watch
Mackenzie River Dwarf-primrose	*Douglasia arctica*		X		G3	S3	BLM Sensitive
MacKenzie Valley Mannagrass	*Glyceria pulchella*		X		G5	S3S4	
Macoun's Draba	*Draba macounii*	X	X		G3G4	S3	
Manyhead Sedge	*Carex sychnocephala*		X		G4	S2	
Northern Bugleweed	*Lycopus uniflorus*		X	X	G5	S3S4	
Northern Sedge	*Carex deflexa*		X	X	G5	S2S3	
Pacific Buttercup	*Ranunculus pacificus*			X	G3	S3S4	
Pale Agoseris	*Agoseris glauca*			X	G5	S2S3Q	
Parry's Sedge	*Carex parryana*			X	G4	S2	
Peck's Sedge	*Carex peckii*		X		G4G5	S2	
Poverty Rush	*Juncus tenuis*		X		G5	S2	
Pygmy Aster	*Symphyotrichum pygmaeum*	X			G2G4	S2	BLM Sensitive
Rattlesnake Fern	*Botrychium virginianum* (L.)		X	X	G5	S3	
Red Bulrush	*Blysmopsis rufa*			X	GNR	SH	
Richardson's Phlox	*Phlox richardsonii*		X		G4		BLM Watch
Robbins' Pondweed	*Potamogeton robbinsii*		X	X	G5	S2	BLM Watch
Rock Stitchwort	*Minuartia dawsonensis*	X	X		G5	S3S4	
Rosendahl's Golden Saxifrage	*Chrysosplenium rosendahlii*	X			G4G5Q	S1S2	
Sageleaf Willow	*Salix candida*		X		G5	S3	
Scrabrous Black Sedge	*Carex atratiformis*		X	X	G5	S3	
Selkirk's Violet	*Viola selkirkii*		X	X	G5?	S3S4	
Siberian Oatgrass	*Trisetum sibiricum* ssp. *litorale*	X	X		G5T4Q	S3	BLM Sensitive
Siberian Wormwood	*Artemisia tanacetifolia L.*		X		G4?	S3	BLM Sensitive
Slender Wedgescale	*Sphenopholis intermedia*	X	X		G5	S1	

TABLE 3.3.3-1

Rare and Sensitive Plants Potentially Occurring in the Project Area

Plants		Ecoregion			Status		
Common Name	**Scientific Name**	**Arctic Tundra**	**Intermontane Boreal**	**Alaska Range**	**Global Rank**	**State Rank**	**Federal Listings**
Small Saxifrage	*Saxifraga adscendens* ssp. *oregonensis*		X		G5T4T5	S2S3	
Small-Leaf Bittercress	*Cardamine microphylla*	X			G3G4	S2	BLM Watch
Spiny Phlox	*Phlox hoodii*			X	G5		
Spreading Dogbane	*Apocynum androsaemifolium L.*		X		G5	S3	
Sticky Leaf Arnica	*Arnica ovata*			X	G5	S3S4Q	
Three-lobe Beggarticks	*Bidens tripartita L.*		X		G5	S1	
Trianglelobe Moonwort	*Botrychium ascendens*			X	G3	S2S3	BLM Sensitive
Umbrella Starwort	*Stellaria umbellata*	X	X	X	G5	S3S4	
Vahl's Alkaligrass	*Puccinellia vahliana*	X	X		G4	S3	BLM Watch
Western Polypody	*Polypodium sibiricum*		X	X	G5?	S3	
Western Quillwort	*Isoetes occidentalis*			X	G4G5	S3S4	
Wheat Sedge	*Carex atherodes*	X	X		G5	S3S4	
Yellow Avens	*Geum aleppicum* ssp. *strictum*		X	X	G5T5	S3	
Yellow Lady's Slipper	*Cypripedium parviflorum*	X			G5TNR	S2S3	
Yellowstone Draba	*Draba incerta*			X	G5	S3	
Yenisei River Pondweed	*Potamogeton subsibiricus*	X	X		G3G4	S3S4	BLM Watch

Sources: AKNHP, 2014c; Nawrocki et al., 2013; NRCS, 2014

Status Codes:

G = Global
S = State
1 = Critically imperiled (typically 5 or fewer occurrences)
2 = Imperiled (6-20 occurrences)
3 = Vulnerable to extirpation or extinction (21-100 occurrences)
4 = Apparently secure (Usually more than 100 occurrences)
5 = Demonstrably secure
Q = Questionable taxonomy that may reduce conservation priority
? = Inexact numeric rank

3.3.4 Marine Vegetation Resources

3.3.4.1 Liquefaction Facility

The shoreline near the Liquefaction Facility is semi-exposed with mobile sediments composed primarily of sand beaches (NMFS, 2014c). No marine algal beds occur in the intertidal zone (NMFS, 2014c). Small patches of the perennial rockweed (*Fuscus gardneri*), a sheet-like green algae (*Ulva* spp. or *Monostroma* spp.), a filamentous brown algae – sea felt (*Pylaiella littoralis*), a filamentous green algae – green string lettuce (*Ulva linza* [as *Enteromorpha* c.f. *linza*]), and patches of a diatomaceous film were documented along the eastern Cook Inlet shoreline at Kalifornski Beach and/or Moose Point, south and north of the Liquefaction Facility, respectively (Lees et al., 2013). At both of these locations the only perennial macroalgae, rockweed, was represented by young-of-year plants and conditions were considered too harsh to allow for overwinter survival (Lees et al., 2013).

3.3.4.2 Interdependent Facilities

Beaufort Sea

Offshore in Stefansson Sound, east of West Dock, mud and silt substrates are interrupted with sporadic boulders and cobble that support arctic kelp beds (Barnes and Reimnitz, 1974), referred to as the Boulder Patch (Dunton and Schonberg, 2000). Trawls conducted in dredge disposal and disposal reference areas north of West Dock, investigated by Houghton (2012), generally contained macroalgae including: brown algae – arctic suction-cup kelp (*Laminaria solidungula*); and red algae – red blade (*Dilsea socialis* [as *Neodilsea integris*]), common sea oak (*Phycodrys fimbriata* [as *Phycodris rubens*]), and sea brush (*Odonthalia dentata*). Most of the macroalgae were not attached to bottom materials, suggesting they had drifted from other locations, although a few of the arctic suction-cup kelp were attached to small gravels or coarse sand. The presence of considerable amounts of macroalgae, including some attached to pebbles, in the trawl samples north of West Dock indicates that there may be patches of cobble or boulders within the area (Houghton, 2012).

Cook Inlet

The Interdependent Facility located in Cook Inlet is the Mainline, which will cross through upper Cook Inlet to the Kenai Peninsula. The shoreline where the Mainline corridor will enter upper Cook Inlet, south of the Beluga River mouth, consists of semi-protected, mobile sediments composed primarily of sand and gravel, or is a mud flat (NMFS, 2014c). No macroalgae were noted during previous sampling near this area (Lees et al., 2013) or are listed on shoreline maps (NMFS, 2014c). However, it is likely that a biofilm covers the tidal flats.

The shoreline in the area where the Mainline will exit upper Cook Inlet, at Boulder Point, consists of semi-protected mobile sediments (mixture of sand and gravel) and scattered boulders (NMFS, 2014c). No macroalgae were noted during previous sampling near this area (Lees et al., 2013). Rockweed and scattered annual green algae (*Ulva* spp. [as *Enteromorpha* spp.]) were found at Point Woronzoff and north of Point MacKenzie (Houghton et al., 2005a: Station KA 13 and KA 16). The rockweed at Station KA 16 was on the northeast face of large granite boulders that may offer some protection against ice scour.

3.3.5 Potential Construction Impacts and Mitigation Measures

The construction and operation of the Project has the potential to directly and indirectly impact vegetation resources. A general summary of potential impacts to vegetation resources from construction and operation of this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report will identify site-specific impacts to vegetation, or in the vicinity of, the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed mitigation measures, including site-specific measures.

3.3.6 Potential Operational Impacts and Mitigation Measures

A general summary of potential impacts to vegetation resources from operation of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report will identify site-specific impacts to vegetation resources crossed, or in the vicinity of, the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed mitigation measures, including site-specific measures.

3.4 WILDLIFE AND TERRESTRIAL RESOURCES

A diversity of wildlife habitats and species occurs across the Project, encompassing most all of the resources evaluated in the ADF&G's Comprehensive Wildlife Conservation Plan (ADF&G, 2006). For most wildlife, habitats are largely intact. The exceptions are urbanized or industrial areas such as portions of the Arctic Coastal Plain, the Fairbanks area, the Matanuska-Susitna Valley, the Anchorage Bowl, and portions of the Kenai Peninsula. For many species, little is known and accurate assessment of the health of populations or their key habitats is unavailable. Much of the Project would be located along existing transportation corridors and within industrialized areas on the North Slope and on the Kenai Peninsula. The exceptions would be the PTTL and the portion of Mainline from south of Talkeetna where the route will leave the Parks Highway and cross on either side of the Susitna River (Figure 3.4-1). The Project skirts the Arctic National Wildlife Refuge; Gates of the Arctic National Park; Yukon Flats National Wildlife Refuge; Denali National Park and Preserve; and the Kenai National Wildlife Refuge. Areas of critical environmental concern identified by the State of Alaska that would be skirted or crossed north to south include Sagwon Bluffs, Toolik Lake RNA, Galbraith Lake, Snowden Mountain, Sukakpak Mountain, Nugget Creek, Poss Mountain, and Jim River. Significant wildlife habitats, identified in ADF&G habitat atlases (ADF&G, 1985, 1986a, b) or designated by state or federal management agencies that occur within the Project area are listed in Table 3.4-1.

Many plants and animals are widely distributed throughout Alaska and within the Project area. Because changes in biotic conditions across Alaska are reflected and previously described based on ecoregions, this discussion is organized by ecoregions. Where possible, specific wildlife resources associated with the Liquefaction Facility and Interdependent Facilities are described.

TABLE 3.4-1

Significant Wildlife Habitats Potentially Affected by the Project

Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
LIQUIFACTION FACILITY							
Liquefaction Plant	Nikiski	Kenai National Wildlife Refuge / Migration and Nesting	TBD	TBD	TBD	Waterbirds and shorebirds – spring to fall	TBD
		Spring Concentration Area	TBD	TBD	TBD	Waterfowl - spring	TBD
		Nesting Habitat	TBD	TBD	TBD	Waterfowl – spring, summer	TBD
Marine Terminal	Nikiski	Kenai National Wildlife Refuge / Migration and Nesting Habitat	TBD	TBD	TBD	Waterbirds and shorebirds; Cook Inlet Salmon Fishery	TBD
		Spring Concentration Areas	TBD	TBD	TBD	Waterfowl - spring	TBD
		Nesting Concentration Area	TBD	TBD	TBD	Waterfowl – spring, summer	TBD
	Cook Inlet	Redoubt Bay Critical Habitat Area / Migration and Nesting Habitat	TBD	TBD	TBD	Waterbirds and Shorebirds; critical habitat for Tule white-fronted goose – spring to fall	TBD
		Trading Bay State Game Refuge / Migration and Nesting Habitat	TBD	TBD	TBD	Waterbirds and Shorebirds – spring to fall	TBD
PIPELINES							
Mainline	TBD	Nesting Area	19	TBD	TBD	Geese – spring, summer	TBD
	TBD	Nesting Concentration Area	32	TBD	TBD	Ducks – spring, summer	TBD
	TBD	Calving Range	16	TBD	TBD	CAH Caribou – spring, summer	TBD
	TBD	Franklin Bluffs Peregrine Falcon ZRA / Nesting	2	TBD	TBD	Raptor nesting – spring, summer	TBD
	TBD	Nesting Concentration Area	9	TBD	TBD	Geese and Ducks – spring, summer	TBD
	TBD	Winter Range	155	TBD	TBD	CAH Caribou – fall to spring	TBD
	TBD	Sagawon Bluffs Peregrine Falcon ZRA / Nesting	6	TBD	TBD	Raptor nesting – spring, summer	TBD
	TBD	Winter Habitat	47	TBD	TBD	Moose – fall to spring	TBD
	TBD	Spring Concentration Area	9	TBD	TBD	Waterfowl – spring	TBD

TABLE 3.4-1

Significant Wildlife Habitats Potentially Affected by the Project

Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
	TBD	Migration Route – North/South, crosses pipeline route	21	TBD	TBD	Caribou – spring, fall	TBD
	TBD	Slope Mountain Peregrine Falcon ZRA / Nesting	3	TBD	TBD	Raptor nesting – spring, summer	TBD
	TBD	Mineral Lick Area	0	TBD	~2 mi NW	Dall sheep - spring	TBD
	TBD	Migration Route – North/South, parallel to pipeline	22	TBD	TBD	Caribou – spring, fall	TBD
	TBD	Migration Route – North/South, crosses pipeline route	30	TBD	TBD	Waterfowl – spring, fall	TBD
	TBD	Winter Use Area	19	TBD	TBD	Dall Sheep	TBD
	TBD	Galbraith Lake ACEC / Lambing, Mineral Licks	12	TBD	TBD	Dall Sheep – spring	TBD
	TBD	Atigun Pass / Nesting	29	TBD	TBD	Raptor nesting – spring, summer	TBD
	TBD	West Fork Atigun ACEC / Lambing, Mineral Licks	7	TBD	TBD	Dall Sheep – spring	TBD
	TBD	Dall Sheep Range	30	TBD	TBD	Dall Sheep – year round	TBD
	TBD	Migration Route – North/South, parallel to pipeline route; Atigun Pass	70	TBD	TBD	Waterfowl – spring, fall	TBD
	TBD	Migration Route – Northeast	11	TBD	TBD	Caribou – spring, fall	TBD
	TBD	Winter Habitat	138	TBD	TBD	Caribou – fall to spring	TBD
	TBD	Mineral Lick Area	0	TBD	<1mi S	Dall sheep - spring	TBD
	TBD	Mineral Lick Area	0	TBD	<2 mi NW	Dall sheep - spring	TBD
	TBD	Spring Concentration Area / Berry Area	37	TBD	TBD	Brown bear – spring, summer	TBD

TABLE 3.4-1

Significant Wildlife Habitats Potentially Affected by the Project

Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
	TBD	Snowden Mountain ACEC / Mineral Lick	10	TBD	TBD	Dall sheep – spring, year round habitat	TBD
	TBD	Mineral Lick Area	0	TBD	<1 mi E	Dall sheep - spring	TBD
	TBD	Mineral Lick Area	0	TBD	2 mi NE	Dall sheep - spring	TBD
	TBD	Mineral Lick Area	0	TBD	4 mi SE	Dall sheep – spring	TBD
	TBD	Nugget Creek ACEC / Lambing, Mineral Lick	5	TBD	TBD	Dall sheep - spring	TBD
	TBD	Poss Mountain ACEC / Mineral Lick	2	TBD	TBD	Dall sheep – spring, year round habitat	TBD
	TBD	Dall Sheep Range	13	TBD	TBD	Dall sheep – year round	TBD
	TBD	Spring Concentration Area / Berry Area	25	TBD	TBD	Brown bear – spring, summer	TBD
	TBD	Jim River ACEC / Nesting	17	TBD	TBD	Raptor nesting – spring, summer	TBD
	TBD	Winter Habitat	4	TBD	TBD	Moose – fall to spring	TBD
	TBD	Yukon River Peregrine Falcon ZRA	4	TBD	TBD	Raptor nesting – spring, summer	TBD
	TBD	Winter Habitat	31	TBD	TBD	Moose – fall to spring	TBD
	TBD	Winter Habitat	3	TBD	TBD	Moose – fall to spring	TBD
	TBD	Tanana Valley State Forest	7	TBD	TBD	Various	TBD
	TBD	Tanana Valley State Forest	7	TBD	TBD	Various	TBD
	TBD	Calving Habitat	11	TBD	TBD	Moose – spring	TBD
	TBD	Winter Habitat	40	TBD	TBD	Moose – fall to spring	TBD
	TBD	Minto Flats State Game Refuge / Migration, Nesting, Various	10	TBD	TBD	Waterfowl – spring to fall; Moose, black bear, and furbearers – year round	TBD
	TBD	Minto Flats State Game Refuge / Migration, Nesting, Various	2	TBD	TBD	Waterfowl – spring to fall; Moose, black bear, and furbearers – year round	TBD
	TBD	Nesting Concentration Area	3	TBD	TBD	Waterfowl – spring, summer	TBD

TABLE 3.4-1

Significant Wildlife Habitats Potentially Affected by the Project

Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
	TBD	Winter Habitat	29	TBD	TBD	Moose – fall to spring	TBD
	TBD	Calving Habitat	21	TBD	TBD	Moose- spring	TBD
	TBD	Migration Route – East/West crosses route	2	TBD	TBD	Waterfowl - spring, fall	TBD
	TBD	Winter Range	33	TBD	TBD	Caribou – fall to spring	TBD
	TBD	Migration Route – North/South, parallel to pipeline route	50	TBD	TBD	Waterfowl – spring, fall	TBD
	TBD	Rut (Breeding) Area	8	TBD	TBD	Moose - fall	TBD
	TBD	Winter Habitat	46	TBD	TBD	Moose – fall to spring	TBD
	TBD	Migration Route – East/West	1	TBD	TBD	Caribou – spring, fall	TBD
	TBD	Calving Habitat	38	TBD	TBD	Moose – spring	TBD
	TBD	Winter Habitat	38	TBD	TBD	Moose – fall to spring	TBD
	TBD	Alaska Range Foothills IBA / Nesting	23	TBD	TBD	Raptor, golden eagle – spring, summer	TBD
	TBD	Spring Concentration Area	5	TBD	TBD	Brown bear - spring	TBD
	TBD	Dall Sheep Range	5	TBD	TBD	Dall sheep – year round	TBD
	TBD	Mineral Lick Area	0	TBD	~ 4 to 5 W	Dall sheep – spring	TBD
	TBD	Dall Sheep Range	4	TBD	TBD	Dall sheep – year round	TBD
	TBD	Winter Range	4	TBD	TBD	Caribou –fall to spring	TBD
	TBD	Spring Concentration Area / Chalitna River	1	TBD	TBD	Trumpeter swan - spring	TBD
	TBD	Winter Habitat	9	TBD	TBD	Moose – fall to spring	TBD
	TBD	Dall Sheep Range	4	TBD	TBD	Dall sheep – year round	TBD
	TBD	Rut (Breeding) Area	32	TBD	TBD	Moose – fall	TBD
	TBD	Winter Habitat	32	TBD	TBD	Moose – fall to spring	TBD

TABLE 3.4-1

Significant Wildlife Habitats Potentially Affected by the Project

Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
	TBD	Denali National Park / Various	40	TBD	TBD	Moose, brown bear, caribou, Dall sheep, wolves, furbearers, raptors, and waterfowl – seasonal and year round	TBD
	TBD	Kahiltna Flats – Petersville Road IBA / Migration, Nesting	25	TBD	TBD	Trumpeter swan, tule greater white-fronted geese – spring to fall	TBD
	TBD	Winter Habitat	33	TBD	TBD	Moose – fall to spring	TBD
	TBD	Nesting and Brood-rearing Area	55	TBD	TBD	Trumpeter swan – spring, summer	TBD
	TBD	Winter Habitat	2	TBD	TBD	Moose – fall to spring	TBD
	TBD	Winter Habitat	9	TBD	TBD	Moose – fall to spring	TBD
	TBD	Calving Area	6	TBD	TBD	Moose – spring	TBD
	TBD	Rut (Breeding) Area	14	TBD	TBD	Moose – fall	TBD
	TBD	Calving Area	16	TBD	TBD	Moose – spring	TBD
	TBD	Winter Habitat	16	TBD	TBD	Moose – fall to spring	TBD
	TBD	Susitna Flats State Game Refuge; / Migration, Moose	15	TBD	TBD	Waterfowl, shorebirds – spring, fall; Moose – year round	TBD
	TBD	Nesting and Brood-rearing Area	3	TBD	TBD	Trumpeter swan – spring, summer	TBD
	TBD	Nesting and Brood-rearing Concentration Area	5	TBD	TBD	Trumpeter swan – spring, summer	
	TBD	Migration Staging	3	TBD	TBD	Waterfowl – fall	TBD
	TBD	Migration Staging, Nesting	1	TBD	TBD	Waterfowl – spring to fall	TBD
	TBD	Nesting and Brood-rearing Area	17	TBD	TBD	Trumpeter swan – spring, summer	TBD
	TBD	Migration, Nesting	10	TBD	TBD	Waterfowl – spring, summer	TBD

TABLE 3.4-1

Significant Wildlife Habitats Potentially Affected by the Project

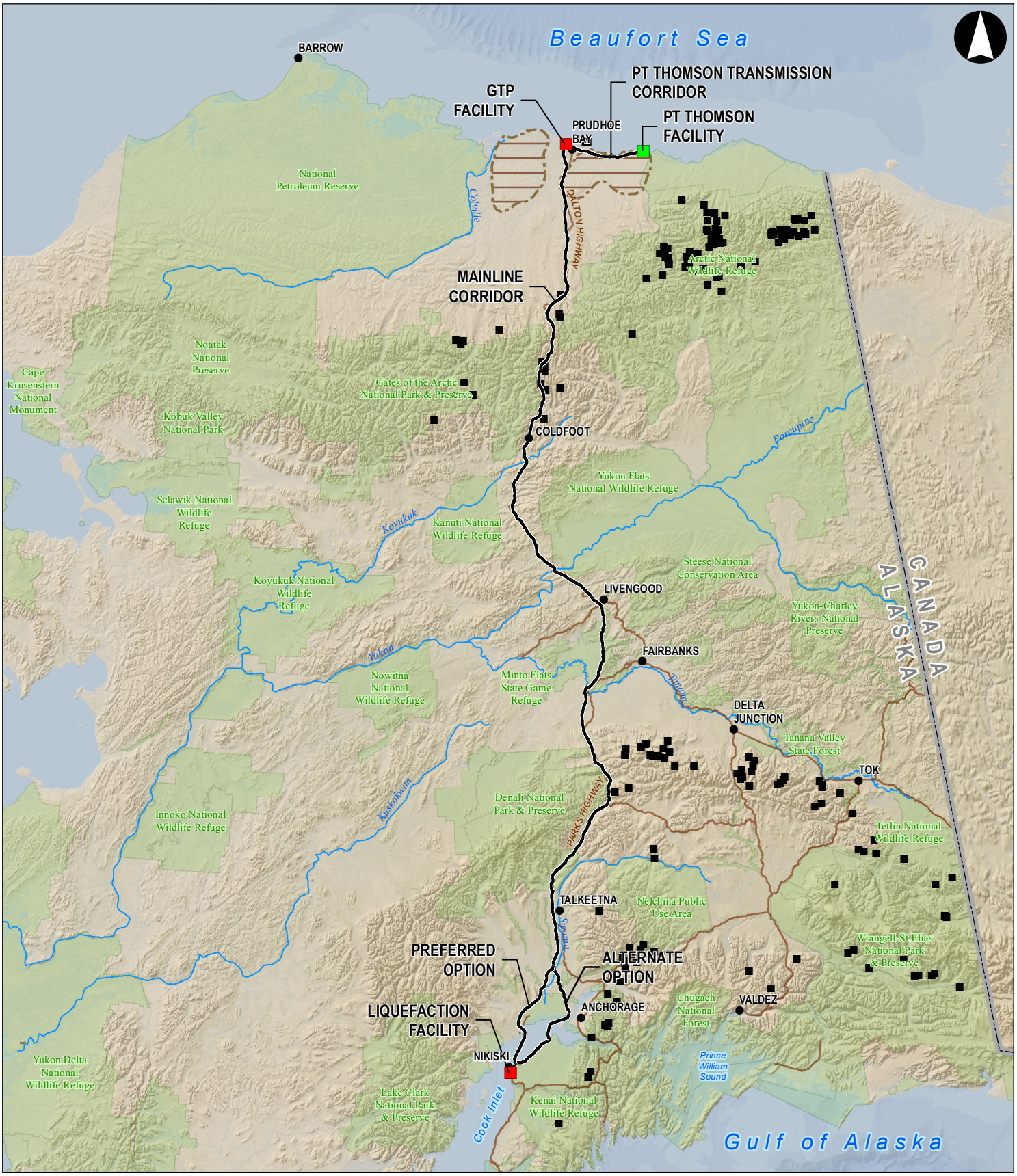
Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
	Cook Inlet	Kenai National Wildlife Refuge / Migration and Nesting	TBD	TBD	TBD	Waterbirds and shorebirds – spring to fall; Cook Inlet salmon fishery	TBD
PTTL	TBD	Arctic National Wildlife Refuge/ Migration and Nesting Habitat	TBD	TBD	TBD	Waterfowl and Shorebirds – spring to fall	TBD
	TBD	Nesting Habitat	31	TBD	TBD	Geese – spring, summer	TBD
	TBD	Nesting Concentration Area	29	TBD	TBD	Waterfowl – spring, summer	TBD
	TBD	Calving Range	44	TBD	TBD	CAH Caribou – spring, summer	TBD
PBTL	TBD	Nesting Habitat	TBD	TBD	TBD	Waterfowl – spring, summer	TBD
PIPELINE ABOVEGROUND FACILITIES							
Compressor Stations	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Heater Stations	TBD	TBD	TBD	TBD	TBD	TBD	TBD
PTU Meter Station	PTU	Arctic National Wildlife Refuge / Migration and Nesting	TBD	TBD	TBD	Waterbirds and shorebirds – spring to fall	Winter
		Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
Prudhoe Bay Meter Station	GTP	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
Mainline Meter Station	GTP	TBD	TBD	TBD	TBD	TBD	TBD
Liquefaction Facility Meter Station	At Liquefaction Facility	Kenai National Wildlife Refuge / Migration, Nesting	TBD	TBD	TBD	Waterbirds and shorebirds – spring to fall; Cook Inlet salmon fishery	TBD
MLBVs (not on Compressor sites)	TBD	TBD	TBD	TBD	TBD	TBD	TBD
PIPELINE ASSOCIATED INFRASTRUCTURE							
Access roads	TBD	TBD	TBD	TBD	TBD	TBD	TBD
ATWS	TBD	TBD	TBD	TBD	TBD	TBD	TBD

TABLE 3.4-1

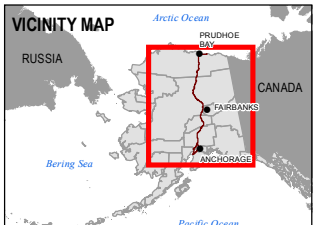
Significant Wildlife Habitats Potentially Affected by the Project

Facility	Location (Milepost)	Name / Habitat Type	Length Crossed or Area (mile)	Construction Right-of-Way Width (feet)	Distance and Direction to Closest Facility (mile)	Description of Sensitive Wildlife – Season	Construction Season
Contractor yards	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Pipe yards	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Construction camps	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Disposal sites	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Material sites	TBD	TBD	TBD	TBD	TBD	TBD	TBD
GTP							
GTP	GTP	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
ASSOCIATED GTP INFRASTRUCTURE							
Offshore West Dock	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Module Staging Area	TBD	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
Access Roads	TBD	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
Construction Camp	TBD	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
Material Sites	TBD	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter
Water Reservoir, Pump Facilities, Transfer Line	TBD	Nesting Area	TBD	TBD	TBD	Waterfowl – spring, summer	Winter

Source: ADF&G, 1985, 1986a, b; Arthur and Del Vecchio, 2009.



VICINITY MAP



LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Known Mineral Licks
- Project Corridor
- Major Highways
- Major Rivers
- State and Federal Conservation Lands
- Caribou Calving Areas

0 35 70 140 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4-1 Wildlife Refuges, Calving Areas, Mineral Licks, Other Significant Habitats Associated with the Alaska LNG Project.mxd

DISCLAIMER

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WILDLIFE REFUGES, CALVING AREAS, MINERAL LICKS, OTHER SIGNIFICANT HABITATS ASSOCIATED WITH THE ALASKA LNG PROJECT

FIGURE 3.4-1

Alaska LNG

3.4.1 General Ecological Provinces and Habitats

The Beaufort Sea and Stefansson Sound and three Level 2 terrestrial ecoregions have been delineated within the Project area (refer to Section 3.3). The Level 2 and Level 3 ecoregions include the following:

- Arctic Tundra Ecoregion
    - Beaufort Coastal Plain Ecoregion
    - Brooks Foothills Ecoregion
    - Brooks Range Ecoregion
- Intermontane Boreal Forest Ecoregion
    - Kobuk Ridges and Valleys Ecoregion
    - Ray Mountains Ecoregion
    - Yukon-Tanana Uplands
    - Tanana-Kuskokwim Lowlands Ecoregion
- Alaska Range Transition Ecoregion
    - Alaska Range Ecoregion
    - Cook Inlet Basin Ecoregion

Ecoregions are defined based on perceived patterns of a combination of causal and integrative factors, including climate, land surface form, natural vegetation, and surficial geology. Transitional areas along ecoregion boundaries are areas sharing characteristics of two or more adjacent ecoregions, and the boundary between regions typically supports species common to each area. A summary of common wildlife found in each ecoregion is summarized in Table 3.4.1-1, followed by a brief description of each ecoregion as it pertains to wildlife. Ecoregions are described in order north to south; the Liquefaction Faciltiy will be located in the Cook Inlet Basin Ecoregion.

TABLE 3.4.1-1

Common Wildlife Occurring in the Project Area by Ecoregions

Ecoregions	Representative Wildlife
Beaufort Sea-Stefansson Sound	Birds: Loons, eiders, long-tailed ducks, scoters, jaegers, arctic tern, glaucous gulls. Mammals: Polar bear, ringed seal, bearded seal, spotted seal, bowhead whale, and beluga whale. Reptiles/amphibians: None

TABLE 3.4.1-1

Common Wildlife Occurring in the Project Area by Ecoregions

Ecoregions	Representative Wildlife
Arctic Tundra (Beaufort Coastal Plain)	Birds: Greater white-fronted geese, snow geese, tundra swans, brant, eiders, loons, glaucous gulls, black guillemots, ptarmigan, jaegers, long-billed dowitcher, dunlin, semipalmated sandpiper, pectoral sandpiper, buff-breasted sandpiper, and stilt sandpiper Mammals: 4 caribou herds (Central Arctic, Teshekpuk Lake, Western Arctic, and Porcupine), muskoxen, lemmings, barren ground shrews, singing voles, arctic ground squirrels, arctic and red foxes, polar bears, gray wolves, and brown bear Reptiles/amphibians: None
Arctic Tundra (Brooks Foothills)	Birds: Smith's longspurs, peregrine falcons, Baird sandpiper, stilt sandpiper, buff-breasted sandpiper Mammals: 3 caribou herds (Central Arctic, Western Arctic, Porcupine), muskoxen, arctic ground squirrel, brown bear, wolf, insular vole Reptiles/amphibians: None
Arctic Tundra (Brooks Range)	Birds: Golden eagles, horned larks, Smith's longspur Mammals: Dall sheep, caribou, gray wolves, brown bear, Alaska marmot, singing vole Reptiles/amphibians: Wood frog
Intermontane Boreal (Kobuk Ridges and Valleys)	Birds: Gray jays, boreal chickadees, boreal owls, great gray owls, Mammals: Caribou, marten, mink, short-tailed weasel, least weasel, Canada lynx, beaver, muskrat, arctic ground squirrels, brown bears, wolverine, gray wolves Reptiles/amphibians: Wood frog
Intermontane Boreal (Ray Mountains)	Birds: Olive-sided flycatchers, blackpoll warblers, boreal owls, great gray owls, rusty blackbirds Mammals: small caribou herds, Canada lynx, marten, moose, brown bears, wolves, red fox Reptiles/amphibians: Wood frog
Intermontane Boreal (Yukon-Tanana Uplands)	Birds: Smith's longspurs, gray jays, boreal chickadees, northern flickers, red-tailed hawks, boreal owls, peregrine falcons Mammals: Dall sheep, hoary marmots, arctic ground squirrels, black bears, brown bears, wolverines, wolves, marten, mink, short-tailed weasels, least weasels, Canada lynx, yellow-cheeked voles, northern flying squirrels, caribou, moose Reptiles/amphibians: Wood frog
Intermontane Boreal (Tanana-Kuskokwim Lowlands)	Birds: common loons, horned grebe, red-necked grebe, trumpeter swans, common goldeneye, ruffed grouse, belted kingfishers, alder flycatchers, Hammond's flycatchers, olive-sided flycatchers, blackpoll warblers, boreal owls, great gray owls, rusty blackbirds Mammals: caribou herds, black bear, red squirrels, northern bog lemmings, yellow-cheeked voles, mink, marten, muskrat, moose, river otter Reptiles/amphibians: Wood frog
Alaska Range Transition (Alaska Range)	Birds: Smiths longspur, golden eagle, Mammals: brown bears, gray wolves, wolverines, Dall sheep, caribou, hoary marmots, singing voles, pikas Reptiles/amphibians: Wood frog
Alaska Range Transition (Cook Inlet Basin)	Birds: tundra and trumpeter swans, western sandpipers, dunlins, rock sandpipers, long-billed and short-billed dowitchers, Hudsonian godwits, black-legged kittiwakes, common murres, snow geese (migration), olive-sided flycatchers, blackpoll warblers, common raven Mammals: moose, brown and black bears, beavers, muskrats, pygmy shrew, northern water shrew, caribou, Cook Inlet beluga whales, northern sea otter, harbor seals, Dall's and harbor porpoise, minke whales Reptiles/amphibians: Wood frog

Sources: Nowacki et al., 2001; ADF&G, 2006

3.4.1.1 Liquefaction Facility

The Liquefaction Facility is located in the Cook Inlet Basin Ecoregion. A description of the common wildlife resources that could potentially occur within the Project area is provided below.

Cook Inlet Basin

The diversity of habitats within the Cook Inlet region results in a diversity of wildlife. The numerous land, ponds, and wetlands attract large numbers of shorebirds and waterfowl, including tundra and trumpeter swans. Large numbers of western sandpipers, dunlins, rock sandpipers, long and short billed dowitchers, and Hudsonian godwits use Cook Inlet for breeding, resting, or wintering. Black-legged kittiwakes and common murres nest in colonies along its shores. Nearly the entire population of Wrangell Island Snow geese migrates across the mouth of the Kenai River and Trading Bay in the spring. Sensitive landbirds in the ecoregion include olive-sided flycatchers and blackpoll warblers. The mix of wetland habitats supports moose, brown and black bears, beavers, muskrats, pygmy shrew and northern water shrew.

3.4.1.2 Interdependent Facilities

The Interdependent Facilities for the Project are located throughout the various ecoregions of Alaska. A description of the common wildlife resources that could potentially occur with the Project area is provided below.

Beaufort Coastal Plain

Areas along the Beaufort Coastal Plain can be highly productive and annually produce 500 to 1,000 pounds of vegetation per acre, an important source of food for wildlife, particularly caribou, waterfowl, and shorebirds. Because of the limited growing season, the vast majority of migratory wildlife species are present on the Beaufort Coastal Plain only during the summer, typically arriving in late May or early June and leaving by late August or September.

In addition to large herds of caribou, mammals of this region include the polar bear, brown bear, muskoxen, wolf, wolverine, mink, ermine, least weasel, and lemming. Polar bears predominately live on the ice pack; however, polar bears can range up to 60 miles inland. Many of the terrestrial mammals either hibernate or undergo seasonal migration as an adaptation to winter. Other mammals become nomadic (i.e., Arctic foxes) or remain active beneath the snowpack (i.e., collared and brown lemmings).

Arctic fox are common on the ice pack and coastal areas during the winter. Muskoxen and gray wolves are found in limited numbers across the Beaufort Coastal Plain during this time of year, and wolverines are infrequently present.

Common small mammals inhabiting the Beaufort Coastal Plain include shrews, voles, and brown and collared lemmings. These resident species are critical to the ecosystem as prey items. Lemmings may be the most important mammals on the Beaufort Coastal Plain because several predators, including mammals and birds, depend on them as prey species. In years with cyclical declines in the number of lemmings, the Arctic and red fox are forced to switch from lemmings to young birds and eggs as dietary mainstays.

The wet tundra and aquatic habitat, including shallow water wetlands, lakes and ponds, provide productive habitat for millions of migrating waterfowl and shorebirds during the summer months. Canada geese, greater white-fronted geese, snow geese, and brant nest on the Beaufort Coastal Plain and along the Project's northern section in Alaska from mid-May to early September. Canada and greater white-fronted geese nest in isolated pairs, while brant and snow geese nest in colonies of a few to several hundred pairs. Tundra swans are also common breeders, nesting from May to early June and brood-rearing from July to mid-September.

Eighteen species of ducks have been recorded on the Beaufort Coastal Plain, including spectacled, Steller's, and king eiders; long-tailed ducks; and northern pintails.

The Beaufort Coastal Plain is an important breeding area for several species of shorebirds, approximately 24 of which occur on the central North Slope. Only four species of birds are regular winter residents on the Beaufort Coastal Plain: the common raven, snowy owl, willow ptarmigan, and gyrfalcon. Ravens are relatively common and are often associated with areas of human habitation. Snowy owls can also be common on the Beaufort Coastal Plain in winter when their primary food, lemmings, is available.

Over 30 species of passerines have been recorded on the Beaufort Coastal Plain, but only one, the Lapland longspur, is commonly observed nesting on the tundra. Many of the passerines migrate from wintering areas in temperate and tropical regions in North and South America, though a few species migrate from Asia.

Brooks Foothills

Wildlife species inhabiting the Brooks Foothills Ecoregion are similar to those of the Beaufort Coastal Plain; however, the presence of drier vegetation communities and stream/river riparian areas provide for greater species diversity. Ermine and wolves are typically encountered in the Foothills and, more infrequently, on the Beaufort Coastal Plain (U.S. Department of the Interior [DOI], 1979). In addition, lemming populations differ between these areas with more collared lemmings than brown lemmings in the foothills. Additional species of shrews and voles are found in the foothills than are found in the wet tundra areas of the Beaufort Coastal Plain.

Caribou are common across the foothills, and moose are found occasionally in wet meadows and shrub communities along rivers. Carnivorous mammals, including ermine, least weasel, wolverine, red fox, and wolf, inhabit the foothills, and their population densities usually reflects those of their respective preferred prey items. Common resident prey species include voles, lemmings, Arctic ground squirrels, and hares. Caribou are also an important prey species for the larger predators such as wolverines, brown bears, and the wolf.

The increased wildlife diversity in the foothills versus that of the Beaufort Coastal Plain is a direct reflection of the increase in diversity of habitats. These different habitats are indicators of the various soil moisture regimes and soil types found in the foothills. These habitats provide food and cover that are not present on the plain, resulting in the success of herbivorous species, especially small mammals that do not inhabit the Beaufort Coastal Plain. The resulting increase in resident small prey mammals is directly reflected by an increase in the populations of resident carnivorous mammals and predatory birds.

Brooks Range

The lack of ground cover over much of the Brooks Range limits the numbers of large and small herbivorous mammals. This, in turn, limits the presence of larger, predatory mammals. At lower elevations, shrews, voles, and lemmings may be present. At higher elevations, small to medium size mammals may be limited to the Alaska vole, hoary marmot, and collared pika, all of which may inhabit rocky substrates.

The Brooks Range is an important sport hunting area in Alaska that supports large mammals, such as caribou, brown and black bear, wolf, and Dall sheep. The Brooks Range is the primary habitat for Dall sheep in the Project area. Caribou migrate through passes of the Brooks Range, but do not spend extensive periods foraging or resting in this ecoregion. Larger mammalian carnivores, such as wolves, may be found in the mountains, but usually only in the vicinity of Dall sheep or migrating caribou. Smaller mammals include wolverine, hoary marmot, red and Arctic fox, Arctic ground squirrel, snowshoe hare, lemming, and pika.

Brown bears are common residents in the Brooks Range, but their density is low. Brown bears are efficient and flexible omnivores. Although the bulk of their diet is vegetation, bears will eat caribou and calves, moose and calves, Dall sheep lambs, carrion, adult birds, young birds, and eggs when encountered. Ground squirrels are also an important food source for brown bears.

During the summer months, the Brooks Range is an important nesting area for several songbirds. Raptors are prominent in much of this area and include golden eagles, peregrine falcons, gyrfalcons, rough-legged hawks, northern harriers, and snowy and short-eared owls. The snowy and short-eared owls are ground nesters, and other raptors nest at traditional sites on cliffs or rock outcroppings.

Intermontane Boreal Ecoregion

This segment includes the Kobuk Ridge and Valleys, Ray Mountains, Yukon-Tanana Uplands, and Tanana-Kuskokwim Lowlands. The species presented here are all-inclusive, since many of the species commonly found in this Level 2 ecoregion are similar throughout the Level 3-ecoregions noted above.

Mammals inhabiting the forested areas of the Intermontane Boreal Ecoregion include brown and black bears, moose, caribou, wolves, ermines, least weasels, marten, snowshoe hares, pika, hoary marmot, red squirrel, voles, and shrews. Some of these species, including pika and hoary marmot, are suited to the rocky nature of the higher elevations, while others, including wolves, ermine, and bears, prefer the lower elevation and open forests. Most of these species are resident year-round, but hibernate or undergo seasonal movements locally to optimum foraging grounds. The small mammals are critical to the ecoregion as prey items. Beaver, river otter, mink, and muskrat are common near lakes and large streams of this ecoregion.

The open, mixed deciduous-conifer forests support a large variety of birds. 200,000 to 300,000 sandhill cranes migrate through the Project area along the Tanana River during their spring and fall migrations.

Much of the wildlife found in the Project area in Alaska is particularly important because the species have recreational, aesthetic, subsistence, or commercial value. Several areas in the Project corridor have been identified as sensitive wildlife habitats or have been designated as wildlife and game management areas. These habitats and areas are discussed in more detail in Section 3.4.2.

Alaska Range

The Alaska Range provides habitat to many of the larger species, including moose, brown bear, and caribou. White-tailed ptarmigan and golden eagles can be found in the Alpine tundra portions of the ecoregion. Northern bog lemmings are common in the more poorly drained areas of the region.

Cook Inlet Basin

The Cook Inlet Basin Ecoregion is described above in Secton 3.4.1.1.

3.4.2 Marine Mammals

Marine mammals are protected under the Marine Mammal Protection Act (MMPA), 16 U.S.C § 1361 et seq. (1972). NMFS and USFWS are given authority to implement the MMPA. In the Project area, USFWS is responsible for the conservation and management of Pacific walrus, northern sea otters, and polar bears; NMFS is responsible for management of seals, sea lions, whales, dolphins, and porpoises. Any activity authorized by a federal agency that could impact marine mammals requires consultation with either the NMFS or the USFWS. Marine mammals potentially occurring in the Project area are listed in Table 3.4.2-1. Many of the marine mammals that potentially occur within the Project area are also protected as threatened or endangered under the ESA. These ESA-listed marine mammals are discussed in Section 3.5.1.

Among the 1994 amendments to the MMPA was the addition of a mechanism to authorize the take of a small number of marine mammals incidental to activities other than commercial fishing and a definition of the term "harassment" found in the definition of the term "take." Harassment means any act of pursuit, torment, or annoyance that (A) has the potential to injure a marine mammal or marine mammal stock in the wild; or (B) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. 16 U.S.C. § 1362 (18)(a). The NMFS has identified underwater noise-exposure criteria corresponding to these two levels of harassment. Level A harassment includes auditory injury. The NMFS criteria for Level A harassment, which are intended to represent cautionary estimates for the onset of auditory system injury, are unweighted sound-pressure levels (SPLs) of 190 decibels (dB) root mean square (rms) re 1 microPascal (μPa) SPL for pinnipeds (seals, sea lions) and 180 dB_{rms} re 1 μPa SPL for cetaceans (whales, dolphins, porpoises). Level B harassment includes behavioral disturbance. The NMFS criteria for Level B harassment (behavioral disturbance) are 160 dB_{rms} re 1 μPa SPL for impulsive sounds and 120 dB_{rms} re 1 μPa SPL for continuous sounds. NMFS is reviewing current research and assessing the need to update these criteria (NOAA, 2013).

TABLE 3.4.2-1

Marine Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat
SEALS				
Bearded Seal, Beringia DPS	*Erignathus barbatus*	GTP	May–October (some year-round)	Bering, Chukchi and Beaufort seas; shelf waters, ice–associated
Harbor Seal	*Phocis vitulina richardii*	Marine Terminal, Mainline	Year round	Gulf of Alaska, Bering Sea, Cook Inlet; near coast, estuaries, may

TABLE 3.4.2-1

Marine Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat
				travel miles up rivers
Spotted Seal	*Phoca largha*	GTP	Summer	Bering, Chukchi, Beaufort seas, shelf waters and coastal
WHALES				
Beluga Whale	*Delphinapterus leucas*	GTP	Summer	Bering, Chukchi, Beaufort seas; Cook Inlet[a]; coastal or near ice
Killer Whale	*Orcinus orca*	Marine Terminal, Mainline	Summer	Gulf of Alaska, Cook Inlet, Bering, Chukchi, Beaufort seas; coastal waters
PORPOISES AND DOLPHINS				
Harbor Porpoise	*Phocoena phocoena*	Marine Terminal, Mainline	Year-round, summer	Gulf of Alaska, Cook Inlet, Bering, Chukchi, and Beaufort seas; coastal waters

Source: Allen and Angliss 2014

[a] The Cook Inlet Beluga Whale is listed as endangered under the ESA (see Table 3.5.1-1)

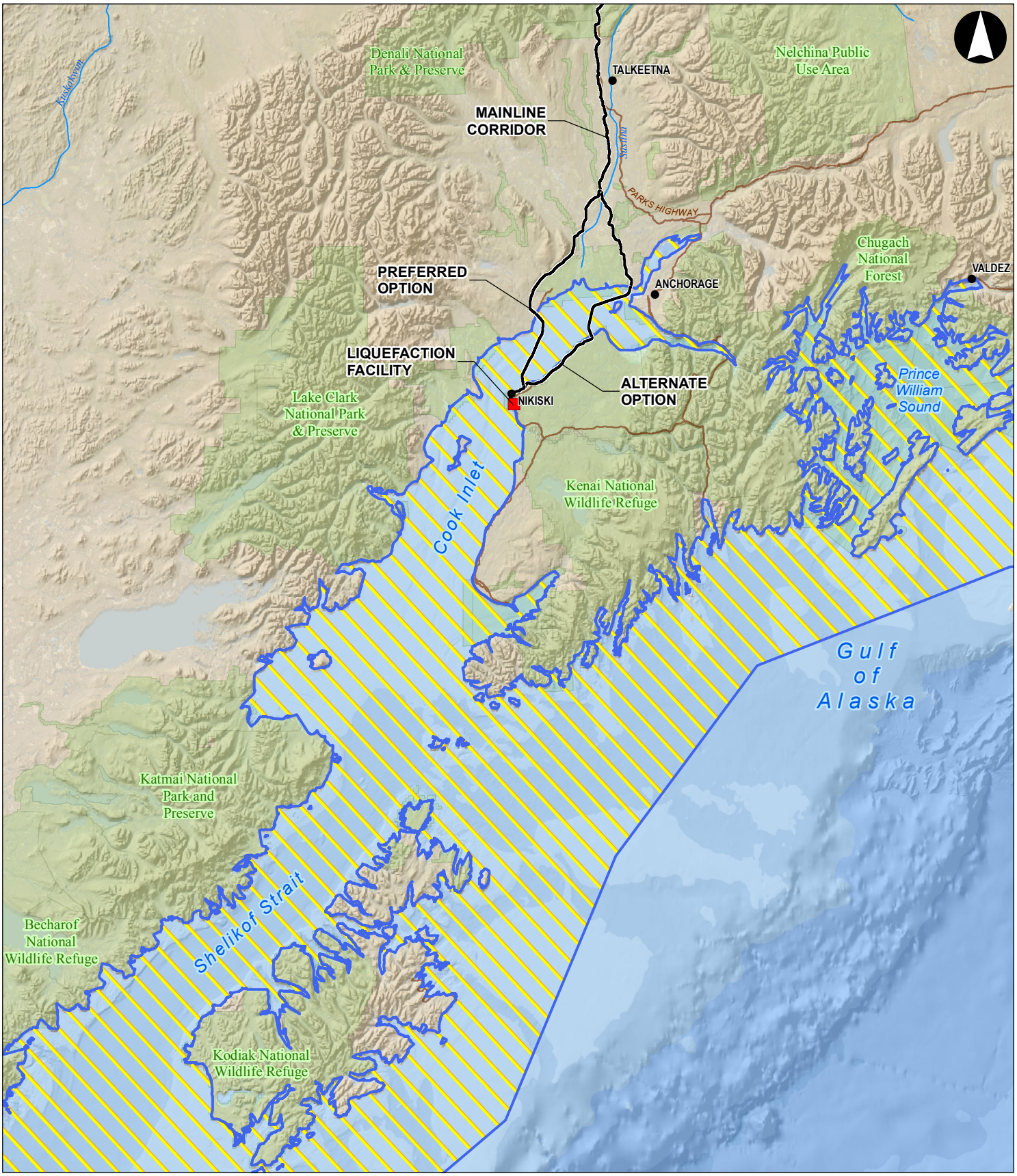
3.4.2.1 Liquefaction Facility

Non-ESA listed marine mammals that occur in Cook Inlet near the Liquefaction Facility include: harbor seals, killer whale, and harbor porpoise (Table 3.4.2-1). These marine mammals are described below, with additional information on occurrence in association with proposed Project facilities provided at the end of each description.

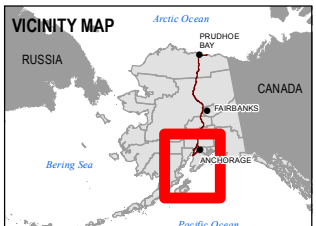
Harbor Seals

Harbor seals (*Phoca vitulina richardii*) inhabit coastal and estuarine waters along the West Coast, including southeast Alaska west through the Gulf of Alaska and Aleutian islands, in the Bering Sea and Pribilof Islands (Allen and Angliss, 2014). Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice, and forage on a wide variety of schooling fish, flatfish, crustaceans, and squid in marine, estuarine and, occasionally, fresh waters (Allen and Angliss, 2014). Harbor seals are considered nonmigratory, but make local movements associated with tides, weather, season, food availability, and reproduction (Allen and Angliss, 2014).

Harbor seals in Alaskan waters are assigned to 12 separate stocks. Of these stocks, harbor seals in the Cook Inlet/Shelikof stock are likely to occur within the Project area in Upper Cook Inlet (Figure 3.4.2-1).



VICINITY MAP



LEGEND

- Project Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Harbor Seal Distribution
- State and Federal Conservation Lands

0 15 30 60 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_2-1 Harbor Seal Distribution in Cook Inlet.mxd

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HARBOR SEAL DISTRIBUTION IN COOK INLET

FIGURE 3.4.2-1

Alaska LNG

The Cook Inlet/Shelikof stock was estimated at 22,900 seals in 2006 and is considered stable (Allen and Angliss, 2014).

Killer Whale

Killer whales (*Orcinus orca*) from both resident and transient stocks are found in the Gulf of Alaska. (Figure 3.4.2-2). Killer whales are widely distributed, although they occur in higher densities in colder and more productive waters (Allen and Angliss, 2014). Killer whales are toothed whales that feed on fish, birds, squid, turtles, and marine mammals. In general, resident stocks feed primarily on fish, while transient stocks eat primarily marine mammals. Killer whales have been implicated as causing significant mortality for both northern sea otters and Cook Inlet beluga whales.

Killer whales are found throughout all Alaskan marine waters, but occur most commonly over the continental shelf from Southeast Alaska through the Aleutian Islands and northward to the Chukchi and Beaufort seas. Whales from several resident and transient Pacific stocks could occur in the Project area in the Gulf of Alaska, Bering, Chukchi, and Beaufort seas. The estimated populations and trends for these killer whale stocks are eastern North Pacific Northern Resident stock – 261, increasing; combined Gulf of Alaska, Aleutian Islands, Bering Sea transient stock – 587, unknown; AT1 Transient stock – 7, declining (Allen and Angliss, 2014). Only one of these stocks, the AT1 Transient stock is considered depleted under the MMPA.

Killer whales are unlikely to occur near construction activities near the Marine Terminal in Upper Cook Inlet.

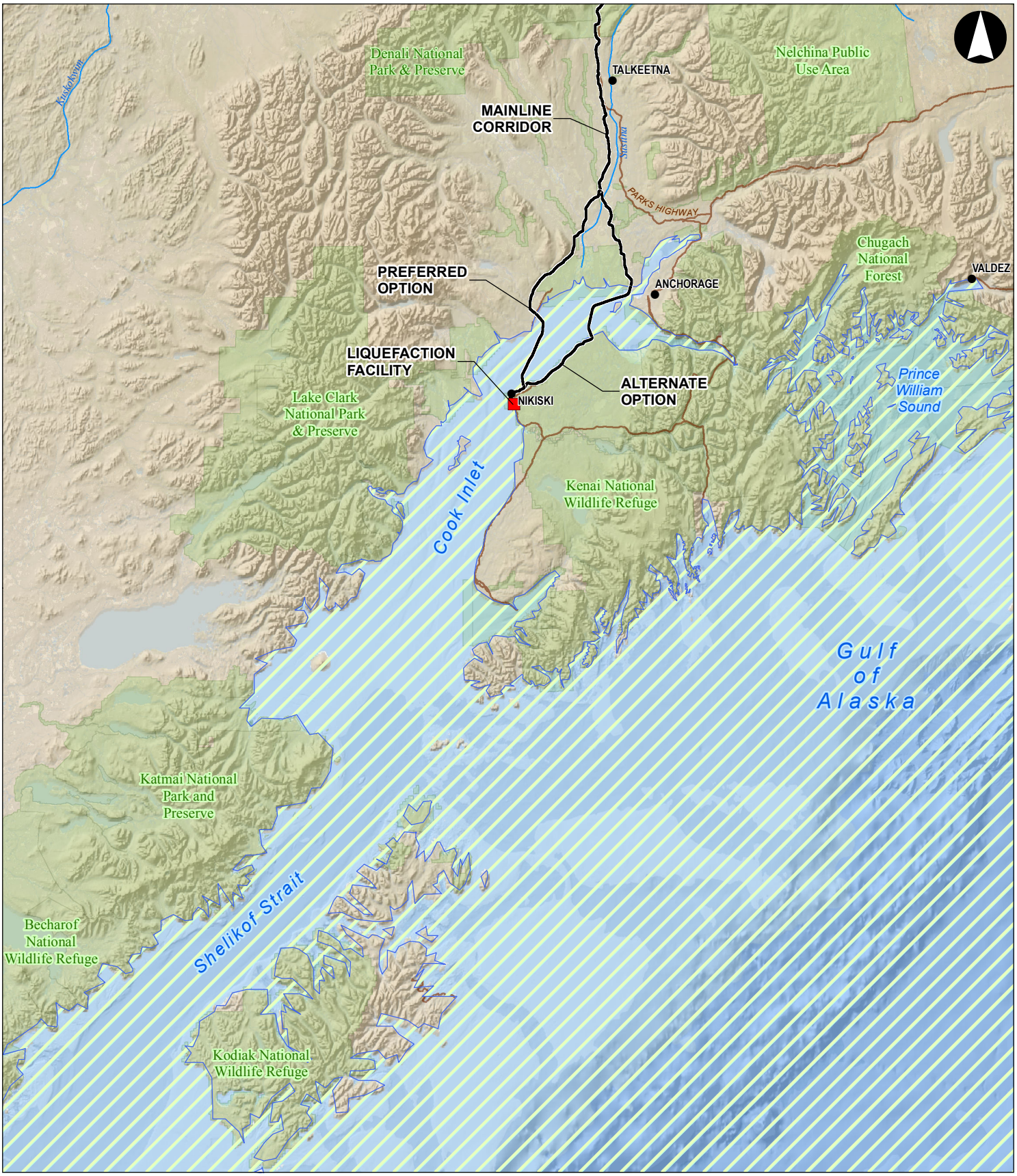
Harbor Porpoise

Harbor porpoises (*Phocoena phocoena*) are widely distributed in coastal areas from southeast Alaska to the Beaufort Sea (Allen and Angliss, 2014). They occur year-round in coastal areas on the south side of the Alaska Peninsula and Aleutian Islands (Figure 3.4.2-3). They occur most frequently in waters less than 300 feet deep; primarily frequenting coastal waters where they feed on schooling fish and invertebrates, including herring, mackerel, smelt, and squid. They generally travel alone or in small groups and are often concentrated in nearshore areas, bays, tidal areas, and river mouths. Three stocks of harbor porpoises have been defined for Alaskan waters, although with more data, additional stocks are likely to be distinguished (Allen and Angliss, 2014). The Gulf of Alaska stock occurs within the Project area. No reliable population estimate or trend is available; the previous estimate from 1998 was 25,987 for the Gulf of Alaska stock (Allen and Angliss, 2014).

Harbor porpoises are likely to occur near the Marine Terminal in Upper Cook Inlet (Allen and Angliss, 2014).

3.4.2.2 Interdependent Facilities

Non-ESA listed marine mammals that occur in the Beaufort Sea that could occur near the Offshore West Dock modifications include: bearded seals, spotted seals, and beluga whales (Table 3.4.2-1).



VICINITY MAP

LEGEND

- Project Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Killer Whale Distribution
- State and Federal Conservation Lands

0 15 30 60 Miles

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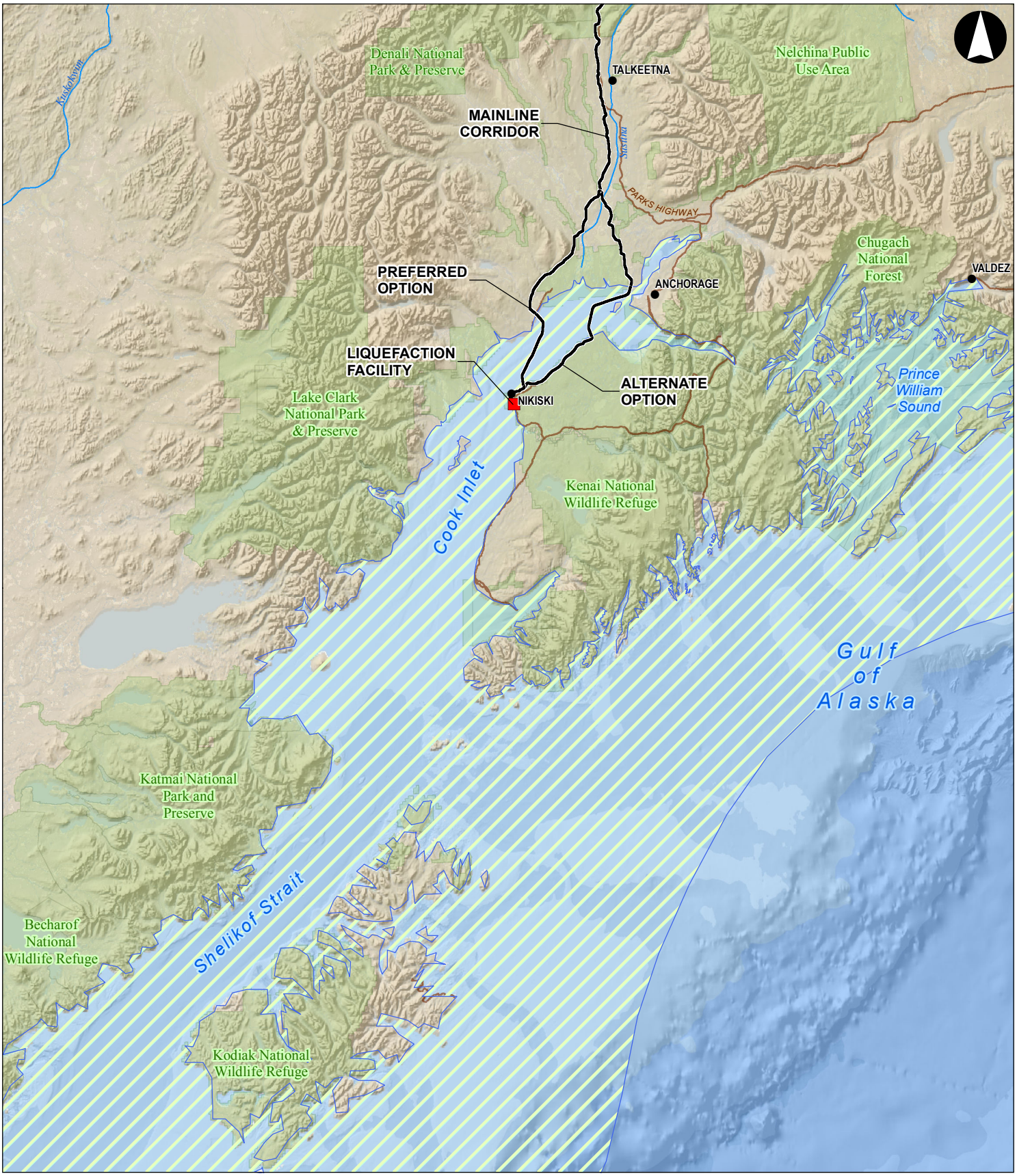
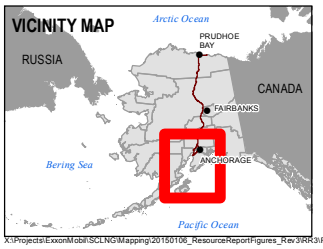
KILLER WHALE DISTRIBUTION IN COOK INLET

FIGURE 3.4.2-2

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_2-2 Killer Whale Distribution in Cook Inlet.mxd





X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_2-3 Harbor Porpoise Distribution in Cook Inlet.mxd

LEGEND

- Project Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Harbor Porpoise Distribution
- State and Federal Conservation Lands

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HARBOR PORPOISE DISTRIBUTION IN COOK INLET

FIGURE 3.4.2-3

Alaska LNG

Bearded Seal, Beringia DPS

Bearded seals in Alaska waters belong to the Alaska stock (Allen and Angliss, 2014) and the Beringia DPS. Bearded seals are an important subsistence resource. The bearded seal Beringia DPS was previously listed as threatened due to concern for the long-term survival of the population because of declines in sea-ice cover and quality in the Arctic, which is used by bearded seals for whelping and rearing pups, breeding, and haulout during molting (77 FR 76740). The Beringia DPS distribution extends over continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian seas (Allen and Angliss, 2014). On July 25, 2014, the United States District Court for the District of Alaska determined that NMFS's listing decision was arbitrary and capricious in light to the lack of any quantified threat of extinction within the reasonably foreseeable future and the finding that existing protections were adequate. The Court vacated the listing rule and remanded the rule back to NMFS for reconsideration. An appeal has been filed. Bearded seals remain protected under the MMPA.

Bearded seals overwinter in the Bering Sea, migrating north through the Bering Strait during April and May, as the sea-ice retreats. Seasonal movements and distributions are tied to seasonal changes in sea-ice conditions (Cameron et al., 2010). Bearded seals move north in late-spring and summer as the ice melts and then move south in the fall as sea-ice forms (Cameron et al. 2010). A few bearded seals remain near coasts and may haul out along shorelines in the Bering, Chukchi, and Beaufort seas (Cameron et al. 2010); they are most common in the Beaufort Sea over the continental shelf during August through October.

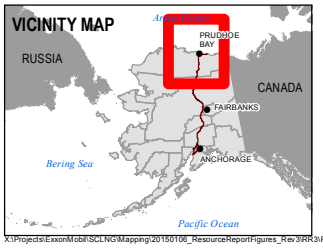
A few bearded seals are expected to occur near West Dock in summer.

Spotted Seals

Spotted seals (*Phoca largha*) are distributed along the continental shelf of the Bering, Chukchi, and Beaufort seas (Figure 3.4.2-4; Allen and Angliss, 2014). They are an important subsistence resource. Spotted seals overwinter in the Bering Sea along the ice edge making east-west movements along the ice edge (Allen and Angliss, 2014). During spring the seals prefer to the southern edge of the ice front and move northward following the sea ice retreat or into nearshore habitats. In summer and fall, spotted seals use coastal haulouts regularly, although they are generally associated with pack ice (Allen and Angliss, 2014). They forage on small schooling fish, shrimp, and octopus.

Spotted seals in Alaskan waters are assigned to a single stock, the Alaska stock, which has been designated the Bering Distinct Population Segment (DPS), which includes spotted seals in areas in the Beaufort, Chukchi, and East Siberian seas (Boveng et al., 2009). A recent estimate based on aerial surveys in the Bering Sea indicated the population was 133,700 with a 95 percent confidence interval of 137,300 to 793,100 (Ver Hoef et al., 2014). No reliable population estimates or trends are available (Allen and Angliss, 2014).

A few spotted seals are likely to occur near West Dock in summer.



X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_2-4 Spotted Seal Distribution in the Beaufort Sea.mxd

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Spotted Seal Distribution
- State and Federal Conservation Lands

0 15 30 60 Miles

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SPOTTED SEAL DISTRIBUTION IN THE BEAUFORT SEA

FIGURE 3.4.2-4

Alaska LNG

Beluga Whale

Beluga whales (*Delphinapterus leucas*) from the Eastern Chukchi Sea and Beaufort Sea stocks winter in the Bering Sea and summer in the Eastern Chukchi, or Beaufort seas (Figure 3.4.2-5; Allen and Angliss, 2014). Beluga whales from the Beaufort Sea and Eastern Chukchi Sea (Suydam 2009) stocks overlap in distribution during summer/fall and individuals from either stock could occur in the Beaufort Sea. Beluga whales are a subsistence resource. During winter, belugas occur in offshore waters associated with pack ice, in the spring, they move into warmer coastal estuaries, bays, and rivers where they molt and give birth (Allen and Angliss, 2014). Annual migrations may cover thousands of kilometers. Beluga whales are toothed whales that feed primarily on fish, squid, crabs, and clams.

The estimated populations and trends for the four beluga whale stocks are Beaufort Sea stock – 32,453, unknown; and Eastern Chukchi Sea stock – 3,710, stable (Allen and Angliss, 2014). Neither of these stocks are designated as depleted; although, because these beluga whales are closely associated with sea ice, concerns exist about climate change and related effects on prey availability (Allen and Angliss, 2014).

Cook Inlet beluga whales are discussed in Section 3.5.

3.4.3 Large Mammals

Big game mammals important to resident and subsistence hunters and wildlife enthusiasts in the Project area include wolf, caribou, moose, Dall sheep, muskoxen, brown bear, and black bear (Table 3.4.3-1).

TABLE 3.4.3-1

Terrestrial Large Mammals Potentially Occurring in the Project Area by Ecoregion

Common Name	Scientific Name	Habitat	Location in Project Area		
			Arctic Tundra	Intermontane Boreal	Alaska Range Transition
Black bear	*Ursus americanus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Riparian Zone; Rocks/Caves		√	√
Brown bear	*Ursus arctos*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra; Grass, Sedge; Riparian Zone; Rocks/Caves	√	√	√
Caribou	*Rangifer tarandus*	Boreal Forest; Low Shrub; Alpine, Arctic Tundra	√	√	√
Dall sheep	*Ovis dalli*	Alpine Tundra; Rocks/Caves	√	√	√
Moose	*Alces americanus*	Boreal, Coastal Forest; Tall Shrub; Alpine Tundra; Riparian Zone	√	√	√
Muskoxen	*Ovibos moschatus*	Alpine, Arctic Tundra	I		
Wolf	*Canis lupus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra; Gasslands; Riparian Zone; Nearshore Coast; Rocks/Caves	√	√	√

Sources: ADF&G, 2014d; MacDonald and Cook, 2009.

Notes:

√ = documented or very likely to occur in the Project area.

I = introduced in the Project area.

SUMMER DISTRIBUTION OF BELUGA WHALES IN THE BEAUFORT SEA

FIGURE 3.4.2-5

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Beluga Whale Distribution

0 25 50 Miles

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SCALE:	1:3,000,000		
DATE:	2015-01-06	SHEET:	1 of 1

VICINITY MAP

Beaufort Sea Stock

Eastern Chukchi Stock

Chukchi Sea

Beaufort Sea

BARROW

GTP FACILITY

PT THOMSON TRANSMISSION CORRIDOR

PT THOMSON FACILITY

PRUDHOE BAY

MAINLINE CORRIDOR

DALTON HIGHWAY

COLDFOOT

Colville

Koyukuk

Yukon

Porcupine

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_2-5 Summer Distribution of Beluga Whales in the Beaufort Sea.mxd

3.4.3.1 Liquefaction Facility

Large mammals that may occur near the Liquefaction Facility include moose, black bear, wolf, caribou from the Kenai Peninsula herds, and brown bear (Table 3.4.3-1). These large mammals are described below, with additional information on their range and potential occurrence near the Liquefaction Facility and Interdependent Facilities.

Black Bear

Black bears (*Ursus americanus*) occur over most of the forested areas of the state, with an estimated 100,000 bears in Alaska. Habitats favored by black bears include riverine scrub, lowland broadleaf forest, lowland needleleaf forest, and upland broadleaf forest. The northern limit of black bears in Alaska is the Brooks Range.

June through July is when mating takes place. The cubs are born in their dens following a gestation period of about seven months. The cubs are born blind and nearly hairless, weighing in under a pound. One to four cubs may be born, but two is most common. Cubs remain with their mothers through the first winter following birth. Black bears spend the winter months in a state of hibernation. Their body temperatures drop, their metabolic rate is reduced, and they sleep for long periods. Bears enter this dormancy period in the fall, after most food items become hard to find. They emerge in the spring when food is again available. Occasionally, in the more southern ranges, bears will emerge from their dens during winter. In the northern part of their range, black bears may be dormant for as long as 7 to 8 months. Females with cubs usually emerge later than lone bears. Dens may be found from sea level to alpine areas, in rock cavities, hollow trees, excavations, or even piled vegetation on the ground.

Black bears are opportunistic, although their foraging habits follow a pattern. Upon emerging in the spring, freshly sprouted green vegetation is their main food item, but they will eat nearly anything. Winter-killed animals are readily eaten and, in some areas, black bears have been found to be effective predators on new-born moose calves. As summer progresses, feeding shifts to salmon if they are available, but in areas without salmon, bears rely on vegetation, berries, ants, grubs, and other insects.

Brown Bear

Brown bears (*Ursus arctos*) occur throughout mainland Alaska. Brown bears are very adaptable and consume a wide variety of foods. Common foods include salmon, berries, grasses, sedges, cow parsnip, ground squirrels, carrion, and roots. In many parts of Alaska, brown bears are capable predators of moose and caribou, especially newborns. Bears may also be attracted to human camps and homes by improperly stored food and garbage, as well as by domestic animals.

Cubs are born in the den during January and February. Twins are most common, but litter sizes can range from 1 to 4. Females and cubs emerge from dens in spring. The mating season is in the spring (May to July). Bears enter their dens around September to late October, depending on the geographic area, and remain there until spring. Pregnant females are usually the first to enter dens in the fall. These females, with their newborn cubs, are the last to exit dens. Adult males, on the other hand, enter dens later and emerge earlier than most other bears. In northern areas, bears may spend up to 8 months in dens, while in areas with relatively mild winters, such as Kodiak, some male bears stay active all winter. Bears den in a variety of terrain ranging from pingos, streams, and lake banks at low elevations, to mountain slopes near the crest of the Brooks Range.

Bear populations in Alaska are considered healthy. Bear density within an area depends on the quality of the habitat. In areas of low productivity, such as on Alaska's North Slope, bear density may be as low as 1 bear per 300 square miles. Where food is abundant, bear density may be as high as 1 bear per square mile. In Interior Alaska, bear densities tend to be intermediate with about 1 bear per 15 to 25 square miles.

Caribou

Caribou (*Rangifer tarandus*) are distributed across Alaska and are managed as herds, which collectively encompass about 766,000 animals (Figure 3.4.3-1; ADF&G, 2011). Herds are defined based on their calving ranges (Skoog, 1968). South of the Brooks Range the Project passes through habitats used by the Hodzana Hills (HH), Ray Mountains (RM), White Mountains (WH), Delta, Denali, Kenai Mountains (KM), and Kenai Lowlands (KL) (Figure 3.4.3-1). The Liquefaction Facility is within the range of the KL caribou herd (Figure 3.4.3-1).

Calving occurs in mid-late May in Interior Alaska, and in early June in northern and southwestern Alaska. Most adult cows are pregnant every year and give birth to one calf. After calving, caribou coalesce into large post-calving aggregations of primarily cows and calves, which are later joined by bulls forming even larger aggregations during late-June to early July in response to mosquito harassment. ADF&G takes advantage of these large aggregations to photograph and count the caribou in each herd. These aggregations grow and may split and reform and move in response to weather and insects, generally moving into the direction of the prevailing winds. Summer aggregations of caribou in the arctic may contain animals from one or more herds. As insects abate in late summer and early fall, caribou scatter to forage and rut (breed). For the WAH, bulls spar during September, but actual rut, marked by serious fighting and breeding, occurs during mid to late October. Rut likely occurs during September for more southerly herds based on calving dates. After the rut, caribou move to wintering areas. Like most herd animals, the caribou must keep moving to find adequate food. Large herds often migrate long distances (up to 400 miles) between summer and winter ranges. Smaller herds may not migrate at all. In summer (May-September), caribou eat the leaves of willows, sedges, flowering tundra plants, and mushrooms. They switch to lichens, dried sedges, and small shrubs in September. Caribou movements are probably triggered by changing weather conditions, such as the onset of cold weather or snowstorms. Once migration is triggered, caribou can travel up to 50 miles a day.

Kenai Peninsula Caribou Herds

Caribou were once abundant on the Kenai Peninsula before a series of large fires in the late 1800s, which may have destroyed much of the lichen forage used by caribou as winter forage. It is likely that large-scale fires combined with unregulated hunting caused caribou to be extirpated from the Kenai Peninsula by the early 1900s. Reintroduction of caribou to the Kenai Peninsula began in the mid-1960s and established the Kenai Mountain (KM) and Kenai Lowland (KL) herds (McDonough, 2011).

Kenai Mountains Herd

The KM herd is comprised of about 300 caribou in GMU 7 that range over 540 square miles (1,400 square kilometers) in the Chickaloon River, Big Indian Creek, and Resurrection Creek drainages. Past population fluctuations suggest that this herd may be limited to 300-400 animals due to limited winter range (McDonough, 2011). This herd is not located in the vicinity of any proposed facilities, however it

ALASKA CARIBOU HERDS

FIGURE 3.4.3-1

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers

0 35 70 140 Miles

Herd Name		Herd Size (2011)
1	Adak	3,000
2	Beaver Mountains	70
3	Central Arctic	67,000
4	Chisana	700
5	Delta	2,985
6	Denali	2,100
7	Farewell-Big River	750
8	Fortymile	52,000
9	Fox River	75
10	Galena Mountain	100
11	Hodzana Hills	780
12	Kenai Lowlands	100
13	Kenai Mountains	275
14	Killey River	250
15	Macomb	1,300
16	Mentasta	350
17	Murichatna	30,000
18	Nelchina	46,500
19	Northern Peninsula	2,000
20	Nushagak Peninsula	800
21	Porcupine	169,000
22	Rainy Pass	1,500
23	Ray Mountains	1,370
24	Southern Peninsula	900
25	Sunshine Mountains	370
26	Teshekpuk	55,000
27	Tonzana	1,000
28	Unimak	300
29	Western Arctic	325,000
30	White Mountinas	650
31	Wolf Mountain	450

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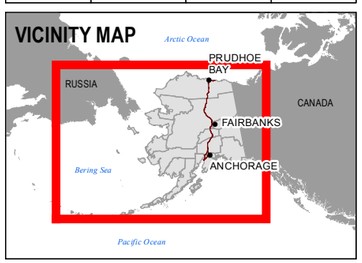
DATE:	2015-01-08	SHEET:	1 of 1

VICINITY MAP



X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_3-1 Alaska Caribou Herds.mxd

does range across road corridors that would likely be used for Project-related transportation to the Kenai Peninsula.

Kenai Lowlands Herd

The KL herd is comprised of 120 caribou that summer in GMU 15A, north of the Kenai Airport to the Swanson River and in the western portion of GMU 15B. This herd winters on the lower Moose River to the outlet of Skilak Lake and in the area around Browns Lake. The KL herd range encompasses about 463 square miles (1,200 square kilometers) around the communities of Soldotna, Kenai, and Sterling. Growth of this herd has been limited by predation; free-ranging domestic dogs and coyotes kill calves in summer and wolves prey on all ages during winter. This herd is not currently hunted (McDonough, 2011). This herd ranges in the vicinity of the proposed LNG plant and terminal.

Moose

Alaska supports about 175,000 to 200,000 moose (*Alces americanus*) that are widely distributed across most of the state. Moose are especially abundant on timberline plateaus, along major rivers of Southcentral and Interior Alaska, and on recently burned areas that have dense stands of willow, aspen, and birch shrubs. Moose calve in the spring, with calves weaned in the fall. Breeding occurs in late September and early October. During fall and winter, moose consume willow birch and aspen twigs. During summer, moose feed on forbs, vegetation in shallow ponds, and the leaves of birch willow and aspen. Moose make seasonal movements between calving, rutting, and wintering areas, traveling from a few miles to as many as 60 miles. Suitable moose habitat is characterized by mixed forest elements, dominated by white spruce, black spruce, paper birch, quaking aspen, and balsam poplar. Shrub communities of alder and willow are most common in riparian sites and surrounding lakes and meadows. Dwarf shrubs such as resin birch (*Betula glandulosa*), Labrador tea (*Ledum decumbens*), crowberry (*Empetrum nigrum*), and blueberry (*Vaccinium uliginosum*) are common in the uplands (Bertram and Vivion, 2002).

Western Kenai Peninsula: Total population is about 5,000 to 6,000 moose (GMU 15A – 1,670 ± 264 [95 percent CI]; 15B – 700 to 1,000; 15C – 2,500 to 3,500). Kenai moose populations are affected by severe winters. Moose populations in GMU 15A have been in decline, perhaps in part in response loss of habitat quality because of vegetation succession in burn areas from 1969. Predation and collisions with automobiles are leading causes of declines in the GMU 15A population. The moose population in subunit 15B has been relatively stable for the past decade. Vehicle mortalities for the 2008-2009 season were 101 for GMU 15A, 41 for GMU 15B, and 40 for GMU 15C (Selinger, 2010).

Wolf

Wolves (*Canis lupus*) occur throughout mainland Alaska, with an estimated population of 7,000 to 11,000 wolves. Wolves are found within nearly all of their historic range, except in urban areas, although they are found on the outskirts of Anchorage, Fairbanks, and Juneau. Wolves are social animals and usually live in packs that include parents and pups of the year. The average pack size is 6 or 7 animals. Pack members often include some yearlings and other adults, and packs maintain territories. Packs of 20 to 30 wolves sometimes occur, and these larger packs may have two or three litters of pups from more than one female. Typically one female wolf in a pack has a litter of about 7 pups each year. Pups are born in dens. Most adult male wolves in Interior Alaska weigh from 85 to 115 pounds; females average 10 to 15 pounds lighter and rarely weigh more than 110 pounds. In most of mainland Alaska, moose and/or

caribou are the primary prey for wolves, with Dall sheep, squirrels, snowshoe hares, beaver, and occasionally birds and fish as supplements in the diet. The rate at which wolves kill large mammals varies with prey availability and environmental conditions. A pack may kill a deer or moose every few days during the winter. Wolves were considered scarce in the arctic tundra region, and common in both the interior boreal and Alaska Range regions with no changes in populations based on indices developed from the 2012-2013 Trappers Survey (ADF&G, 2013b).

3.4.3.2 Interdependent Facilities

In addition to the large mammals described above, Dall sheep and muskoxen may occur near Interdependent Facilities. Caribou from the arctic and mountain herds may also occur near Interdependent Facilities. All of the large mammals described above for the Liquefaction Facility are likely to occur near Interdependent Facilities (Table 3.4.3-1). Additional information on abundance and habitats used by large mammals near Interdependent Facilities are discussed below.

Caribou

Caribou (*Rangifer tarandus*) are distributed across Alaska and are managed as herds, which collectively encompass about 766,000 animals (Figure 3.4.3-1; ADF&G, 2011). Herds are defined based on their calving ranges (Skoog, 1968). South of the Brooks Range the Project passes through habitats used by the Hodzana Hills (HH), Ray Mountains (RM), White Mountains (WH), Delta, Denali, Kenai Mountains (KM), and Kenai Lowlands (KL) caribou herds (Figure 3.4.3-1). Caribou are nomadic and are the most abundant large mammal in the arctic, where four herds are recognized: West Arctic (WAH), Teshekpuk, (TCH) Central Arctic (CAH), and Porcupine (PCH; Figure 3.4.3-1). The Project will cross through the calving range for the CAH (Figure 3.4-1). Calving CAH caribou occur on either side of the Sagavanirktok River. The Mainline corridor will be located between these two calving ranges; the PTTL will cross through the eastern calving range (Figure 3.4-1). The calving ranges for the WAH, TCH, and PCH are not near the Project.

<u>Arctic Caribou Herds</u>

Central Arctic Herd

The CAH was recognized as a discrete herd in the mid-1970s. This herd traditionally calves between the Colville and Kuparuk rivers and between the Sagavanirktok and Canning rivers. The summer range extends from Fish Creek, just west of the Colville River, eastward along the coast to inland within about 30 miles to the Katakturuk River in the Arctic National Wildlife Refuge. The CAH winters in the northern and southern foothills and mountains of the Brooks Range. The CAH range overlaps with the PCH on their summer and winter

The CAH increased from 5,000 animals in the 1970s to 13,000 in the early 1980s to 23,000 in the early 1990s, and then declined to 18,000 in the mid-1990s. Subsequently, the herd increased at a rate of 9.5 percent per year from 18,100 caribou in 1995 to 65,000 caribou in 2010 and then declined to 50,753 in 2013 (Lenart, 2014). A decline in the CAH in the mid-1990s was attributed to decreased productivity related to cumulative effects from petroleum development in the calving area between the Colville and Kuparuk rivers that resulted in changes in calving distribution and increased energy expenditure during the insect season for cows exposed to oilfield infrastructure (Cameron et al., 2005). Productivity in this calving area, over the 30-year period from 1978 to 2008, has also been related to weather patterns

reflecting the annual intensity of the Arctic Oscillation (Joly et al., 2011). Typical Arctic Oscillation weather patterns associated with decreased caribou productivity include: decreased sea-level pressure, increased winter and decreased summer temperatures, and increased annual precipitation, snowfall, winter cloudiness, and summer cloudiness (Joly et al., 2011). Herd increases are attributed to high parturition rates, high early summer calf survival, and low adult mortality (Lenart, 2011a). Other factors potentially responsible for the changes in herd numbers may include winter mortality and emigration/immigration (Cronin et al., 1997, 2000). The Mainline corridor would cross the summer and winter range for the CAH and the PTTL would cross the east calving range for this herd (Figure 3.4-1).

Porcupine Caribou Herd

The PCH migrates between Alaska, and the Yukon and Northwest Territories in Canada. In the 1980s and 1990s, most of the PCH calved in the Arctic NWR, often on the coastal plain east of the Canning River. Since 2000 the PCH has primarily calved in the Yukon, with calving in 5 of 9 years on the coastal plain between the Alaska-Canada border and the Babbage River. In 2010, 56 percent of radio-collared cows calved in the Arctic NWR, with 16 percent of these in the 1002 Area on the coastal plain east of the Canning River (Caikoski, 2011). In summer 2010, most PCH caribou were distributed across the northern foothills of the Brooks Range between the Jago and Hulahula Rivers, but in late June and early July a portion of the herd moved to the south side of the Brooks Range. Those caribou that stayed north of the Brooks Range moved west between the Canning River and Hulahula River drainages. In fall and winter, PCH disperse over a large area including the Coleen and Middle Fork Chandalar river drainages near Arctic Village (Caikoski, 2011; Figure 3.4.3-1). The PCH reached a peak of 178,000 in 1989 and declined to 123,000 in 2001, during a period when many PCH caribou calved in the Yukon, then increased to 169,000 in 2010 (Caikoski, 2011). Prior to 2010, population estimates were considered minimum estimates. The most recent population estimate in 2013 was 197,000 (± 28,561 95 percent confidence interval [CI]) (Caikoski, 2014). This herd is an important subsistence resource and is jointly management by the U.S. and Canada through the International Porcupine Caribou Board. A few PCH could range near the Project corridor during summer or winter; but this herd generally ranges well east of the Project corridor (Caikoski, 2014). The PTTL would be located west of the PCH calving range (Caikoski, 2014).

Teshekpuk Caribou Herd

The TCH was recognized as a discrete herd from the WAH and CAH in 1978, based on calving distribution. The TCH primarily ranges on the coastal plain north of the Brooks Range during spring and summer. Intensive studies of this herd have shown high fidelity to calving areas surrounding Teshekpuk Lake, extensive use of coastal habitats between Cape Halkett and Barrow for in sect relief, broad use of the coastal plain west of the Colville drainage in late summer, and highly variable use of winter ranges (Parrett, 2011; Person et al., 2007). During an attempted photocensus on July 31, 2010, collared TCH cows were aggregated with collared cows from both the CAH and the WAH (Parrett, 2011). Movement and range overlap between these 3 herds continue, with potential for influencing the population estimates. Emigration has been primarily in the direction of TCH into the WAH (Parrett, 2011); although CAH were mixed with TCH animals during both the 2011 and 2013 photocensuses (Parrett, 2014). The winter distribution of the TCH has been shifting in recent years, and remains unpredictable; although there is use of the central Brooks Range (Parrett, 2011). High (32 percent) adult female mortality was observed in 2012-2013 (Parrett, 2014). The most recent photo census for the TCH on July 16, 2013 indicates the herd was 39,000 ± 15 percent Standard Error with an annual rate of decrease of about 18 percent (Parrett,

2014). The Project corridor would cross the summer and winter range for the TCH; the calving area for this herd is primarily located around Teshekpuk Lake, well west of the Project corridor.

Western Arctic Herd

The WAH is the largest caribou herd in Alaska, ranging over 157,000 square miles. In spring, most mature cows travel north toward calving grounds in the Utukok Hills; bulls and lag and generally move toward summer range in the Wulik Peaks and Lisburne Hills. Following calving, cows and calves move southwest toward the Lisburne Hills. Summer range consists of the Brooks Range and its northern foothills west of the Trans-Alaska pipeline. During summer, the WAH moves eastward through the Brooks Range. WAH caribou are more dispersed during fall as they move southwest toward wintering grounds. In the early 1970s, the WAH was estimated at 242,000 animals. The herd reached 400,000 in the 1990s and fluctuated around between 400,000 and 475,000 until it began to decline around 2007 (Dau, 2011). T he current estimate is 325,000 (Dau, 2011). The Project corridor would skirt wintering areas used by the WAH (sub Area 5 in the central Brooks Range, north of the Koyuktuk River and west of the Dalton Highway, sub Area 6 in the Koyukuk drainage south of the Brook Range) (Dau, 2011). Average winter (November through March) densities in these sub areas were 2.7 and 2.1 caribou per square mile during winters of 2006 through 2010, respectively (Dau, 2011).

Mountain Caribou Herds

Hodzana Hills Herd

The HH herd, with about 780 caribou, is named for the area where these caribou calve. Small groups of caribou in the Hodzana Hills were previously considered part of the Ray Mountains herd. Traditional ecological knowledge suggests that this herd is a relict population of once vast herds that migrated across western Alaska. This herd resides and calves primarily in the hills at the headwaters of the Dall, Kanuti, and Hodzana rivers, on the border of Units 24A and 25D (Hollis, 2011). In October 2006, a few groups were located south of Caribou Mountain on the west side of the Dalton Highway. Caribou groups observed along the Dalton Highway near Finger Mountain belong to the Hodzana Hills herd (Hollis, 2011). Caribou from the HH herd would occur in the Project corridor along the Dalton Highway near Finger Mountain.

Ray Mountains Herd

The RM herd, with about 1,850 caribou, calves in the Ray Mountains around Kilo Hot Springs and winters to the north in the Kanuti and Kilolitna River area. Traditional ecological knowledge suggests that this herd is a relict population of once vast herds that migrated across western Alaska. During winter this herd is primarily located on the northern slopes of the Ray Mountains and during calving on the southern slopes of the Ray Mountains in the upper Tozitna River drainages. Summer range is in the alpine areas of the Ray Mountains, frequently in the Spooky Valley area around Mount Henry Eakins and occasionally south of the upper Tozitna River (Hollis, 2011). Caribou from the Ray Mountains Herd would normally range west of the Project corridor.

White Mountain Herd

The WM herd was recognized as a discrete herd in the late 1970s, with 100 to 200 caribou. The current herd size is 530 to 500 (Seaton, 2011a). This herd remains year-round in the White Mountains. The White Mountains National Recreation Area, managed by BLM, encompasses most of the WM herd range. Calving is widespread and dispersed, similar to other small mountain herds (Barten et al., 2001). Calving is primarily in the higher elevations east of Beaver Creek, with some scattered calving west of Beaver Creek. Post-calving aggregations occur from mid June to late July east of Beaver Creek to Mount Prindle; and this herd winters (Seaton, 2011a). The range of this herd is located about 15 miles east of the Project corridor; few if any WM herd caribou would be expected within the Project corridor.

Delta Herd

The Delta herd primarily ranges through the foothills of the central Alaska Range between the Parks and Richardson highways, north of the divide separating the Tanana and Susitna river drainages much of which is within GMU 20A. This herd has also used the upper Nenana and Susitna river drainages north and south of the Denali Highway (Seaton, 2011b). The Delta herd has been the focus of research and intensive management with long-term studies of population dynamics, ecology, and predator-prey relationships. The Delta herd calves between the Delta and Little Delta rivers, into the foothills between Dry Creek and the Delta River, and the upper Wood River, Dick Creek, upper Wells Creek, upper Nenana, and upper Susitna drainages. During the remainder of the year the Delta herd is generally distributed among the northern foothills from the Delta to the Nenana River. Caribou from the Delta herd have been found south of the Alaska Range in the Susitna River drainage along the Denali Highway and south to Butte Lake. Mixing with the Nelchina herd in recent years has complicated accurate herd size estimates (Seaton, 2011b). Caribou from the Delta herd could occur in the Project corridor near the Parks Highway.

Denali Herd

The Denali herd, estimated at about 2,300 caribou, primarily uses Denali National Park for its range (Adams, 2013). This herd has been monitored continuously since 1984 (Adams, 2013). Seasonal ranges within the park used by this herd were described by Boertje (1985); the Denali herd calve in two areas the Stampede and Cantwell calving areas; moving into summering and wintering areas in the Kantishna Hills, Stampede Hills and north of Mount McKinley. The Cantwell calving is northwest of the Parks highway and southwest of Cantwell (Boertje, 1985). The Denali herd is considered to be slowly increasing (NPS, 2013; Adams, 2013). Caribou from the Denali herd could occur within the Project corridor near Denali National Park along the Parks Highway.

Nelchina Herd

The Nelchina herd calves in the eastern Talkeetna Mountains from the Little Nelchina River north to Fog Lakes. This area is also used during postcalving and early summer. During summer and early fall caribou disperse, with fall distribution extending from the Denali Highway near Butte Lake, across the Alphabet Hills and to the Lake Louise flats. In 2009 and 2010, rutting was concentrated in the center of GMU 13. Winter range for the NCH extends from Cantwell in GMU 13E east across GMUs 11 and 12 into the Yukon Territory. The Nelchina herd has remained at over 30,000 caribou since 2005; the current estimate is 45,000 (Schwanke, 2011). The Nelchina herd is important to large numbers of hunters because of its

accessibility from the road system and proximity to Anchorage and Fairbanks. Caribou from the Nelchina herd could occur within the Project corridor near the Parks Highway.

Dall Sheep

Dall sheep (*Ovis dalli*) are found in Alaskan mountain ranges including the Kenai Mountains, the Chugach Mountains, the Alaska Range, the White Mountains, and the Central and Eastern Brooks Range. Dall sheep are found in relatively dry country and frequent a special combination of open alpine ridges, meadows, and steep slopes with extremely rugged "escape terrain" in the immediate vicinity. They use ridges, meadows, and steep slopes for feeding and resting. When danger approaches they flee to the rocks and crags to elude pursuers. They are generally high country animals but sometimes occur in Alaska in rocky gorges below timberline.

Lambs are born to ewes in late May or early June. As lambing time approaches, ewes seek solitude and protection from predators in the most rugged cliffs available on their spring ranges. Ewes form matrilineal groups with their offspring and show fidelity to annual ranges, while rams live in bands and travel more widely, mixing with ewe groups during the mating season in late November and early December. The diets of Dall sheep vary from range to range. During summer, food is abundant, and a wide variety of plants is consumed. Winter diet is much more limited and consists primarily of dry, frozen grass and sedge stems available when snow is blown off the winter ranges. Some populations use significant amounts of lichen and moss during winter. Many Dall sheep populations visit mineral licks during the spring and often travel many miles to eat the soil at these unusual geological formations.

Major rivers subdivide the landscape that potentially present barriers to sheep movement, thereby contributing to genetic sub-structuring of the population over time (Craig and Leonard, 2009). Suitable habitat for Dall sheep in the Project area are found within the BLM-managed Galbraith Lake ACEC (refer to Section 3.4.8), and nearby mountain valleys of the Interior. Other habitat features, including mineral licks and escape terrain, have been shown to be essential components of Dall sheep habitat, which have led to their designation as ACECs (Craig and Leonard, 2009). Craig and Leonard (2009) studied the movements and habitat use of Dall sheep in five ACECs on BLM-managed land in the eastern Brooks Range, including the Galbraith Lake ACEC. All of the ACECs in the Craig and Leonard (2009) study were used by sheep year-round. Sheep were found to generally select summer habitats that were in the in the high terrain with rock and gravel surface that was sparsely vegetated. Lambing and ewes habitat were commonly located in or near escape terrain.

Dall sheep populations in Alaska are generally considered to be healthy. Sheep numbers typically fluctuate irregularly in response to a number of environmental factors. Sheep populations tend to increase during periods of mild weather. Then, sudden population declines may occur as a result of unusually deep snow, summer drought, or other severe weather. Low birth rates, predation (primarily by wolves, coyotes, and golden eagles) and a difficult environment tend to keep Dall sheep population growth rates lower than for many other big game mammals.

Moose

Moose habitats would be crossed by Interdependent Facilities from the Arctic Tundra to Cook Inlet (Table 3.4-1) primarily through portions of GMUs 26B, 24A, and 20F within the Dalton Highway Management Corridor north of the Yukon River; and portions of GMUs 20F, 20B, 20A/20C, 13E, 16A,

16B, 14A, and 15A south of the Yukon River. Small portions or borders of GMU 25A, 25D, and 14C would also be crossed.

Arctic Tundra [Beaufort Coastal Plain, Brooks Foothills] (GMU 26B)

Moose are not abundant on the Coastal Plain, and are generally associated with narrow strips of riparian shrub habitats except during calving and summer when there some seasonal movements away from riparian corridors occurs (Lenart, 2010). The Mainline would cross through moose wintering habitat in this GMU. The moose population in GMU 26B declined during the early 1990s due to a combination of disease, weather, predation and insect harassment. The population gradually increased during the 2000s to about 570 moose in the spring 2008 (Lenart, 2010). Low recruitment in 2008 and 2009 and potential high adult mortaility led to decreased abundance to 450 moose in the spring 2010 trend counts (Lenart, 2010).

Intermontane Boreal [Brooks Range, Ray Mountains] (GMU 24A)

Local moose densities throughout GMU 24 are typical of interior Alaska ranging from 0.25 to 2.0 moose per square mile (Stout, 2010). The Mainline parallels the GMU 24A Middle Fork composition area that with 0.87 moose per square mile in fall 2008 with a total of about 100 moose (Stout, 2010). The Mainline crosses through moose winter habitat in the Fish Creek drainage. The majority of cows appear to be non-migratory in the upper Koyukuk drainage with 40 percent moving more than 12 miles between summer and winter ranges (Stout, 2010).

Intermontane Boreal [Ray Mountains] (GMU 20F)

Moose densities have been low fluctuating from 0.25 and 0.50 moose per square mile for many years, presumably due to predation and habitat limitations (Hollis, 2010). Much of the habitat is mature black spruce that is poor quality moose habitat although many riparian habitats subalpine hills and burns contain habitats of sufficient quality to sustain higher densities of moose (Hollis, 2010). The Mainline would cross through moose wintering habitat in riparian areas of the Yukon River and Hess Creek.

Intermontane Boreal [Ray Mountains, Tanana-Kuskokwim Lowlands] (GMU 20B)

Moose densities have increased in this subunit since the 1990s to an estimated 1.9 moose per square mile in 2008 (Seaton, 2010). Moose are distributed throughout this unit, with both migratory and nonmigratory populations; from February to April some bull and cow moose migrate from the Chena and Salcha River drainages to summer range on the Tanana Flats in GMU 20A (Seation, 2010). Browse surveys indicate that use of preferred browse is moderately high, and consequently antlerless harvests have been used in portions of central Unit 20B to limit moose population growth (Seaton, 2010). The number of moose-vehicle collision mortality has been substantial in some years averaging 148 per year from 2002 to 2009 (range 122 to 189 per year; Seaton, 2010). Habitat enhancement project have included prescribed fire and regeneration of decadent willows by planting and crushing willows in recently logged areas (Seation, 2010). The Mainline would cross through moose wintering and calving habitats in Minto Lakes area, and Tatalina, Chatanika, and Tanana river drainages.

Intermontane Boreal and Alaska Range [Tanana-Kuskokwim Lowlands, Alaska Range] (GMU 20A and 20C)

The Mainline would generally follow along the border between the world class moose resource in GMU 20A and the relatively low moose densities in GMU 20C (Young, 2010; Hollis, 2010). Most of Denali National Park and Preserve is within GMU 20C. Moose densities remained at an estimated 2.5 to 3.1 moose per square mile in GMU 20A during 2005 to 2009 with an estimated decline in about 4 percent per year (± 2 percent per year Standard Error [SE]) in the cow segment of the population (Young, 2010). Several large fires over the past decade may improve productivity for the GMU 20A moose population which is considered to be above habitat capacity (Young, 2010). Moose densities in GMU 20C are estimates at 0.58 moose per square mile within Denali National Park and 0.25 moose per square mile outside the park based on 1991 and 1994 surveys, respectively (Hollis, 2010). Highway and train collisions are considered underreported for both of these GMUs with a reported average of 11 moose per year (range 6 to 18 moose collision mortalities per year, Hollis, 2010; Young, 2010). The Mainline would cross through calving, rut, and winter moose habitat along the valley along the border between GMU 20A and 20B.

Alaska Range [Alaska Range and Cook Inlet Basin] (GMU 13E)

Fall moose density in GMU 13E was 0.9 moose per square mile in 2009 (Tobey and Schwanke, 2010). Moose are considered to be increasing throughout GMU 13 due to a combination of good productivity, mild winters, and lower wolf predation due to predator management (Tobey and Schwanke, 2010). Vehicle and train collisions are estimated at about 75 moose per year (Tobey and Schwanke, 2010). The Mainline would cross thorugh rut and winter habitat along the Chulitna River drainage in GMU 13E).

Alaska Range [Cook Inlet Basin] (GMU 16A)

This moose population in GMU 16A on the west side of the Susitna River has fluctuated greatly (Peltier, 2010a). Severe winters and predation are factors, and this is an area where intensive management is taking place (Peltier, 2010a). The population estimate is about 1,619 ± 197 in 2005 (Peltier, 2010a). About 15 moose per year are killed by cars (Peltier, 2010a). The Mainline preferred route would cross through winter habitat in the Susitna, Moose Creek, and Skwentna river drainages.

Alaska Range [Cook Inlet Basin] (GMU 16B)

This moose population in GMU 16B on the west side of the Susitna River does not appear to have recovered from the severe winter of 1999-2000 when deep snow and icing lead to high mortality (Peltier, 2010b). The population estimate was 4,323 ± 529 in 2009 (Peltier, 2010b). The Mainline preferred route would cross through calving, rut, and winter habitat in the Skwentna and Susitna river drainages in GMU 16B.

Alaska Range [Cook Inlet Basin] (GMU 14A)

The moose population in GMU 14A on the east side of the Susitna River and the Matanuska-Susitna Valley was estimated at 6,613 ± 727 [80 percent confidence interval] in 2007 and appears to have remained stable since 2001 (Peltier, 2010c). An average of 232 moose per year were killed by cars and trains in GMU 14A during 2000 to 2009 (range 132 to 382; Peltier, 2010c).

Muskoxen

Muskoxen (*Ovibos moschatus*) occur on the Arctic Coastal Plain. Muskoxen use coastal plain river corridors, floodplains, foothills, and bluff habitats year-round (Reynolds et al., 2002). Muskoxen have a low reproductive potential usually producing a single calf (Lent, 1998). Females 3 or more years of age averaged 0.68 births per female during 2007 to 2011 (Arthur and Del Vecchio, 2013). Calves are usually born from April through June (Lent, 1998). During 2007 through 2011, most muskoxen calves (58 percent) were born between May 1 and May 15, with 83 percent born by June 1; although a small number of calves may be born throughout the summer (Arthur and Del Vecchio, 2013).

Muskoxen eat larger proportions of grasses and sedges and smaller proportions of forbs in coastal compared to inland sites (Arthur and Del Vecchio, 2013). During summer, muskoxen form relatively small groups and travel more widely than during winter when groups tend to be larger and more sedentary (Lenart, 2011b). Radio-collared muskoxen used the Sagavanirktok River, the Sagavanirktok River delta, and the Canning River during 2007 to 2011 (Arthur and Del Vecchio, 2013).

The number of muskoxen in the area between the Colville and Canning rivers (Game Management Unit 26B) declined between 2003 and 2006, but remained stable at about 200 during 2007 through 2010 (Lenart, 2011b). While emigration from Artic NWR may have caused some of the decline in that area, reduced net productivity and recruitment were also evident (Reynolds et al., 2002; Lenart, 2003). Predation by brown bears has been identified as the most important factor limiting the growth of this population accounting for 57 percent of calf mortality and 62 percent of adult mortality with known causes (Arthur and Del Vecchio, 2013). Muskoxen are occasionally struck by vehicles on the Dalton Highway (Lenart, 2011b).

3.4.4 Furbearers and Small Mammals

Furbearers and small mammals potentially occurring in the Project area with typical habitats and regional occurrence are listed in Table 3.4.4-1. Brief descriptions of these animals follow. The primary references for this information are MacDonald and Cook (2009), the ADF&G Species Home – Animals (2014d), and the AKNHP Animal Data Portal website (2014a). Their habitats are briefly described. In general from north to south the diversity of native furbearers and small mammals increases, with 20 species in the Arctic Tundra Ecoregion, 35 species in the Intermontane Boreal Ecoregion, and 32 species in the Alaska Range Transition Ecoregion (MacDonald and Cook, 2009). Many furbearers and small mammals that occur within the proposed Project area are moderately to widely distributed throughout Alaska (MacDonald and Cook, 2009). The AKNHP tracks four furbearers and small mammals within the ecoregions crossed by the Project; Alaska marmot, Alaska tiny shrew, American water shrew, and little brown myotis. The Alaska tiny shrew is also a BLM Sensitive Species.

Two introduced small mammals, the house mouse (*Mus musculus*) and brown rat (*Rattus norvegicus*) generally occur in association with residential areas, refuse dumps, sewers, wharfs, and beaches, although their distribution and abundance in Alaska are not well known. House mice have been reported in the Project area from Fairbanks, Palmer, Eagle River, Anchorage, and Kasilof (MacDonald and Cook, 2009). Brown rats have been reported in the Project area from Fairbanks, Tanana, and Kenai (MacDonald and Cook, 2009). These animals have damaged sensitive Alaska ecosystems, especially seabird colonies in the Aleutian Islands; millions have been spent to eradicate rats from island seabird nesting colonies in the Aleutian Islands. They also carry diseases that are transmissible to humans and other wildlife. Rats are spread primarily by marine vessels, maritime shipping, and shipwrecks, but may also be transported by

aircraft (Fritts, 2007). Wildlife regulations on rats prohibit transport, harboring, or release of live mice or rats (5 AAC 92.141).

TABLE 3.4.4-1

Furbearers and Small Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Habitats	Status[a]	Location in Project Area[b]		
				AT	IB	AR
RODENTS						
Squirrels						
Alaska Marmot	*Marmota broweri*	Alpine Tundra; Rocks/Caves	Unknown	√	√	
Arctic Ground Squirrel	*Spermophilus parryii*	Alpine, Arctic Tundra; Grass; Rocks/Caves; Sparse Vegetation	Locally Abundant	√	√	√
Hoary Marmot	*Marmota caligata*	Alpine Tundra; Rocks/Caves	Common		√	√
Northern Flying Squirrel	*Glaucomys sabrinus*	Boreal, Coastal Forest	Unknown		√	√
Red Squirrel	*Tamiasciurus hudsonicus*	Boreal, Coastal Forest, Artificial Structures	Common		C nc	C nc
Woodchuck	*Marmota monax*	Boreal Forest	Rare-Uncommon		√	
Beavers						
American Beaver	*Castor Canadensis*	*Marsh; Lakes & Ponds; Rivers & Streams; Riparian Zone*	Common-Abundant		C nc	C nc
Mice and Voles						
Brown Lemming	*Lemmus trimucronatus*	Low Shrub; Alpine, Arctic Tundra; Grass, Sedge, Bog; Riparian Zone; Rocks/Caves	Scarce-Abundant	√	√	√
Collared Lemming	*Dicrostonyx groenlandicus*	Low Shrub; Alpine, Arctic Tundra; Rocks/Caves	Scarce-Abundant	√		
Common Muskrat	*Ondatra zibethicus*	Marsh; Lakes & Ponds; Rivers & Streams; Riparian Zone	Common-Abundant		S nc	S nc
Meadow Jumping Mouse	*Zapus hudsonius*	Boreal, Coastal Forest; Alpine Tundra; Grass, Sedge, Marsh; Riparian Zone	Locally Abundant		√	√
Meadow Vole	*Microtus pennsylvanicus*	Grass, Sedge, Bog, Marsh; Riparian Zone	Common-Abundant		√	√
Northern Bog Lemming	*Synaptomys borealis*	Boreal, Coastal Forest; Tall, Low Shrub; Grass, Sedge, Bog, Marsh; Riparian Zone	Rare-Uncommon		√	√
Northern Red-backed Vole	*Myodes rutilus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Riparian Zone; Rocks/Caves; Sparse Vegetation; Artificial Structures	Very Common-Abundant	√	√	√
Root Vole	*Microtus oeconomus*	Tall, Low Shrub; Alpine, Arctic Tundra; Grass, Sedge, Bog Marsh; Riparian Zone; Rocks/Caves	Common	√	√	√
Singing Vole	*Microtus miurus*	Low Shrub; Alpine tundra; Grass; Riparian Zone; Rocks/Caves	Moderately Abundant	√	√	√
Taiga Vole	*Microtus xanthognathus*	Boreal Forest; Tall, Low Shrub; Grass; Riparian Zone	Unknown		√	
Mice/Rodents	*Various*	Trappers Survey		A nc	C nc	C nc

TABLE 3.4.4-1

Furbearers and Small Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Habitats	Status[a]	Location in Project Area[b]		
				AT	IB	AR
Porcupine						
North American Porcupine	*Erethizon dorsatum*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass, Marsh; Riparian Zone; Rocks/Caves; Sparse Vegetation; Artificial Structures	Common	√	√	√
LAGOMORPHS – Pikas and Hares						
Collared Pika	*Ochotona collaris*	Alpine Tundra; Rocks/Caves; Sparse Vegetation	Locally Common		√	√
Snowshoe Hare	*Lepus americanus*	Boreal Forest; Tall Shrub; Riparian Zone	Common-Abundant	C -	C -	C nc
INSECTIVORA – Shrews						
Alaska Tiny Shrew	*Sorex yukonicus*	Boreal Forest; Tall Shrub; Grass; Riparian Zone; Rocks/Caves	Rare	√	√	√
American Water Shrew	*Sorex palustris*	Boreal, Coastal Forest; Tall Shrub; Grass, Marsh; Lakes & Ponds, Rivers & Streams, Riparian Zone	Local Uncommon		√	√
Barren Ground Shrew	*Sorex ugyunak*	Alpine, Arctic Tundra; Grass, Marsh; Riparian Zone; Rocks/Caves	Variable	√		
Cinereus Shrew	*Sorex cinereus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass, Sedge, Bog, Marsh; Riparian Zone; Rocks/Caves	Common	√	√	√
Dusky Shrew	*Sorex monticolus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass; Riparian Zone	Common-Abundant	√	√	√
Pygmy Shrew	*Sorex hoyi*	Boreal Forest; Tall Shrub; Grass, Sedge, Bog, Marsh; Riparian Zone	Rare-Uncommon		√	√
Tundra Shrew	*Sorex tundrensis*	Boreal Forest; Tall Shrub; Alpine, Arctic Tundra; Riparian Zone	Uncommon -Common	√	√	√
BATS						
Little Brown Myotis	*Myotis lucifugus*	Boreal, Coastal Forest; Riparian Zone; Rocks/Caves; Artificial Structures	Common		√	√
CARNIVORES – Feline, Canine, Weasels						
American Marten	*Martes Americana*	Boreal, Coastal Forest	Common		C -	S nc
American Mink	*Neovison vison*	Boreal, Coastal Forest; Grass, Marsh; Lakes & Ponds; Rivers & Streams; Riparian Zone	Common		S nc	S nc
Arctic Fox	*Vulpes lagopus*	Arctic Tundra; Fast, Pack Sea Ice	Common	S nc		
Canada Lynx	*Lynx Canadensis*	Boreal Forest; Tall Shrub; Riparian Zone	Common-Abundant	C -	S -	C nc
Coyote	*Canis latrans*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass; Riparian Zone; Sparse Vegetation	Locally Common		C nc	C nc
Ermine	*Mustela ermine*	Boreal, Coastal Forest; Tall, Low	Common	C	C	C

TABLE 3.4.4-1

Furbearers and Small Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Habitats	Status[a]	Location in Project Area[b]		
				AT	IB	AR
		Shrub; Alpine, Arctic Tundra; Riparian Zone; Rocks/Cave		nc	nc	nc
Least Weasel	*Mustela nivalis*	Boreal Forest; Tall, Low Shrub; Arctic Tundra; Riparian Zone	Uncommon -Abundant	√	√	√
North American River Otter	*Lontra Canadensis*	Lakes & Ponds; Rivers & Streams; Riparian Zone; Coastal Beaches	Common		A nc	A nc
Red Fox	*Vulpes vulpes*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass; Riparian Zone; Sparse Vegetation	Common	C nc	S nc	C nc
Wolverine	*Gulo gulo*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra	Uncommon	S nc	S nc	S nc
TOTAL				**20**	**35**	**32**

Sources: ADF&G, 2014d; MacDonald and Cook, 2009; AKNHP, 2014a

[a] State-wide status based primarily on MacDonald and Cook (2009)

[b] Ecoregions: AR – Alaska Range Transition; IB – Intermontane Boreal; AT – Arctic Tundra

Presence based on range maps published by AKNHP. Region-specific 2012-2013 abundance and population trend where reported are based on the Alaska Trappers Survey (ADF&G, 2013b).
Abundance: S = scarce, C = common, A = abundant;
Population Trend: nc = no change, - = decrease, + = increase
√ = documented or very likely to occur in the Project area.

3.4.4.1 Liquefaction Facility

Most small mammals potentially occurring near the Liquefaction Facility are widely distributed and could also occur near Interdependent Facilities in the Alaska Range, Intermontane Boreal, and Arctic Tundra ecoregions (Table 3.4.4-1). There are three exceptions, collared lemming and arctic fox are limited in distribution to the Arctic Tundra ecoregion, and taiga voles are limited in distribution to the Intermontane Boreal ecoregion (Table 3.4.4-1).

Alaska Marmot

The Alaska marmot (*Marmota caligata*) makes its summer home in talus slopes, boulder fields, and rock outcrops north of Yukon River in alpine areas of the Brooks Range and the Ray Mountains in the Project area. They are social animals and although each family has their own separate burrow, their burrows are located close together, forming a colony. True hibernators, Alaska marmots create a special winter den with a single entrance that is usually plugged in September after all colony members are inside. No animals can leave until the plug thaws in early May. These dens are relatively permanent, with some being used for more than 20 years. Alaska marmots mate before they emerge from their winter dens and two to six young are born about a month later in late May or June. Young disperse after their first year and may live 10 years or more. They feed on grasses, flowering plants, berries, roots, mosses and lichens, attaining their maximum weight in late summer prior to hibernation. Population is considered low, but stable throughout their range.

Arctic Ground Squirrel

Arctic ground squirrels (*Spermophilus parryii*) are widely distributed and common throughout the arctic and subarctic alpine and subalpine habitats in northern, eastern, and southwestern Alaska. They occur in tundra, along roadsides, subalpine brushy meadows, lakeshores, and sandbanks where they dig extensive burrow systems that may be used for many years. They do not occur in permafrost areas. They are social animals that live in colonies of 5 to 50 members. Arctic ground squirrels eat stems and leaves, seeds, fruits, and roots of grasses, sedges, woody plants, and mushrooms. They store their food in burrows for consumption in spring. They mate in May with litters being born in late June. Both sexes reach maturity by their second spring.

Hoary Marmot

Hoary marmots (*Marmota caligata*) are found in similar habitats as the Alaska marmots, but they occur in the alpine areas of Alaska south of the Yukon River. Hoary marmots have a similar life history to the Alaska marmot, except hoary marmots den alone and mate after emerging from their dens in the spring.

Northern Flying Squirrel

The northern flying squirrel (*Glaucomys sabrinus yukonensis*) is a nocturnal gliding mammal that occurs as far north as Interior Alaska. Flying squirrels eat mushrooms, berries, and tree lichens. Forested habitats, with at least some mature coniferous trees, are needed for feeding and den sites. Den sites include tree cavities and clumps of abnormal branches caused by tree rust diseases, called witches' brooms. Witches' brooms are the most common denning sites in Interior Alaska and are used exclusively during winter. Flying squirrels in Alaska breed between March and late June, depending on the severity of the winter, with young being born from May to early July. They can reproduce at 1 year of age and few live past 4 years of age. Predators include owls, hawks, and carnivorous mammals.

Red Squirrel

Red squirrels (*Tamiasciurus hudsonicus*) are found in spruce forests over most of Alaska. They are active all year, staying in their nests only during severe cold spells or inclement weather. Red squirrels are solitary, except during mating in February and March. Young are born 36 to 40 days later and remain with their mother until the following winter. In summer, red squirrels spend most of their time cutting and storing green spruce cones in caches. They also eat mushrooms, seeds, berries, buds, fungi, and occasionally insects and bird eggs. Nests are either built in a hole in a tree trunk or made of tightly constructed mass of twigs, leaves, mosses, and lichens in the densest foliage of a tree. Main predators of the red squirrel include hawks, owls, and marten.

Woodchuck

Woodchucks (*Marmota monax*) dig their dens in wind deposited soils along river valleys in the dry lowlands of interior Alaska. Like the hoary marmot, wood chuck den alone and mate after emerging from their dens in April or May. Woodchuck dens may be up to 30 feet long and end with a chamber with a large grass nest. Most marmot dens, including woodchucks, have a main entrance and several concealed entrances. They live for two to six years with mating occurring once each year in early spring. Females give birth to two to six young in late spring to early summer.

American Beaver

Beavers (*Castor canadensis*) are distributed over most of Alaska from near the crest of the Brooks Range south to the middle of the Alaska Peninsula. Beavers inhabit lakes, ponds, marshes, rivers, and streams, where they create wetland habitats that are used by many other animals. Beavers are managed as furbearers, and are considered common and abundant throughout their range in Alaska. After mating (which takes place in January or February), the female prepares for a new litter. Two to four kits on average are born anytime from late April to June. Their eyes are open at birth and the kits are covered with soft fur. They can swim at 4 days and dive at 2 months of age. The young beavers live with their parents until they are 2 years old. Beavers construct dams and lodges from felled trees, mud, plants, and sticks. Dens may be constructed in banks or as lodges in slower moving water. Dens and lodges are used year after year and are used as a food cache, rearing area, and home. The life of a beaver colony is governed largely by food supply. Beavers eat not only bark, but also aquatic plants of all kinds, roots, and grasses. As they exhaust the food supply in the area, the beavers must forage farther from their homes, thus increasing the danger from predators. When an area is cleared of food, the family migrates to a new home. In Alaska wolves, lynx, bears, and humans are important predators of beavers.

Brown Lemming

The brown lemming (*Lemmus trimucronatus*) is the only true lemming in Alaska. They are found throughout North America and Siberia in open tundra areas, often in low-lying, flat meadow habitats dominated by sedges, grasses, and mosses. Lemmings are active day and night all year long, forming networks of trails a few inches below the land or snow surface. Foods include tender shoots of grasses and sedges in summer and frozen, but still green plant material, moss shoots, and bark and twigs of willow and dwarf birch. Breeding may occur during winter, but is usually restricted to the summer. Lemmings are known for their wide population fluctuations, reaching peak abundance every 3 to 5 years. All lemmings are staple prey for larger animals including weasels, foxes, wolves, wolverines, mink, marten, owls, hawks, gulls, and jaegers.

Common Muskrat

The muskrat (*Ondatra zibethicus*) are year round residents throughout most of mainland Alaska south of the Brooks Range. They are considered widespread and common. They live in small family groups in small lakes, ponds, marshes, slow streams, sloughs, drainage ditches, and brackish estuaries. Ideal habitat is permanent wetlands with abundant vegetation that are deep enough to not freeze up in winter. Muskrats den in burrows and cone-shaped lodges constructed in wet areas. They are primarily herbivorous, feeding on roots and stems of aquatic plants, but may eat mussels, shrimp, and small fish. Females have two litters per year and give birth to seven to eight young per litter. Females reach maturity at nine to ten months. Young disperse in autumn or spring.

Meadow Jumping Mouse

The meadow jumping mouse (*Zapus hudsonius*) occurs from the Alaska Range south throughout Southcentral Alaska. They prefer moist lowland habitats with relatively thick vegetation of open grassy and brushy areas of marshes, meadow, swamps, and streamsides. They are typically solitary and active year-round, nesting in burrows that are underground or under logs or grass clumps. Jumping mice eat invertebrates, seeds, leaves, buds, fruits, and subterranean fungi. Litter size can range from 2 to 9

individuals, with females having 2 to 3 litters per year. Densities of meadow jumping mice can range from 3 to 19 per acre.

Meadow Vole

Meadow voles (*Microtus pennsylvanicus*) are found in Interior and Southcentral Alaska west to Bristol Bay. *Microtus* voles live in colonies of a few to 300 individuals in grassy meadows where they build runways through the grasses or snow dig underground burrows between food and nesting chambers. They do not hibernate, but feed on grasses and seeds throughout the year. They live about one year, with young starting to breed at three to six weeks. Voles can become very numerous over short periods of time. Females can have up to six litters of four to eight young each per year.

Northern Bog Lemming

The northern bog lemming (*Synaptomy borealis*) is distributed across forested Alaska, although distributions are localized and poorly documented. They are usually uncommon to rare, but can become numerous. Bog lemmings inhabit open habitats including damp meadows, marshes, bogs, and fens that have an abundance of grasses, sedges, mosses, and low shrubs. They live in burrows among sedges and grasses where moisture levels are high. Bog lemmings feed on green parts of low vegetation and probably on slugs and snails. Breeding occurs from May to August, with litters ranging from two to eight.

Northern Red-backed Vole

Northern red-backed vole (*Clethrionmys rutilus*) occurs throughout mainland Alaska. They are solitary or live in small family groups in grassy meadows or forested habitats. They do not build runways but will use runways built by *Microtus* voles. Red-backed voles are omnivorous and will eaten grass, seeds, fruit, lichens, fungi, insects and meat. Red-backed voles breed from late winter until August. Litters can range from two to 11, and young reach maturity in 2 to 4 months. Most red-backed voles live 10 to 12 months. Voles are the base of the food chain for many animals and birds in Alaska including weasels, marten, foxes, coyotes, all owls, most hawks, inland breeding gulls, and jaegers.

Root Vole

Root voles (*Microtus oeconomus*) occur throughout Alaska. This vole is a widespread and abundant rodent that prefers damp, densely vegetated areas along the edges of lakes, streams and marshes, but also occurs in tundra, taiga, forest-steppe and even semi desert habitats.

Singing Vole

Singing voles (*Microtus miurus*) have a poorly known distribution, but have been found on the North Slope, Seward Peninsula, and Brooks Range, appear to be absent in the Interior, but found again in the Alaska Range south to the Kenai Peninsula. They are found on high, well-drained slopes, willows stands, wet tundra and stream banks, alpine areas, and subarctic tundra.

North American Porcupine

Porcupines (*Erethizon dorsatum*) occur in most of the forested areas in the state. They are solitary and primarily nocturnal, sleeping in a tree or hollow during the day. Porcupines are chiefly arboreal, feeding

on the inner bark of spruce, birch and hemlock and spruce needles in winter and buds and young green leaves of birch, aspen, cottonwood, and willow in spring and summer. They seek out salt sources. They do not build a nest, but use natural cavities, hollow logs, or thick vegetation as dens. Breeding takes place in fall and a single young is born in the spring. Young stay with their mother during the summer but are fully weaned and disperse by October. Porcupines can live up to 18 years in the wild.

Collared Pika

Collared pikas (*Ochotona collaris*) live in colonies in mountainous terrain, in old rock slides, talus slopes, or around large boulders, usually with a meadow or patches of vegetation in the vicinity. Small burrows at the edge of rock piles and the presence of small (BB-size), dark, oval droppings indicate the existence of a pika colony. The presence of their "hay piles" will positively identify the colony. The peak of the breeding season occurs in May and early June as snow begins to melt and the first green plants of the season start to appear. Female pikas can breed and produce young at about 1 year of age. The young are born blind and nearly hairless after a 30-day gestation period. L itters of one to four are cared for by the mother. Pikas are generalist herbivores, feeding on the stems and leaves of various grasses, forbs, and small shrubs. Pikas do not hibernate, and their survival during the winter is dependent on the success of their haying season. Each pika may make several haystacks within its territorial boundaries, which by late August may be up to two feet high and two feet in diameter.

Snowshoe Hare

Snowshoe hares (*Lepus americanus*) are distributed over the state except for the lower Kuskokwim Delta, the Alaska Peninsula, and the area north of the Brooks Range. Snowshoe hares are found in mixed spruce forests, wooded swamps, and brushy areas. They do not dig burrows or build nests but use natural shelters and depressions and rest under branches or bushes. They travel on well-established trails or runways, which become deeply worn in the snow or forest floor. Winter trails follow the pathways as summer trails. Snowshoe hares breed at about 1 year of age and have two to three litters per year. Breeding begins in mid-May and lasts through August. Gestation is 36 to 37 days. First litters are born around the middle of May in Interior Alaska and average about four leverets (young hares). The second litter, in years of increasing abundance, often averages six young, and occasionally a third litter. They feed on a wide variety of plant material—grasses, buds, twigs, and leaves in the summer and spruce twigs and needles, bark, and buds of hardwood such as aspen and willow in the winter. Populations of snowshoe hare are subject to cycles of high abundance and scarcity. Hare populations will build up over a period of years to peak abundance with as many as 600 animals per square mile, followed by a sudden decline to a very low level. Possible reasons for these cycles may include over browsed food supply, predators, and shock disease due to stress, parasites, or a combination of these factors.

Alaska Tiny Shrew

The Alaska tiny shrew (*Sorex yukonicus*) may be widespread but is rare in subarctic Alaska. This shrew has been collected over a wide range of habitat types including wetlands/bog and coniferous and mixed forests and riparian habitats. Shrews in general tend to have several litters of 5 to 8 offspring per year. Shrews rarely live beyond 18 months.

American Water Shrew

The American water shrew (*Sorex palustris*) is a large, semiaquatic, blackish-gray shrew with a long bicolored tail and large hind feet fringed with short stiff hairs. Total length is 5.5 to 6.3 inches including a 2.4 to 3.1-inch tail. Water shrews occur from southeast Alaska north through Prince William Sound and the Kenai Peninsula. Water shrews are most abundant along small cold streams with thick overhanging riparian growth. They are also found around lakes, ponds, marshes, bogs, and other lentic habitats. Water shrews are rarely far from water. Nest sites are near water in underground burrows, rafted logs, beaver lodges, and other areas providing shelter. Like other shrews, the water shrew seems to be an opportunistic predator, and their diet varies greatly with geographic area and probably with season. They are primarily dependent upon aquatic insects, but also eat various other invertebrates and may take small vertebrates (fishes, amphibians) when available. Water shrews hunt under and on top of water.

Barren Ground Shrew

Barren grounds shrews (*Sorex ugyunak*) appear to be restricted to the northern region, from the Brooks Range northward to the Arctic coast. They favor low sedge-grass meadows and thickets of dwarf willow and birch; often in damp to wet vegetation with grasses and sedges. Their diet is likely similar to other shrews in Alaska as invertivores eating primarily insects and other invertebrates, also carrion, small vertebrates, and occasionally seeds. Barren ground shrews are widespread in arctic Alaska north of tree line. Their abundance fluctuates.

Cinereus Shrew

The cinereus shrew (*Sorex cinereus*) is a medium-sized shrew that is common and abundant throughout most of mainland Alaska. The breeding season may last from March through September, usually with two litters, maybe three per year. Gestation lasts 18 days. Litter size is two to ten (average around seven). Nest sites are typically in shallow burrows or above ground in logs and stumps. Cinereus shrews are especially abundant in riparian areas with dense ground cover. Annual fluctuations in population size are large; density estimates range from 1 to 12 shrews per acre.

Dusky Shrew

The dusky shrew (*Sorex monticolus*) is widely distributed from the Brooks Range south throughout mainland Alaska. They are found in many different habitats, from coastal and boreal forests to riparian shrub thickets in the mountains and in the subarctic tundra-taiga transition at higher latitudes. The breeding season extends from April-August, with an average litter size of about five, ranging up to seven. These shrews may have two or more litters per year. Most individuals probably do not live longer than 18 months. Dusky shrews apparently are not territorial in the breeding season and may move widely. In late summer, discrete territories are established and the daily movements of neighboring animals do not overlap. Dusky shrews feed primarily on insects and other small invertebrates (worms, sowbugs, molluscs, etc.), and some vegetable matter. The population size is unknown but is suspected to be large and secure.

Pygmy Shrew

Pygmy shrews (*Sorex hoyi*) are distributed throughout much of Southcentral and interior Alaska to just north of the Yukon River, south to northern Prince William Sound and the Kenai Peninsula. They are

found in a variety of habitats, but appear to prefer grassy openings of boreal forest. Moist habitats are preferred over dry areas. Females give birth to one litter of three to eight per year. Juveniles are able to breed in their second summer; however, their life span is 16 to 17 months. They are primarily dependent on invertebrates including insect larvae, beetles, and spiders. Population size is unknown.

Tundra Shrew

Tundra shrews (*Sorex tundrensis*) are distributed throughout mainland Alaska, except the Kenai Peninsula, and Southcentral coastal area. Habitats used include dense tundra and shrub tundra vegetation made up of grasses and shrubs (i.e., alder, dwarf birch, and willows) on hillsides and other well-drained sites. In Alaska, tundra shrews feed on insect larvae, earthworms, and some plant material. The population size is unknown, although high numbers have been reported in the arctic.

Little Brown Myotis

The little brown myotis or bat (*Myotis lucifugus*) is widely distributed across Alaska in summer. They occur in numerous habitats, but generally associate with coastal forested habitats and interior riparian forests. Bats use echolocation to find and capture insects while hunting at night. The lack of darkness during summer at high latitudes reduces that amount of time available for foraging. Little brown bats usually mate during August through October. Ovulation and fertilization are delayed until spring, and gestation lasts 50 to 60 days. Females give birth to a single pup in their first or second year. They may use buildings for roosts and maternity colonies. Maternity colonies range in size from 70 to 200 in Interior Alaska. The young are weaned and become capable of flying on their own within about 3 weeks. In Southeast Alaska, pregnant females have been captured as early as June 4 and as late as July 2 and juvenile bats have been captured or collected from mid-June through late August. A spike in observations of bats in mid-August suggests young bats emerge in August in more northern reaches of the state. Whether little brown bats in Interior Alaska migrate to milder climates to hibernate is unknown. Observation of bats in Fairbanks in early October and near the Tanana river in early May suggest that they may hibernate in the vicinity. The population size and status of little brown bats in Alaska is unknown. They are apparently widespread but in low numbers.

American Marten

American martens (*Martes americana*) are carnivorous, furbearing member of the weasel family. Martens are usually found in the uplands and inhabit most forested regions in Alaska. Mating occurs in July and August, with a 6-month delayed implantation. The litter, averaging three young, is born in April or May. Juvenile martens usually disperse from their mother's territory during the autumn. Martens depend heavily on meadow voles and red-backed voles or mice for food over much of Alaska. Fluctuations in food availability often create corresponding fluctuations in marten populations. Martens also forage on berries, especially blueberries, small birds, eggs, and vegetation. The population size of American Marten in Alaska is unknown, but populations are likely large because martens are widespread and widely trapped.

American Mink

Mink (*Neovision vison*) are found throughout most of mainland Alaska in close association with water, preferring saltwater beaches, riparian habits of lakeshores, marshes, and stream banks. Mink breed from March through April, depending on latitude. In mink and other weasels, the fertilized egg does not attach

to the uterus to develop right away as in most mammals. Fetal development takes about 30 days to complete. In Interior and western Alaska most births occur during June. Litter size varies from 4 to 10 kits. The den is generally a burrow or hollow log near a pond or a stream. In most cases the den used has been constructed and deserted by other animals. Mink will eat virtually anything they can catch and kill, including fish, birds, bird eggs, insects, crabs, clams, and small mammals.

Canada Lynx

Canada lynx (*Lynx canadensis*) inhabit much of Alaska's forested terrain and use a variety of habitats, including spruce and hardwood forests, and both subalpine and successional communities. The best lynx habitat in Alaska occurs where fires or other factors create and maintain a mixture of vegetation types with an abundance of early successional growth. Mating occurs in March and early April and kittens are born about 63 days later under a natural shelter such as a spruce felled by wind, a rock ledge, or a log jam. Lynx kitten's eyes open at about 1 month of age, and they are weaned when 2 to 3 months old. Most litters include two to four kittens, but sometimes as many as six are born and survive. The production and survival of lynx kittens is strongly influenced by cyclic changes in snowshoe hare and other small game populations. The primary prey of lynx in most areas is the snowshoe hare, which undergoes an 8- to 11-year cycle of abundance. This cycle appears to be caused by the interaction of hares with their food and predators. Lynx numbers fluctuate with those of hares and other small game, but lag 1 or 2 years behind. Lynx are considered common in the areas where they occur.

Coyote

Coyotes (*Canis latrans*) are members of the dog family, averaging 22 to 33 pounds or about one-third the size of wolves. Males are slightly heavier than females. Few records of the coyote north of the Yukon River exist, although they do occur in this area. Portions of the state with the highest densities of coyotes are the Kenai Peninsula, and the Matanuska and Susitna valleys. Coyotes breed between January and March. Shortly before whelping, one or more dens are prepared for the litter. Coyotes give birth to an average of five to seven blind and helpless pups. Coyotes den in a variety of protected places and frequently take over the dens of other animals. It is not unusual for coyotes to move their pups to other dens. Family units may begin to break up as early as August. In Alaska, coyotes are found mostly as mated pairs with an established territory. In interior Alaska territories may be about 40 square kilometers. Coyotes are absent or scarce where wolves are abundant, and foxes are similarly less abundant where coyotes are numerous. Coyote are opportunistic; snowshoe hares, microtine rodents (voles), and carrion comprise the bulk of their diet while marmots, ground squirrels, muskrats, fish, insects, and even Dall sheep are also taken.

Ermine

Ermine (*Mustela ermine*) occur through the Alaska mainland. Ermine pelage is reddish-brown above and creamy white below in summer, and changes to completely white in winter with the tip of the tail remaining black in all seasons. Ermine resemble the long-tailed weasel (*Mustela frenata*) in general appearance and coloration, but is smaller, has a shorter tail, and has white fur on the inner side of the hind legs. Least weasels (*Mustela nivalis*) are also similar in appearance to ermine, but are smaller and do not have any black on the tail. Ermine mate in late spring to early summer. One litter of 4 to 13 (average of 6) young is born usually in April or May. Females care for young alone. Dens are located in hollow logs or under logs, stumps, roots, brush piles, or rocks. Snow provides vital insulation against extreme air temperatures. Ermine are carnivores that consume mainly small mammals, especially voles and mice.

Ermine are adapted to a wide variety of habitats, but prefer wooded areas with thick understory near watercourses, and often occupy early successional or forest-edge habitats, wet meadows, marshes, ditches, riparian woodlands, or river banks with high densities of small mammals and adequate subnivean foraging space. Shrews and rabbits may also be taken and occasionally other small vertebrates and insects. Ermine foraging strategies are particularly well-adapted to northern environments where prolonged snow cover gives small predators, able to access under snow tunnels, a competitive advantage, and where voles are the most abundant prey. Dens are located in hollow logs or under logs, stumps, roots, brush piles, or rocks. Snow provides vital insulation against extreme air temperatures.

Least Weasel

Least weasels (*Mustela nivalis*) are found throughout mainland Alaska. They are solitary, except during breeding season and when females have young. Least weasels occur in a variety of habitats including forest, brush, and open tundra habitats. On the arctic slope, weasels typically live in areas with topographic relief, such as slopes, rock slides, and streambeds. They also use meadows, marshes, and riparian areas where small rodents are available. Least weasels may breed throughout the year but breeding occurs primarily in spring and late summer. Young are born in abandoned underground burrows made by other mammals. When rodents are plentiful, least weasels may breed in winter under snow. Gestation lasts 34 to 37 days, including the 10 to 12 days between fertilization and implantation. Litter size averages 4 to 5 in temperate zone, higher in arctic latitudes; with 2 litters per year common. Young are tended by both parents. Family groups break up when young are about 9 to 12 weeks old. Reproductive output increases when food is abundant (more young are born, greater survivorship). Litters have 3 to 10 young, but can be greater in northern Alaska when rodents are abundant. Least weasels are specialist predators of small mammals, especially voles, lemmings, and other mice. When small rodents are scarce, they may consume other small vertebrates, insects, or worms. Their population density fluctuates with rodent populations.

North American River Otter

The North American river otter (*Lontra canadensis*) is found throughout mainland Alaska with the exception of the area adjacent to the arctic coast east of Point Lay. River otters in Alaska breed in spring, usually in May. Adults weigh 15 to 35 pounds and are 40 to 60 inches in length. On the average, females are about 25 percent smaller than males. Mating can take place in or out of the water. One to six pups (usually two or three) are born the next year any time from late January to June following a gestation period of 9 to 13 months. River otters in Alaska hunt on land and in fresh and salt water eating snails, mussels, clams, sea urchins, insects, crabs, shrimp, octopi, frogs, a variety of fish, and occasionally birds, mammals, and vegetable matter.

Red Fox

The red fox (*Vulpes vulpes*) is recognized by its reddish coat, its white-tipped tail, and black "stockings," although many color variations exist. Red foxes prefer broken country, extensive lowland marshes, and crisscrossed hills and draws. The species is most abundant south of the arctic tundra, although red foxes are also present in tundra regions, which it shares with the Arctic fox. Where the ranges of these two foxes overlap, the red fox is dominant. In these areas, red foxes have been observed digging Arctic foxes from their dens and killing them. Red foxes breed during February and March. A litter of four pups is common, though a litter of 10 is not a rarity. Both parents care for the young. The family unit endures until autumn, when it breaks up and each animal is on its own. The den is a hole in the earth, 15 to 20

feet long, usually located on the side of a knoll. It may have several entrances. Sometimes foxes dig their own dens. More often, though, they appropriate and enlarge the home sites of small burrowing animals, such as marmots. The red fox is omnivorous. Although it might eat muskrats, squirrels, hares, birds, eggs, insects, vegetation, and carrion, voles seem to be its preferred food. Foxes cache excess food when the hunting is good.

Wolverine

Wolverines (*Gulo gulo*) are found throughout Alaska but wolverines tend to avoid some areas or exist at lower densities because the habitat is not suitable for denning or is highly developed or used by people. They are primarily solitary creatures throughout most of the year. Wolverines travel extensively in search of food. In general, males have larger home ranges that females, females not accompanied by kits have larger ranges compared to females with kits, and home range size and use changes with season of the year. In Alaska, resident male home range sizes are large ranging between 200 and 260 square miles. Resident females have home ranges as large as 115 square miles. Home range size and use patterns are thought to be a response to the availability of food resources or for adult females the presence of persistent snow cover for denning. Movements of 40 miles in a day have been documented. Studies in Southcentral Alaska found that wolverines preferred higher elevations during the summer and lower elevations during the winter due to varying food availability. Denning areas typically consist of fell fields with deep snow cover. Few wolverines live longer than 5 to 7 years in the wild, although some may survive to 12 or 13 years of age. Primary natural mortality factors include starvation, and being killed by larger predators, primarily wolves, and by other wolverines.

3.4.4.2 Interdependent Facilities

Many of the furbearers and small mammals discussed under the Liquefaction Facility section above are widely distributed and could also occur near Interdependent Facilities in the Alaska Range Transition Ecoregion, Intermontane Boreal, and Arctic Tundra ecoregions based on their ranges (Table 3.4.4-1; ADF&G, 2014d). In addition, collared lemming and arctic fox, which occur in the Arctic Tundra Ecoregion and taiga voles, which occur in the Intermontane Boreal Ecoregion could occur near Interdependent Facilities in these ecoregions (Table 3.4.4-1).

Collared Lemming

The collard lemming (*Dicrostonyx groenlandicus*) is not a true lemming but in summer they look very similar to brown lemmings. Collard lemmings inhabit dry, sandy, or gravelly areas above timberline. This lemming is the only true rodent that turns white during the winter and grows enlarged claws rather like snow shovels that are used to dig through wind-packed snow. They also built networks of tunnels and consume mostly plants like the brown lemming. Collared lemmings have a rapid breeding and short life cycle. Mating usually occurs from March through September, with females having up to 3 litters per year with an average of 4 to 5 young per litter. Few collared lemmings live beyond 1 year of age.

Arctic Fox

The arctic fox (*Vulpes lagopus*) is found in treeless coastal areas of Alaska from the Aleutian Islands north to Point Barrow and east to the Canada border. They prefer tundra habitat, usually near rocky shores, and have been observed ranging far out onto pack ice in winter. Arctic foxes weigh from 6 to 10 pounds. Pups are born in dens excavated by the adults in sandy, well-drained soils of low mounds and

river cutbanks. Dens extend from 6 to 12 feet underground, and are used repeatedly. Mating occurs in early March and early April. Gestation lasts 52 days. Litters average seven pups but may contain as many as 15 pups. Both parents aid in bringing food to the den and in rearing the pups. Pups first emerge from the den at about 3 weeks old and begin to hunt and range away from the den at about 3 months. Family units gradually break up during September and October. During midwinter, foxes lead a mostly solitary existence except when congregating at the carcasses of marine mammals, caribou, or reindeer. Arctic foxes attain sexual maturity at 9 to 10 months, but many die in their first year.

Taiga Vole

The taiga vole (*Microtus xanthognathus*) is only found in Interior Alaska on the Yukon and Kuskokwim river drainages. It prefers boreal forested habitat near water or bogs. Although not commonly encountered, they can be locally abundant.

3.4.5 Bird Resources

Bird resources are described by occurrence with Alaska ecoregions within the Project area. Ecoregions potentially crossed by the Project include the Alaska Range Transition, Intermontane Boreal, and Arctic Tundra (Figure 3.3.1-1) as described in Section 3.3.1.

3.4.5.1 Liquefaction Facility

Cook Inlet Basin Ecoregion Birds

Cook Inlet creates this ecoregion, influencing the climate and adding maritime character. Gently sloping lowlands contain numerous small lakes and wetlands, as well as mixed forested upland habitats. Wetland habitats range from low scrub bogs to wet graminoid marshes (ADF&G, 2006).

The varied habitats found in this ecoregion support diverse bird communities. Shorebirds and waterfowl inhabit the numerous lakes, ponds and wetlands. Trumpeter swans, red-necked grebes, common and Pacific loons, green-winged teal, northern pintail, and common and Barrow's goldeneye commonly nest on lakes and ponds in the region. Many landbirds migrate, breed, or reside within the region. Common nesting passerines include alder flycatcher, tree swallow, violet-green swallow, bank swallow, ruby-crowned kinglet, hermit thrush, American robin, varied thrush, yellow-rumped warbler, orange-crowned warbler, fox sparrow, white-crowned sparrow, and dark-eyed junco. Common resident birds include black-capped chickadee, black-billed magpie, common raven, boreal chickadee, great horned owl, and willow ptarmigan.

Cook Inlet supports large numbers of breeding or migrating shorebirds including western sandpipers, dunlins, rock sandpipers, long- and short-billed dowitchers, and Hudsonian godwits (ADF&G, 2006). Colonial nesting seabirds such as black-legged kittiwakes and common murres nest along Cook Inlet shores (ADF&G, 2006). The numerous salmon runs that occur in the ecoregion attract bald eagles and common ravens.

The Cook Inlet Basin Ecoregion supports the entire populations of some birds. Nearly the entire population of Wrangell Island Snow Geese migrates across the mouth of the Kenai River and Trading Bay each spring and the entire population of tule greater white-fronted geese nests in the boreal forest wetlands on the western side of Upper Cook Inlet (ADF&G, 2006; AKNHP, 2014a; Densmore et al.,

2006). Concentrations of molting and nesting Tule geese also occur in Redoubt Bay, Trading Bay, and Susitna Flats (AKNHP, 2014a). Additional information on birds and important bird habitats in the Cook Inlet Basin Ecoregion is presented under the Alaska Range Transition Ecoregion Birds section below.

3.4.5.2 Interdependent Facilities

Arctic Tundra Ecoregion Birds

The Arctic Tundra ecoregion from north to south consists of the Beaufort Coastal Plain, the Brooks Range Foothills, and the Brooks Range Ecoregions. The Beaufort Coastal Plain Ecoregion of northern Alaska is a complex landscape of lakes, streams, and wetlands scattered across low relief tundra that is underlain by permafrost. The plain gradually gains elevation from the coast southward to the gently rolling foothills of the Brooks Range, changing to the steep mountains of the Alaska Range. Over 100 species of birds have been recorded as regularly occurring in this ecoregion (Table 3.4.5-1). Most nesting shorebirds, geese, ducks, loons, and gulls are more common in the Beaufort Coastal Plain Ecoregion, while nesting raptors are more prevalent in the Brooks Range Foothills and Brooks Range Ecoregions (Armstrong, 2008; AKNHP, 2014a).

Most birds in the Arctic Tundra Ecoregion are migratory, typically present from May to September (Table 3.4.5-1). Migratory birds range internationally; nesting and wintering grounds and migration routes may occur not only in different countries, but across different continents (Clough et al., 1987). The Arctic Tundra Ecoregion supports five resident birds: rock and willow ptarmigan, snowy owl, common raven, and gyrfalcon. Rock ptarmigan and willow ptarmigan are widespread on the Beaufort Coastal Plain, particularly inland from the coast (Johnson and Herter, 1989). Most rock ptarmigan were seen in the moist nonpatterned habitats in the Project area (Woodward-Clyde Consultants and ABR, 1983). A few ptarmigan of either species may overwinter in the Beaufort Coastal Plain, but most winter in the foothills of the Brooks Range (Johnson and Herter, 1989). Snowy owls are locally common breeders on the coastal plain during years when small mammals are abundant, but less commonly occur during the winter in the Arctic Tundra Ecoregion.

Common ravens reside in this ecoregion, where they occasionally nest on buildings and other structures, including oil field facilities near the coast (Johnson and Herter 1989; Powell and Backensto 2009). Common ravens are the earliest breeding birds; nesting begins by early April and young fledge by mid June (Johnson and Herter, 1989). Ravens range widely across the tundra in search of food (e.g., bird eggs, small mammals, and carrion) and have been observed taking eggs of waterbirds (e.g., ducks or shorebirds) in the oil fields.

Important Bird Habitats in the Arctic Tundra Ecoregion

The Arctic National Wildlife Refuge consists of over 19 million acres established to preserve unique wildlife, wilderness and recreational values. This refuge occurs to the east of the Project area in the Beaufort Coastal Plain, Brooks Foothills and Brooks Range ecoregions (Figure 3.4.5-1). More than 200 migratory and resident bird species have been observed on the refuge, with migratory birds coming from all over the world to breed here. Numbers of snow geese on the refuge can range from 13,000 to more than 300,000 birds.

TABLE 3.4.5-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Greater White-fronted Goose	*Anser albifrons*	Breeder	Common
Emperor Goose	*Chen canagica*	Visitant	Rare
Snow Goose	*Chen caerulescens*	Breeder	Uncommon
Brant	*Branta bernicla*	Breeder	Common
Cackling Goose	*Branta hutchinsii*	Breeder	Uncommon
Tundra Swan	*Cygnus columbianus*	Breeder	Uncommon
Trumpeter Swan	*Cygnus buccinators*	Breeder	Rare
American Wigeon	*Anas Americana*	Breeder	Uncommon
Mallard	*Anas platyrhynchos*	Breeder	Rare
Northern Shoveler	*Anas clypeata*	Breeder	Rare
Northern Pintail	*Anas acuta*	Breeder	Common
Green-winged Teal	*Anas crecca*	Breeder	Uncommon
Greater Scaup	*Aythya marila*	Breeder	Uncommon
Steller's Eider [c]	*Polysticta stelleri*	Visitant	Uncommon
Spectacled Eider [c]	*Somateria fischeri*	Breeder	Uncommon
King Eider	*Somateria spectabilis*	Breeder	Uncommon
Common Eider	*Somateria mollissima*	Breeder	Common
Harlequin Duck	*Histrionicus histrionicus*	Breeder	Rare
Surf Scoter	*Melanitta perspicillata*	Breeder	Uncommon
White-winged Scoter	*Melanitta fusca*	Breeder	Uncommon
Black Scoter	*Melanitta nigra*	Breeder	Rare
Long-tailed Duck	*Clangula hyemalis*	Breeder	Common
Red-breasted Merganser	*Mergus serrator*	Breeder	Rare
Willow Ptarmigan	*Lagopus lagopus*	Resident	Common
Rock Ptarmigan	*Lagopus mutus*	Resident	Uncommon
Red-throated Loon [d]	*Gavia stellate*	Breeder	Common
Pacific Loon	*Gavia pacifica*	Breeder	Common
Common Loon	*Gavia immer*	Breeder	Rare
Yellow-billed Loon [d]	*Gavia adamsii*	Breeder	Uncommon
Red-necked Grebe	*Podiceps grisegena*	Breeder	Uncommon
Short-tailed Shearwater	*Puffinus tenuirostris*	Visitant	Uncommon
Northern Harrier	*Circus cyaneus*	Breeder	Rare
Rough-legged Hawk	*Buteo lagopus*	Breeder	Common
Golden Eagle	*Aquila chrysaetos*	Breeder	Uncommon
Merlin	*Falco columbarius*	Visitant	Rare
Gyrfalcon	*Falco rusticolus*	Breeder	Uncommon
Peregrine Falcon [d]	*Falco peregrinus*	Breeder	Rare
Sandhill Crane	*Grus Canadensis*	Breeder	Uncommon
Black-bellied Plover	*Pluvialis squatarola*	Breeder	Uncommon
American Golden Plover [e]	*Pluvialis dominicus*	Breeder	Common
Semipalmated Plover	*Charadrius semipalmatus*	Breeder	Uncommon
Spotted Sandpiper	*Actitis mascularia*	Breeder	Uncommon

TABLE 3.4.5-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Upland Sandpiper [e]	*Bartramia longicauda*	Breeder	Uncommon
Whimbrel [d, e]	*Numenius phaeopus*	Breeder	Uncommon
Bristle-thighed Curlew	*Numenius tahitiensis*	Visitant	Rare
Bar-tailed Godwit [d, e]	*Limosa lapponica*	Breeder	Uncommon
Hudsonian Godwit	*Limosa haemastica*	Visitant	Rare
Ruddy Turnstone	*Arenaria interpres*	Breeder	Uncommon
Red Knot [d, e]	*Calidris cauntus*	Breeder	Rare
Sanderling [e]	*Calidris alba*	Breeder	Rare
Semipalmated Sandpiper	*Calidris pusilla*	Breeder	Common
Western Sandpiper	*Calidris mauri*	Breeder	Uncommon
Red-necked Stint	*Calidris ruficollis*	Breeder	Rare
Least Sandpiper	*Calidris minutilla*	Breeder	Uncommon
White-rumped Sandpiper	*Calidris fuscicollis*	Breeder	Rare
Baird's Sandpiper	*Calidris bairdii*	Breeder	Common
Pectoral Sandpiper	*Calidris melanotos*	Breeder	Common
Dunlin [d, e]	*Calidris alpine*	Breeder	Uncommon
Stilt Sandpiper	*Calidris himantopus*	Breeder	Rare
Curlew Sandpiper	*Calidris ferruginea*	Breeder	Rare
Buff-breasted Sandpiper [d, e]	*Tryngites subruficollis*	Breeder	Rare
Long-billed Dowitcher	*Limnodromus scolopaceus*	Breeder	Common
Wilson's Snipe	*Gallinago delicate*	Breeder	Common
Red-necked Phalarope	*Phalaropus lobatus*	Breeder	Common
Red Phalarope	*Phalaropus fulicaria*	Breeder	Common
Pomarine Jaeger	*Stercorarius pomarinus*	Breeder	Uncommon
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder	Common
Long-tailed Jaeger	*Stercorarius longicaudus*	Breeder	Common
Mew Gull	*Larus canus*	Breeder	Rare
Herring Gull	*Larus argentatus*	Breeder	Rare
Thayer's Gull	*Larus thayeri*	Visitant	Rare
Slaty-backed Gull	*Larus schistisagus*	Visitant	Rare
Glaucous Gull	*Larus hyperboreus*	Breeder	Common
Black-legged Kittiwake	*Rissa tridactyla*	Migrant	Common
Sabine's Gull	*Xema sabini*	Breeder	Common
Ross's Gull	*Rhodostethia rosea*	Migrant	Common
Ivory Gull	*Pagophila eburnean*	Migrant	Uncommon
Arctic Tern [d]	*Sterna paradisaea*	Breeder	Uncommon
Thick-billed Murre	*Uria lomvia*	Migrant	Rare
Black Guillemot	*Cephus grille*	Breeder	Uncommon
Crested Auklet	*Aethia cristatella*	Visitant	Rare
Horned Puffin	*Fratercula corniculata*	Breeder	Occassional
Snowy Owl	*Bubo scandiacus*	Breeder	Uncommon
Short-eared Owl	*Asio flammeus*	Breeder	Common

TABLE 3.4.5-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Says Phoebe	*Sayornis saya*	Breeder	Uncommon
Horned Lark	*Eremophila alpestris*	Breeder	Uncommon
Cliff Swallow	*Petrochelidon pyrrhonota*	Breeder	Uncommon
Common Raven	*Corvus corax*	Resident	Common
American Dipper	Cinclus mexicanus	Breeder	Rare
Arctic Warbler	*Phylloscopus borealis*	Breeder	Common
Bluethroat	*Luscinia svecica*	Breeder	Uncommon
Northern Wheatear	*Oenanthe oenanthe*	Breeder	Uncommon
American Robin	*Turdus migratorius*	Breeder	Rare
Gray-cheeked Thrush	Catharus minimus	Breeder	Common
Eastern Yellow Wagtail	*Motacilla tschutschensis*	Breeder	Uncommon
White Wagtail	Motacilla alba	Migrant	Rare
American Pipit	*Anthus rubescens*	Breeder	Common
Northern Shrike	Lanius excubitor	Breeder	Uncommon
Yellow Warbler	*Dendroica petechial*	Breeder	Rare
Wilson's Warbler	*Wilsonia pusilla*	Breeder	Casual
American Tree Sparrow	*Spizella arborea*	Breeder	Uncommon
Savannah Sparrow	*Passerculus sandwichensis*	Breeder	Common
Fox Sparrow	*Passerella iliaca*	Breeder	Uncommon
White-crowned Sparrow	*Zonotrichia leucophrys*	Breeder	Uncommon
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Visitant	Rare
Dark-eyed Junco	*Junco hyemalis*	Breeder	Rare
Lapland Longspur	*Calcarius lapponicus*	Breeder	Common
Smith's Longspur [d]	*Calcarius pictus*	Breeder	Uncommon
Snow Bunting	*Plectrophenax nivalis*	Breeder	Common
Gray-crowned Rosy Finch	Leucosticte arctoa	Breeder	Rare
Pine Grosbeak	Pinicola enucleator	Visitant	Rare
Rusty Blackbird	*Euphagus carolinus*	Breeder	Rare
Common Redpoll	*Acanthis flammea*	Breeder	Uncommon
Hoary Redpoll	*Acanthis hornemanni*	Breeder	Common

Source: Armstrong, 2008; AKNHP, 2014a

[a] Status: Resident, year-round resident; Breeder, breeding species (migratory); Migrant, nonbreeder traveling; Nonbreeding, overwintering species; Visitant, outside its normal range.

[b] Relative Abundance: Common, certain to be seen or heard in suitable habitat; Uncommon, locally distributed or occurring in low numbers; Rare, species occurs regularly in region but in very small numbers, sighting likelihood poor; Occasional, seen a few times in a 5-year period; Accidental, seen once to twice and may not be seen again.

[c] ESA listed, candidate, or proposed species (USFWS, 2014a)

[d] Bird of Conservation Concern (USFWS, 2008)

[e] Species of High Concern or Highly Imperiled according to the Alaska Shorebird Group: Alaska Shorebird Conservation Plan II (ASG, 2008)

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Ecoregion Boundary
- State and Federal Conservation Lands
- Important Bird Area
- Zones of Restricted Access

0 5 10 20 30 40 Miles

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X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_5-1 Important Bird Habitats in the Arctic Tundra Ecoregion of the Alaska LNG Project.mxd

IMPORTANT BIRD HABITATS IN THE ARCTIC TUNDRA ECOREGION OF THE ALASKA LNG PROJECT

FIGURE 3.4.5-1

Alaska LNG

Beaufort Coastal Plain Ecoregion Birds

The Beaufort Coastal Plain provides important habitat for millions of nesting and migrating shorebirds and waterfowl (Johnson et al., 2007; Bart et al., 2012). Shorebirds are the most abundant and diverse group of avifauna in this ecoregion (Saalfeld et al., 2013). Coastal wetlands, wet meadows, and riparian habitats are particularly important to nesting waterbirds and shorebirds throughout the region (Brown et al., 2007). Eight species of shorebirds and 6 species of waterfowl are common to abundant breeders within the Project area (Table 3.4.5-1).

Representative birds in this ecoregion include common eiders, northern pintail, greater white-fronted goose, Pacific loon, American golden-plover, pectoral and semipalmated sandpiper, red- necked and red phalaropes, glaucous gulls, arctic terns, loons, and Lapland longspur (Clough et al., 1987; Pitelka, 1974).

Arctophila ponds and lakes, those with pendant grass (*Arctophila fulva*) in the center surrounded by a fringe of *Carex aquatilis* or *A. fulva* toward the shore, drained-lake basin complex wetlands, and coastal wetlands (saline-influenced habitats) are used most intensively by waterbirds along the Beaufort Coastal Plain. Researchers have also observed greater use of wetlands containing *Arctophila* by various waterbirds than other habitats. Deep, open lakes are important to diving waterbirds that nest on the Beaufort Coastal Plain (e.g., loons, long-tailed duck, and scaup) because of the availability of prey such as invertebrates and fish. Larger lakes are used annually by large numbers of molting geese. Coastal wetlands have been identified as important habitat for nesting and staging shorebirds, waterfowl, and Lapland longspurs. The Sagavanirktok River corridor contains an extensive riparian shrub habitat; this habitat type is important for a variety of passerines, most of which have a limited distribution on the Beaufort Coastal Plain. Dry tundra, usually limited in distribution in this area, is used preferentially by some birds such as golden-plovers and the buff-breasted sandpiper (BLM, 1998).

Descriptions of the spectacled eider, federally listed as threatened throughout its range, and the Steller's eider, federally listed as threatened in Alaska, are presented in Section 3.5.1. The yellow-billed loon, previously a candidate for listing under the ESA, is also present along the Beaufort Coastal Plain during the nesting season.

Pacific loons are widespread on the Beaufort Coastal Plain. They prefer deeper aquatic grass (*Arctophila fulva*) wetlands, with deep, open lakes used in the brood-rearing period. Red-throated loons are present with scattered distribution. Red-throated loons prefer shallow *Arctophila* lakes that are smaller than 3 acres as well as beaded stream habitat for nesting (BLM, 1998).

Aerial breeding-pair surveys on the Beaufort Coastal Plain indicate that 60 percent of the tundra swans in Alaska use the Beaufort Coastal Plain for nesting. High-density areas are mainly to the west of the Project area in the Colville River Delta area. Spring-migrant swans that nest along the Beaufort Coastal Plain follow the Beaufort Sea coast from the east, arriving from mid- to late-May and remaining until early October. A variety of aquatic habitats are chosen for nesting; the most important appear to be deeper *Arctophila* wetlands. Following the hatch, the young are attended by both parents. *Arctophila* and *Carex* wetlands and deeper open lakes appear to be the most important brood-rearing habitats. Family groups apparently move considerable distances between lakes (Earnst, 2004).

Breeding, nonbreeder, and failed-breeder components of the brant population occupy coastal habitats during the spring, summer, and fall months. Breeding pairs arrive in late May to early June and begin the nesting cycle in early June. Moist sedge-grass meadow tundra in drained lake basins is the preferred

nesting habitat on the central Beaufort Coastal Plain; brackish water habitats, saltmarsh, and *Arctophila* wetlands are also used. Brood-rearing brant use larger lakes without emergent vegetation and coastal fringe areas, particularly tidal slough and tide flat habitats. Brant breed in traditional colonies located primarily within 3 miles of the coast but also as much as 18 to 24 miles inland (BLM, 1998).

Although greater white-fronted geese are widespread at low to moderate densities in the Project area, they are the most abundant goose nesting on the Beaufort Coastal Plain. Aerial surveys from 1986 to 2006 indicate that the white-fronted goose comprises about 80 percent of the goose population observed on the Beaufort Coastal Plain. Higher concentration of white-fronted geese occur west of the Project area in the National Petroleum Reserve-Alaska (NPR-A) (Conant et al., 2007).

Of the 15 duck species that occur in the Project area, pintails and long-tailed ducks are the most common duck breeding on the Beaufort Coastal Plain. On average, these 2 species comprise approximately 84 percent of the nesting ducks observed. Other ducks using the Beaufort Coastal Plain include 3 species of scoters, American widgeon, king eider, green-winged teal, mallard, northern shoveler, red breasted merganser, common eider, goldeneye, bufflehead, Steller's eider, and spectacled eider (Conant et al., 2007). Wetland habitat use is varied among species in this group but appears strongly related to food abundance associated with emergent vegetation in aquatic habitats. The most preferred habitat types include shallow *Carex* and *Arctophila* wetlands, deep *Arctophila* lakes, beaded streams, and deep, open lakes (BLM, 1998).

Spring migrant long-tail ducks follow leads in the ice along the Beaufort coast, arriving in the Project area in late May. Inland routes also are used. At this time, long-tail ducks congregate on open water of large lakes and use deep *Arctophila* wetlands as available. Egg laying is not initiated until late June. Long-tail ducks disperse to shallow *Carex* and *Arctophila* ponds, and deep, *Arctophila* ponds for nesting. They frequently nest in clusters or colonies. Males leave the nesting area during hatch and, together with nonbreeders/failed breeders, move to large Beaufort Coastal Plain lakes and nearshore Beaufort Sea waters to molt and often form extensive congregations up to 50,000 individuals. Females lead the young to deep *Arctophila*, deep-open, or shallow *Carex* lakes with open water shortly after hatch, and molt on deep-open lakes when the young are almost ready to fly (BLM, 1998).

Shorebirds on the Beaufort Coastal Plain use a range of habitats for nesting, brood-rearing, and staging for migration (Johnson et al., 2007). The birds begin to arrive in late May, and most are present by early June. Coastal habitats are not used as migration staging areas by shorebirds during spring and early summer because shore-fast ice prohibits access to these areas at that time. After the birds arrive in the spring, they disperse to breeding territories in areas free of snow (Johnson and Herter, 1989). After the nesting season, in mid to late summer, many shorebirds move to the Beaufort Sea coast to feed in intertidal flats and coastal tundra prior to fall migration to wintering areas (Andres, 1994; Smith and Connors, 1993).

The most common breeding shorebirds in the central Beaufort Coastal Plain region are pectoral sandpiper, semipalmated sandpiper, long-billed dowitcher, red phalarope, and dunlin (Johnson et al., 2007). Other shorebirds are locally abundant such as the Baird's sandpiper and American golden-plover (Rodrigues, 2002a, b). However, interannual abundance and diversity of shorebirds varies considerably (Johnson et al., 2007).

Passerines include white-crowned sparrow, Savannah sparrow, yellow wagtail, Lapland longspur, hoary and common redpolls, and snow bunting. These landbirds are usually omnivorous, with diets dependent

on the availability of food items. Willow and rock ptarmigan are the only gallinaceous birds found on the Beaufort Coastal Plain and are year-round residents (Brewer et al., 2000; Clough et al., 1987).

Brooks Foothills Ecoregion Birds

Riparian willow stands support the highest nesting densities and diversity of passerines. Waterfowl tend to be less abundant in the foothills because of the decreased presence of wet meadows, lakes, and ponds. However, willow and rock ptarmigan are more abundant, especially in shrub-brush habitat along rivers and streams. Raptors, including the peregrine falcon, gyrfalcon, and rough-legged hawk, are common foragers in the foothills and nest on the cliffs and bluffs along the Sagavanirktok River. Migrating raptors arrive in mid-April, and nestlings are fledged in concert with other birds that serve as prey. Common ravens are residents in this ecoregion (Brewer et al., 2000; Clough et al., 1987).

The most common birds in the Brooks Foothills are the hoary and common redpolls, savannah sparrow, jaegers, phalaropes, Wilson's snipe, green-winged teal, and northern pintail (Kessel and Gibson, 1978; Pitelka, 1974). Many passerines use the Brooks Foothills Ecoregion to take advantage of the drier uplands and scrub-shrub habitat.

Brooks Range Ecoregion Birds

Most birds found in the Brooks Range are limited to lower elevations. The diversity of passerines found at the lower elevations of the Brooks Range Ecoregion is similar to the adjoining Arctic Foothills. With increasing distance southward and a corresponding increase in altitude, the diversity and abundance of birds decrease dramatically. The Brooks Range offers warmer summer conditions and more protected microsites, which allow for a greater development of shrubs and for the development of some of the northern-most stands of trees. The terrain is diverse, including cliffs, canyons, alpine tundra, riverine gravel bars, medium-to-tall shrub thickets, coniferous forest, and scattered wetlands and marshes (Brewer et al., 2000).

Birds common to the area include wheatear, gray-cheeked thrush, yellow wagtail, American pipit, Bohemian waxwing, northern shrike, yellow-rumped warbler, Smith's longspur, swallows, rock and willow ptarmigan, common raven, and tree, fox, and white-crowned sparrows in the lower and middle elevations. Additionally, several types of raptors occur in the area.

Intermontane Boreal Ecoregion Birds

The Intermontane Boreal ecoregion from north to south along the Alaska LNG Project corridor crosses the Ray Mountains, Kobuk Ridges and Valleys, Yukon-Tanana Uplands, and the Tanana-Kuskokwim Lowlands Ecoregions. Forty-five species of birds commonly occur in this ecoregion, of which the majority (approximately 80 percent) are migratory (Table 3.4.5-2). Passerines become more common as the diversity of habitats increases.

This area supports breeding waterfowl from the Pacific, Central, and Atlantic Flyways (ADF&G, 1986b). Many waterfowl breeding in the Arctic region also use this area for resting and staging in route to or from their breeding grounds further north. Waterfowl in this area typically arrive shortly before breakup in April or May and stay through freeze-up in October (ADF&G, 1986b). Important waterfowl breeding and staging areas in this region include Minto flats, Lake Minchumina, upper Kantishna River, Bearpaw River drainage, Fish Lake Wetlands, Shaw Creek flats, Lake Mansfield, Fish Lake, the Wolf Lake

wetlands, Dot Lake-Sam Creek, Billy Creek wetlands, Mineral Lakes and the Salchaket Slough and its tributaries (ADF&G. 1986b). Of these, the upper Kantishna River and Salchaket Slough and tributaries occur in the closest proximity to the Project area.

Important Bird Habitats in the Intermontane Boreal Ecoregion

Kanuti National Wildlife Refuge

Kanuti National Wildlife Refuge is located west of the Project area in the Kobuk Ridges and Valleys and Ray Mountains Ecoregions. Protecting migratory bird breeding habitat is central to the mission of this refuge. Nearly 130 species of birds occur in the refuge, with the majority using this area for nesting. Wetland habitats in the refuge are particularly important for the migratory birds that breed here.

Yukon Flats National Wildlife Refuge

Yukon Flats National Wildlife Refuge is located just east of the Project area. This refuge contains a diversity of high-quality bird habitats, resulting in a diversity of birds. More than 150 species of birds can be found in the refuge during spring and summer, including ducks, loons, geese, swans, shorebirds, and landbirds. Yukon Flats has the highest breeding densities of waterfowl in Alaska, supporting up to 2 million ducks annually.

Minto Flats State Game Refuge

The Project area could cross the Minto Flats State Game Refuge. This refuge contains some of the highest quality waterfowl habitats in Alaska and sustains the largest trumpeter swan breeding population in North America (ADF&G, 1992). Minto Flats is also an important spring and fall waterfowl staging area, particularly for geese and swans (Figure 3.4.5-2). Sandhill cranes, loons, and bald eagles regularly nest in the refuge, and peregrine falcons have historically nested adjacent to the refuge. Grouse and ptarmigan use the refuge in large numbers during winter, and small owls and overwintering passerines are also common.

TABLE 3.4.5-2

Intermontane Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Red-throated Loon	*Gavia stellate*	Breeder	Uncommon
Pacific Loon	*Gavia pacifica*	Breeder	Common
Common Loon	*Gavia immer*	Breeder	Common
Horned Grebe [c]	*Podiceps auritus*	Breeder	Common
Red-necked Grebe	*Podiceps grisegena*	Breeder	Common
Double-crested Cormorant	*Phalacrocorax auritus*	Visitant	Accidental
Tundra Swan	*Cygnus columbianus*	Breeder	Uncommon
Trumpeter Swan	*Cygnus buccinators*	Breeder	Uncommon
Greater White-fronted Goose	*Anser albifrons*	Breeder	Uncommon
Snow Goose	*Chen caerulescens*	Migrant	Common
Cackling Goose	*Branta hutchinsii*	Migrant	Rare
Canada Goose	*Branta Canadensis*	Breeder	Common
Green-winged Teal	*Anas crecca*	Breeder	Common

TABLE 3.4.5-2

Intermontane Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Mallard	*Anas platyrhynchos*	Breeder	Common
Northern Pintail	*Anas acuta*	Breeder	Common
Blue-winged Teal	*Anas discors*	Breeder	Rare
Northern Shoveler	*Anas clypeata*	Breeder	Common
Gadwall	*Anas strepera*	Rare	Visitant
Eurasian Wigeon	*Anas penelope*	Visitant	Casual
American Wigeon	*Anas americanan*	Breeder	Common
Canvasback	*Aythya valisineria*	Breeder	Uncommon
Redhead	*Aythya americana*	Breeder	Rare
Ringed-neck Duck	*Aythya collaris*	Breeder	Uncommon
Greater Scaup	*Aythya marlia*	Breeder	Common
Lesser Scaup	*Aythya affinis*	Breeder	Common
Harlequin Duck	*Histrionicus histrionicus*	Breeder	Uncommon
Long-tailed Duck	*Clangula hyemalis*	Breeder	Uncommon
Black Scoter	*Malanitta nigra*	Breeder	Rare
Surf Scoter	*Melanitta perspicillata*	Breeder	Common
White-winged Scoter	*Melanitta fusca*	Breeder	Common
Common Goldeneye	*Bucephala clangula*	Breeder	Common
Barrow's Goldeneye	*Bucephala islandica*	Breeder	Common
Bufflehead	*Bucephala albeola*	Breeder	Common
Hooded Merganser	*Lophodytes cucullatus*	Visitant	Rare
Common Merganser	*Mergus merganser*	Breeder	Common
Red-breasted Merganser	*Mergus serrator*	Breeder	Rare
Osprey	*Pandion haliaetus*	Breeder	Rare
Bald Eagle	*Haliaeetus leucocephalus*	Breeder	Uncommon
Northern Harrier	*Circus cyaneus*	Breeder	Uncommon
Sharp-shinned Hawk	*Accipiter striatus*	Breeder	Common
Northern Goshawk	*Accipiter gentilis*	Resident	Uncommon
Swainson's Hawk	*Buteo swainsoni*	Breeder	Rare
Red-tailed Hawk	*Buteo jamaicensis*	Breeder	Common
Rough-legged Hawk	*Buteo lagopus*	Breeder	Uncommon
Golden Eagle	*Aquila chrysaetos*	Resident	Common
American Kestrel	*Falco sparverius*	Breeder	Common
Merlin	*Falco columbarius*	Breeder	Uncommon
Peregrine Falcon [c]	*Falco peregrinus*	Breeder	Rare
Gyrfalcon	*Falco rusticolus*	Resident	Uncommon
Spruce Grouse	*Canachites canadensis*	Resident	Common
Willow Ptarmigan	*Lagopus lagopus*	Resident	Common
Rock Ptarmigan	*Lagopus mutus*	Resident	Common
White-tailed Ptarmigan	*Lagopus leucurus*	Resident	Uncommon
Ruffed Grouse	*Bonasa umbellus*	Resident	Common
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Resident	Uncommon
American Coot	*Fulica americana*	Breeder	Rare

TABLE 3.4.5-2

Intermontane Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Sandhill Crane	*Grus Canadensis*	Breeder	Uncommon
Black-bellied Plover	*Pluvialis squatarola*	Visitant	Rare
American Golden-Plover [d]	*Pluvialis dominicus*	Breeder	Common
Semipalmated Plover	*Charadrius semipalmatus*	Breeder	Common
Killdeer	*Charadrius vociferous*	Breeder	Rare
Greater Yellowlegs	*Tringa melanoleuca*	Breeder	Rare
Lesser Yellowlegs [c, d]	*Tringa flavipes*	Breeder	Common
Solitary Sandpiper [c. d]	*Tringa solitaria*	Breeder	Uncommon
Spotted Sandpiper	*Actitis macularius*	Breeder	Common
Wandering Tattler	*Heteroscelus incanus*	Breeder	Uncommon
Upland Sandpiper [c, d]	*Bartramia longicauda*	Breeder	Uncommon
Whimbrel[c, d]	*Numenius phaeopus*	Breeder	Common
Hudsonian Godwit [c, d]	*Limosa haemastica*	Visitant	Rare
Bar-tailed Godwit	*Limosa lapponica*	Visitant	Rare
Marbled Godwit	*Limosa fedoa*	Visitant	Occasional
Ruddy Turnstone	*Arenaria interpres*	Visitant	Rare
Surfbird [d]	*Aphriza virgata*	Breeder	Uncommon
Sanderling [d]	*Caldris alba*	Migrant	Rare
Semipalmated Sandpiper	*Calidris pusilla*	Migrant	Common
Western Sandpiper [d]	*Calidris mauri*	Migrant	Rare
Least Sandpiper	*Calidris minutilla*	Breeder	Uncommon
Baird's Sandpiper	*Calidris bairdii*	Migrant	Uncommon
Pectoral Sandpiper	*Calidris melanotos*	Migrant	Common
Rock Sandpiper [c]	*Calidris ptilocnemis*	Visitant	Rare
Dunlin [d]	*Calidris alpine*	Migrant	Common
Stilt Sandpiper	*Calidris himantopus*	Migrant	Rare
Buff-breasted Sandpiper	*Tryngites subruficollis*	Migrant	Rare
Long-billed Dowitcher	*Limnodromus scolopaceus*	Breeder	Uncommon
Wilson's Snipe	*Gallinago delicate*	Breeder	Common
Wilson's Phalarope	*Phalaropus tricolor*	Breeder	Occasional
Red-necked Phalarope	*Phalaropus lobatus*	Breeder	Common
Long-tailed Jaeger	*Stercorarius longicaudus*	Breeder	Rare
Bonaparte's Gull	*Larus phildelphia*	Breeder	Uncommon
Mew Gull	*Larus canus*	Breeder	Common
Herring Gull	*Larus argentatus*	Breeder	Uncommon
Glaucous-winged Gull	*Larus glaucescens*	Visitant	Rare
Glaucous Gull	*Larus hyperboreus*	Visitant	Rare
Arctic Tern	*Sterna paradisaea*	Breeder	Uncommon
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder	Rare
Long-tailed Jaeger	*Stercorarius longicaudus*	Breeder	Common
Rock Pigeon	*Columba livia*	Resident	Common
Mourning Dove	*Zenaida macroura*	Visitant	Rare
Great Horned Owl	*Bubo virginianus*	Resident	Common

TABLE 3.4.5-2

Intermontane Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Snowy Owl	*Bubo scandiacus*	Visitant	Rare
Northern Hawk Owl	*Surnia ulula*	Resident	Common
Great Grey Owl	*Strix nebulosa*	Resident	Uncommon
Short-eared Owl	*Asio flammeus*	Breeder	Common
Boreal Owl	*Aegolius funereus*	Resident	Common
Belted Kingfisher	*Megaceryle alcyon*	Breeder	Common
Downy Woodpecker	*Picoides pubescens*	Resident	Uncommon
Hairy Woodpecker	*Picoides villosus*	Resident	Uncommon
AmericanThree-toed Woodpecker	*Picoides tridactylus*	Resident	Uncommon
Black-backed Woodpecker	*Picoides arcticus*	Resident	Rare
Northern Flicker	*Colaptes auratus*	Breeder	Common
Olive-sided Flycatcher [c]	*Contopus cooperi*	Breeder	Uncommon
Western Wood-Pewee	*Contopus sordidulus*	Breeder	Uncommon
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Breeder	Rare
Alder Flycatcher	*Empidonax alnorum*	Breeder	Common
Hammond's Flycatcher	*Empidonax hammondii*	Breeder	Common
Say's Phoebe	*Sayornis saya*	Breeder	Uncommon
Northern Shrike	*Lanius excubitor*	Resident	Uncommon
Horned Lark	*Eremophila alpestris*	Breeder	Common
Tree Swallow	*Tachycineta bicolor*	Breeder	Common
Violet-green Swallow	*Tachycineta thalassina*	Breeder	Common
Bank Swallow	*Riparia riparia*	Breeder	Common
Cliff Swallow	*Petrochelidon pyrrhonota*	Breeder	Common
Gray Jay	*Perisoreus canadensis*	Resident	Common
Black-billed Magpie	*Pica hudsonia*	Resident	Uncommon
Common Raven	*Corvus corax*	Resident	Common
Black-capped Chickadee	*Poecile atricaillus*	Resident	Common
Boreal Chickadee	*Poecile hundsonicus*	Resident	Common
Gray-headed Chickadee	*Poecile cintus*	Resident	Resident
Brown Creeper	*Certhia americana*	Resident	Rare
American Dipper	*Cinclus mexicanus*	Resident	Uncommon
Golden-crowned Kinglet	*Regulus satrapa*	Visitant	Rare
Ruby-crowned Kinglet	*Regulus calendula*	Breeder	Uncommon
Arctic Warbler	*Phylloscopus borealis*	Breeder	Common
Northern Wheatear	*Oenanthe oenanthe*	Breeder	Uncommon
Mountain Bluebird	*Sialia currucoides*	Breeder	Rare
Townsend's Solitaire	*Myadestes townsendi*	Breeder	Rare
Gray-cheeked Thrush	*Catharus minimus*	Breeder	Common
Swainson's Thrush	*Catharus ustulatus*	Breeder	Common
Hermit Thrush	*Catharus guttatus*	Breeder	Uncommon
American Robin	*Turdus migratorius*	Breeder	Common
Varied Thrush	*Ixoreus naevius*	Breeder	Common
American Pipit	*Anthus rubescens*	Breeder	Common

TABLE 3.4.5-2

Intermontane Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Bohemian Waxwing	*Bombycilla garrulus*	Breeder	Common
European Starling	*Sturnus vulgaris*	Breeder	Rare
Orange-crowned Warbler	*Vermivora celata*	Breeder	Common
Yellow Warbler	*Motacilla flava*	Breeder	Common
Yellow-rumped Warbler	*Dendroica coronata*	Breeder	Common
Townsend's Warbler	*Dendroica townsendi*	Breeder	Common
Blackpoll Warbler	*Dendroica striata*	Breeder	Uncommon
Northern Waterthrush	*Seiurus noveboracensis*	Breeder	Common
Wilson's Warbler	*Wilsonia pusilla*	Breeder	Common
American Tree Sparrow	*Spizella arborea*	Breeder	Common
Chipping Sparrow	*Spizella passerina*	Breeder	Uncommon
Brewer's Sparrow	*Spizella breweri*	Breeder	Rare
Savannah Sparrow	*Passerculus sandwichensis*	Breeder	Common
Fox Sparrow	*Passerella iliaca*	Breeder	Common
Lincoln's Sparrow	*Melospiza lincolnii*	Breeder	Common
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Breeder	Uncommon
White-crowned Sparrow	*Zonotrichia leucophrys*	Breeder	Common
Dark-eyed Junco	*Junco hyemalis*	Breeder	Common
Lapland Longspur	*Calcarius lapponicus*	Breeder	Common
Smith's Longspur [c]	*Calcarius pictus*	Breeder	Rare
Snow Bunting	*Plectrophenax nivalis*	Breeder	Uncommon
Red-winged Blackbird	*Agelaius phoeniceus*	Breeder	Uncommon
Rusty Blackbird [c]	*Euphagus carolinus*	Breeder	Uncommon
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	Breeder	Uncommon
Pine Grosbeak	*Pinicola enucleator*	Resident	Uncommon
White-winged Crossbill	*Loxia leucoptera*	Resident	Uncommon
Common Redpoll	*Acanthis flammea*	Resident	Common
Hoary Redpoll	*Acanthis homemanni*	Nonbreeding	Common
Pine Siskin	*Carduelis pinus*	Breeder	Rare

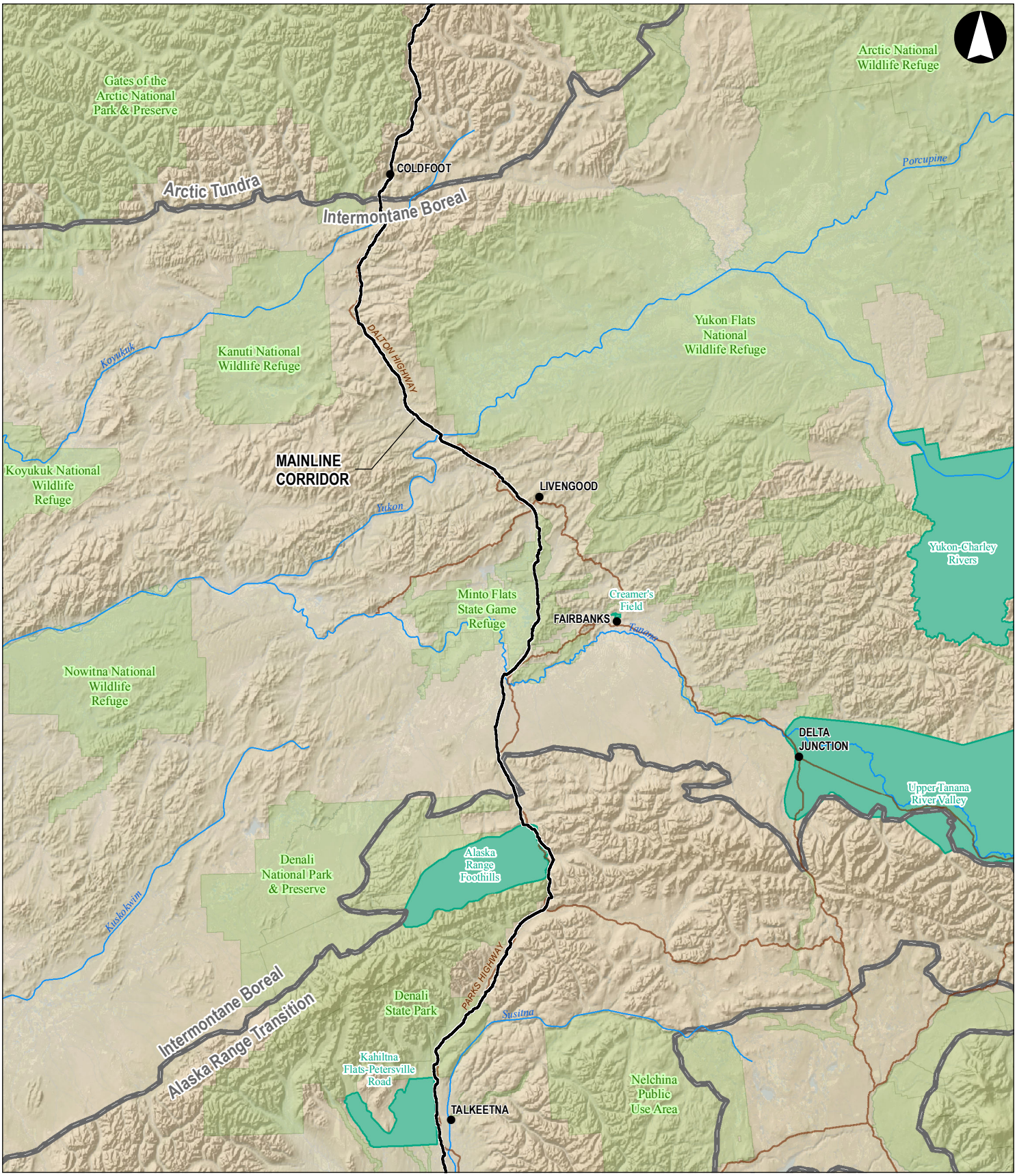
Sources: Armstrong, 2008; AKNHP, 2014a

[a] Status: Resident, year-round resident; Breeder, breeding species (migratory); Migrant, nonbreeder traveling; Nonbreeding, overwintering species; Visitant, outside its normal range.

[b] Relative Abundance: Common, certain to be seen or heard in suitable habitat; Uncommon, locally distributed or occurring in low numbers; Rare, species occurs regularly in region but in very small numbers, sighting likelihood poor; Occasional, seen a few times in a 5-year period; Accidental, seen once to twice and may not be seen again.

[c] Bird of Conservation Concern (USFWS, 2008)

[d] Species of High Concern or Highly Imperiled according to the Alaska Shorebird Group: Alaska Shorebird Conservation Plan II (ASG, 2008)



LEGEND

- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Ecoregion Boundary
- State and Federal Conservation Lands
- Important Bird Area

0 5 10 20 30 40 Miles

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DATE:	2015-01-12	SHEET:	1 of 1

IMPORTANT BIRD HABITATS IN THE INTERMONTANE BOREAL ECOREGION OF THE ALASKA LNG PROJECT

FIGURE 3.4.5-2

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_5-2 Important Bird Habitats in the Intermontane Boreal Ecoregion of the Alaska LNG Project.mxd

Kobuk Ridges and Valleys Ecoregion Birds

The Project will cross a small section in the northeastern corner of this ecoregion (Figure 3.3.1-1). This portion of the ecoregion consists of mountain ridges just south of the Brooks Range. These barren alpine ridges support few birds. Raptors nest on the mountainous high rocky ledges and the migratory American pipit and resident rock and white-tailed ptarmigan nest in the alpine tundra. The increased abundance and diversity of birds, including gray jays, boreal chickadees, boreal owls and great gray owls that are found in the lower elevation boreal forests in this ecoregion (ADF&G, 2006) would most likely not occur in the section of this ecoregion crossed by the Project.

Ray Mountains Ecoregion Birds

The Ray Mountains are located south of the Brooks Range and north of the Yukon River valley. Birds most commonly found in the Ray Mountains include olive-sided flycatchers, blackpoll warblers, boreal owls, great gray owls, rusty blackbirds, rock and willow ptarmigan. Decreasing abundance of birds is found with increasing elevation. Most passerines are migratory and use this region as nesting or resting and as staging grounds during their migration. Nesting and brood rearing are likely to occur in June and July, respectively, with migratory birds leaving by mid- to late September (Brewer et al., 2000). This ecoregion also supports a diverse complement of migratory and resident raptors. Common ravens are common residents.

Yukon-Tanana Uplands Ecoregion Birds

The Yukon-Tanana Uplands consist of rounded mountains between the Yukon and Tanana Rivers, with deep, narrow valleys cut by the rivers into the uplands. The Project corridor will occur just inside the western border of this ecoregion. The open-mixed deciduous-coniferous forest supports a large variety of birds including Smith's longspurs, gray jays, boreal chickadee, northern flicker, red-tailed hawk, and boreal owls (ADF&G, 2006). Peregrine falcons nest in the cliffs of the region.

Tanana-Kuskokwim Lowlands Ecoregion Birds

The Tanana-Kuskokwim Lowlands comprise the alluvial plains between the Ray Mountains and Lime Hills of the Alaska Range. Numerous meandering rivers and lakes occur in the lowlands, with boreal forests dominated by black spruce, white spruce and balsam poplar. The lowland habitats in this ecoregion provide waterbird resting, migration staging, and breeding habitats. The principal waterbirds include common loon, horned and red-necked grebes, trumpeter swans, and common goldeneyes (ADF&G, 2006). The Upper Tanana River Valley serves as a prominent migration corridor, for three major flyways. Between 200,000 and 300,000 sandhill cranes, approximately half of the mid-continental population, migrate through the region stopping along the Tanana River during their spring and fall migrations.

Open, mixed deciduous-conifer forests support a large variety of birds. Ruffed grouse, belted kingfisher, alder, Hammond's and olive-sided flycatchers, blackpoll warbler, boreal owl, great gray owl. and rusty blackbird commonly occur in drier areas within the ecoregions (ADF&G, 2006).

Alaska Range Transition Ecoregion Birds

The Project would cross the Alaska Range and Cook Inlet Basin Ecoregions within the Alaska Range Transition Ecoregion (Figure 3.3.1-3). With about 200 regularly occurring bird species, the Alaska Range Transition Ecoregion supports the greatest diversity of birds in the Project area (Table 3.4.5-3).

Fifty-five resident birds occur in this ecoregion (Table 3.4.5-3). Resident birds likely to occur in subalpine and alpine habitats include willow and rock ptarmigan. Resident birds commonly found on beaches and mudflats include mew and glaucous-winged gulls. Most resident birds occur in forested habitats in this ecoregion. Common forest residents include gray and Steller's jays, black-billed magpie, common raven, black-capped and boreal chickadee, Bohemian waxwing, song sparrow, common redpoll, and pine siskin.

Most birds in this ecoregion are migratory, with the largest concentrations of ducks, geese and shorebirds in this region occurring during spring and fall migrations (ADF&G, 1985; Audubon, 2014). The coastal shorelines and mudflats in Cook Inlet are important resting and feeding habitats for migratory birds. Most waterbirds and shorebirds stopping in the region continue northward and westward to breed, although many waterfowl remain in the coastal and upland habitats of this ecoregion to nest. A few birds, such as rock sandpipers and Steller's eiders, migrate to this ecoregion to overwinter.

Roughly 25 percent of the bald eagle population in the state occurs in Southcentral Alaska (ADF&G, 1985). The highest concentrations of bald eagles are found near the highly productive coastal areas and along inland rivers and lakes. Densities of bald eagles decline away from the coast toward interior portions of this region.

Important Bird Habitats in the Alaska Range Transition Ecoregion

Important Bird Areas (IBAs) are sites that have been determined to provide essential habitat to one or more species of birds during some portion of their year (Audubon, 2014). For an area to qualify as an IBA, it must support a large concentration of birds, provide habitat for a threatened or rare species, or provide habitat for a bird species with a very limited or restricted range. IBAs are ranked as significant on their importance to a bird species at either the global, continental, or state level. IBAs may occur on public or private lands, or both, and may or may not already be protected (Audubon, 2014).

Numerous national and state refuges, as well as IBAs, that provide importation migration and nesting habitats occur near the project area in the Alaska Range Transition Ecoregion (Figure 3.4.5-3).

- The Alaska Range Foothills State IBA occurs adjacent to the project area in the Alaska Range Ecoregion within the northeastern portion of Denali National Park and Preserve. This IBA contains one of the highest reported densities of nesting golden eagles in North America. Substantial numbers of gyrfalcons and other subalpine birds, such as willow ptarmigan and rock ptarmigan, also nest here (Audubon, 2014).

- The Kahiltna Flats-Petersville Road Global IBA contains one of the largest concentrations of nesting trumpeter swans. Wetlands also support large numbers of molting greater white-fronted geese. This IBA supports significant multi-species assemblages and concentrations of migratory landbirds, including 8 Partners in Flight priority species (Audubon, 2014). These landbirds include the gray-cheeked thrush, golden-crowned sparrow, varied thrush, bohemian

waxwing, arctic warbler, white-winged crossbill, blackpoll warbler, and olive-sided flycatcher.

- The Susitna Flats State Game Refuge was primarily established for the spring and fall concentration of migrating waterfowl and shorebirds that occurs here. As many as 100,000 waterfowl use the refuge as a staging area in the spring. Several thousand lesser sandhill cranes and up to 8,000 swans use the Refuge for migrating and nesting. Common shorebirds that use the Refuge include northern phalaropes, dowitchers, godwits, whimbrels, snipe, yellowlegs, sandpipers, plovers, and dunlin. Approximately 10,000 duck, primarily mallards, pintail, and green-winged teal nest in the coastal wetlands of the Refuge. Tule geese, a subspecies of greater-white fronted goose, nest and stage on the Refuge.

- The Susitna Flats Global IBA was designated on the Susitna Flats State Game Refuge for its importance to breeding Hudsonian godwits and overwintering rock sandpipers, two Species of Special Concern (Audubon, 2014). Virtually the entire population of the nominate race of the rock sandpiper (*Calidris ptilocnemis ptilocnemis*) overwinters on this IBA.

- Goose Bay State Game Refuge provides an important spring and fall staging area for waterbird species. Over 20,000 geese, primarily Canada and snow geese, as well as several thousand trumpeter and tundra swans, stop to rest and feed in the refuge in the spring (mid April to mid May). Nesting waterbirds commonly found in the Refuge include mallards, green-winged teal, northern pintail, northern shovelers, snipe, sandhill cranes, whimbrel, greater yellowlegs, and short-billed dowitchers.

- Goose Bay Continental IBA occurs within the Goose Bay State Game Refuge. This IBA was identified for its importance to migrating snow geese. During spring when breakup is late and estuarine habitats in southern Cook Inlet are unavailable, this area is extremely important to migrating geese. It is also readily used by shorebirds.

- The Anchorage Coastal Wildlife Refuge supports at least 130 species of birds with its extensive tidal flats, marsh communities and alder bog forests. Waterbirds commonly found during migration on this Refuge include the lesser Canada goose, mallards, northern pintails, northerner shovelers, American widgeon, canvasbacks, red-necked grebes, horned grebes, yellowlegs, northern phalaropes, trumpeter and tundra swans, snow geese, and short-eared owls.

- The Anchorage Coastal Continental IBA includes the entire coastal wetlands between Ship Creek and Potter Marsh. The southern half of this IBA occurs within the Anchorage Coastal Wildlife Refuge. This IBA was identified for its importance to migrating Hudsonian godwit, sandhill crane, short-billed dowitcher, and snow goose. More than 10,000 of these birds use this site for resting and staging during spring and fall migration. Approximately 160 species occurring annually on this IBA as migrants or breeders, including several species of conservation concern (Audubon, 2014). Species of conservation concern include peregrine falcon, olive-sided flycatcher, trumpeter swan and surfbird.

- The Kenai NWR, containing hundreds of lakes and ponds, has one of the highest densities of nesting common loons in North America (USFWS, 2010a). Trumpeter swans and bald eagles

are frequent these areas. The Chickaloon Watershed and estuary, located on the Upper Cook Inlet portion of this NWR, is a major waterfowl and shorebird migratory staging area. Common breeding songbirds in the forests of the Refuge include dark-eyed junco, yellow-rumped warbler, orange-crowned warbler, Swainson's thrush, boreal chickadee, ruby-crowned kinglet, alder flycatcher, gray jay, and American robin (USFWS, 2010a).

- A portion of the Kenai NWR is designated as the Swanson Lakes Global IBA for its importance to trumpeter swans and migrating greater white–fronted geese (Audubon, 2014). This IBA also supports red-throated loons, a species of conservation concern, and significant multispecies assemblages and concentrations of migratory landbirds, including 9 Partners in Flight priority species (Audubon, 2014). These landbirds include the gray-cheeked thrush, golden-crowned sparrow, varied thrush, bohemian waxwing, rusty blackbird, Townsend's warbler, white-winged crossbill, blackpoll warbler, and olive-sided flycatcher.

- Trading Bay State Game Refuge along the shoreline and intertidal flats on the western side of Cook Inlet south of the Project area encompasses prime waterbird and shorebird habitat. Thousands of migrating and nesting waterbirds use the wetland habitats on this refuge each year. Large concentrations Canada geese, lesser snow geese, Pacific white-fronted geese, Tule white-fronted geese, trumpeter and tundra swans rest and feed in a narrow band of ice-free coast in this Refuge each spring. Nesting waterbirds in the Refuge include trumpeter swans, mallard, northern pintail, green-winged teal, American wigeon, northern shoveler, common eider, red-breasted merganser, scoters, scaup, and goldeneye. Bald eagles and Tule geese are also known to nest within the Refuge.

- Trading Bay is a globally recognized IBA. The entire population of Wrangell Island snow geese uses this IBA as a staging area during spring migration each year. This IBA also supports large numbers of the nominal race of rock sandpiper (Calidris ptilocnemis ptilocnemis) and western sandpiper. Species of conservation concern occurring here include the Hudsonian Godwit, red-throated loon, whimbrel, golden plover, and trumpeter swan (Audubon, 2014).

- Redoubt Bay CHA is located on the western side of Cook Inlet and encompasses the low lying expanse of wetlands and riparian habitats across the Inlet from the Liquefaction Facility. This CHA provides spring and fall feeding and resting habitats for hundreds of thousands of waterfowl, geese, and swans. Several tens of thousands of ducks also nest in this area. During spring, summer and early fall, the Redoubt Bay CHA supports the largest concentration of Tule white-fronted geese in the world.

TABLE 3.4.5-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Red-throated Loon	*Gavia stellate*	Breeder	Common
Pacific Loon	*Gavia pacifica*	Breeder	Uncommon
Common Loon	*Gavia immer*	Breeder	Uncommon
Yellow-billed loon	*Gavia adamsii*	Visitant	Rare
Horned Grebe [e]	*Podiceps auritus*	Breeder	Uncommon

TABLE 3.4.5-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Red-necked Grebe	*Podiceps grisegena*	Breeder	Uncommon
Double-crested Cormorant	*Phalacrocorax auritus*	Visitant	Accidental
Tundra Swan	*Cygnus columbianus*	Migrant	Common
Trumpeter Swan	*Cygnus buccinators*	Breeder	Uncommon
Greater White-fronted Goose	*Anser albifrons*	Breeder	Rare
Emperor Goose	*Chen canagica*	Visitant	Uncommon
Snow Goose	*Chen caerulescens*	Migrant	Common
Brant	*Branta bernicla*	Migrant	Common
Cackling Goose	*Branta hutchinsii*	Migrant	Uncommon
Canada Goose	*Branta Canadensis*	Breeder	Common
Green-winged Teal	*Anas crecca*	Breeder	Common
Mallard	*Anas platyrhynchos*	Resident	Common
Northern Pintail	*Anas acuta*	Breeder	Common
Blue-winged Teal	*Anas discors*	Breeder	Rare
Northern Shoveler	*Anas clypeata*	Breeder	Common
Gadwall	*Anas strepera*	Breeder	Uncommon
Eurasian Wigeon	*Anas Penelope*	Visitant	Casual
American Wigeon	*Anas americanan*	Breeder	Common
Canvasback	*Aythya valisineria*	Breeder	Uncommon
Redhead	*Aythya Americana*	Breeder	Rare
Ringed-neck Duck	*Aythya collaris*	Breeder	Rare
Greater Scaup	*Aythya marlia*	Resident	Common
Lesser Scaup	*Aythya affinis*	Migrant	Rare
King Eider	*Somateria spectabilis*	Nonbreeding	Uncommon
Steller's Eider [d]	*Polysticta stelleri*	Nonbreeding	Common
Common Eider	*Somateria mollissima*	Breeder	Uncommon
Harlequin Duck	*Histrionicus histrionicus*	Breeder	Common
Long-tailed Duck	*Clangula hyemalis*	Breeder	Common
Black Scoter	*Malanitta nigra*	Breeder	Uncommon
Surf Scoter	*Melanitta perspicillata*	Breeder	Common
White-winged Scoter	*Melanitta fusca*	Breeder	Common
Common Goldeneye	*Bucephala clangula*	Breeder	Rare
Barrow's Goldeneye	*Bucephala islandica*	Breeder	Common
Bufflehead	*Bucep[hala albeola*	Breeder	Uncommon
Hooded Merganser	*Lophodytes cucullatus*	Breeder	Rare
Common Merganser	*Mergus merganser*	Resident	Common
Red-breasted Merganser	*Mergus serrator*	Breeder	Common
Northern Fulmar	*Fulmarus glacialis*	Nonbreeding	Common
Sooty Shearwater	*Puffinus griseus*	Nonbreeding	Common
Short-tailed Shearwater	*Puffinus tenuirostris*	Nonbreeding	Uncommon
Fork-tailed Storm Petrel	*Oceanodroma furcate*	Breeder	Common
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Breeder	Uncommon
Double-crested Cormorant	*Phalacrocorax auritus*	Breeder	Common

TABLE 3.4.5-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Red-faced Cormorant	*Phalacrocorax urile*	Breeder	Common
Osprey	*Pandion haliaetus*	Breeder	Rare
Bald Eagle	*Haliaeetus leucocephalus*	Breeder	Common
Northern Harrier	*Circus cyaneus*	Breeder	Uncommon
Sharp-shinned Hawk	*Accipiter striatus*	Resident	Uncommon
Northern Goshawk	*Accipiter gentilis*	Resident	Uncommon
Red-tailed Hawk	*Buteo jamaicensis*	Breeder	Rare
Rough-legged Hawk	*Buteo lagopus*	Migrant	Rare
Golden Eagle	*Aquila chrysaetos*	Resident	Uncommon
American Kestrel	*Falco sparverius*	Migrant	Rare
Merlin	*Falco columbarius*	Breeder	Uncommon
Peregrine Falcon [e]	*Falco peregrinus*	Resident	Rare
Gyrfalcon	*Falco rusticolus*	Resident	Rare
Spruce Grouse	*Canachites Canadensis*	Resident	Uncommon
Willow Ptarmigan	*Lagopus lagopus*	Resident	Uncommon
Rock Ptarmigan	*Lagopus mutus*	Resident	Common
White-tailed Ptarmigan	*Lagopus leucurus*	Resident	Uncommon
American Coot	*Fulica Americana*	Visitant	Rare
Sandhill Crane	*Grus Canadensis*	Breeder	Uncommon
Black-bellied Plover	*Pluvialis squatarola*	Migrant	Common
American Golden-Plover [c]	*Pluvialis dominicus*	Migrant	Common
Pacific Golden-Plover	*Pluvialis fulva*	Migrant	Uncommon
Semipalmated Plover	*Charadrius semipalmatus*	Breeder	Common
Killdeer	*Charadrius vociferous*	Breeder	Rare
Greater Yellowlegs	*Tringa melanoleuca*	Breeder	Common
Lesser Yellowlegs [c, e]	*Tringa flavipes*	Breeder	Common
Solitary Sandpiper [c, e]	*Tringa solitaria*	Breeder	Rare
Spotted Sandpiper	*Actitis macularius*	Breeder	Common
Wandering Tattler	*Heteroscelus incanus*	Breeder	Uncommon
Upland Sandpiper [c, e]	*Bartramia longicauda*	Breeder	Uncommon
Whimbrel [c, e]	*Numenius phaeopus*	Breeder	Uncommon
Hudsonian Godwitd	*Limosa haemastica*	Breeder	Uncommon
Bar-tailed Godwit	*Limosa lapponica*	Visitant	Rare
Marbled Godwit	*Limosa fedoa*	Visitant	Occasional
Ruddy Turnstone	*Arenaria interpres*	Migrant	Common
Black Turnstone	*Arenaria melanocephala*	Migrant	Common
Surfbird [c]	*Aphriza virgate*	Breeder	Uncommon
Red Knot [e]	*Calidris canutus*	Migrant	Common
Sanderling [c]	*Caldris alba*	Migrant	Uncommon
Semipalmated Sandpiper	*Calidris pusilla*	Migrant	Uncommon
Western Sandpiper [c]	*Calidris mauri*	Migrant	Common
Least Sandpiper	*Calidris minutilla*	Breeder	Common
Baird's Sandpiper	*Calidris bairdii*	Migrant	Uncommon

TABLE 3.4.5-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Pectoral Sandpiper	*Calidris melanotos*	Migrant	Common
Rock Sandpiper [e]	*Calidris ptilocnemis*	Visitant	Common
Dunlin [c]	*Calidris alpine*	Migrant	Common
Buff-breasted Sandpiper	*Tryngites subruficollis*	Migrant	Occasional
Short-billed Dowitcher [c, e]	*Limnodromus griseus*	Breeder	Common
Long-billed Dowitcher	*Limnodromus scolopaceus*	Migrant	Common
Wilson's Snipe	*Gallinago delicate*	Breeder	Common
Wilson's Phalarope	*Phalaropus tricolor*	Breeder	Occasional
Red-necked Phalarope	*Phalaropus lobatus*	Breeder	Common
Red Phalarope	*Phalaropus fulicaria*	Migrant	Common
Long-tailed Jaeger	*Stercorarius longicaudus*	Breeder	Rare
Bonaparte's Gull	*Larus phildelphia*	Breeder	Common
Mew Gull	*Larus canus*	Resident	Common
Ring-billed Gull	*Larus delawarensis*	Resident	Rare
Herring Gull	*Larus argentatus*	Resident	Uncommon
Thayer's Gull	*Larus thayeri*	Visitant	Rare
Glaucous-winged Gull	*Larus glaucescens*	Resident	Common
Glaucous Gull	*Larus hyperboreus*	Visitant	Rare
Sabine's Gull	*Xema sabini*	Visitant	Uncommon
Black-legged Kittiwake	*Rissa tridactyla*	Breeder	Common
Aleutian Tern	*Onychoprion aleuticus*	Breeder	Uncommon
Caspian Tern	*Hydroprogne caspia*	Breeder	Rare
Arctic Tern	*Sterna paradisaea*	Breeder	Common
Rock Pigeon	*Columba livia*	Visitant	Occasional
Mourning Dove	*Zenaida macroura*	Visitant	Rare
Pomarine Jaeger	*Stercorarius pomarinus*	Migrant	Common
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder	Common
Long-tailed Jaeger	*Stercorarius longicaudus*	Breeder	Rare
Pigeon Guillemot	*Cepphus Columba*	Resident	Common
Marbled Murrelet	*Brachyramphus marmoratus*	Breeder	Common
Cassin's Auklet	*Ptychoramphus aleuticus*	Resident	Rare
Rock Pigeon	*Columba livia*	Resident	Common
Great Horned Owl	*Bubo virginianus*	Resident	Common
Snowy Owl	*Bubo scandiacus*	Visitant	Rare
Northern Hawk Owl	*Surnia ulula*	Resident	Uncommon
Great Grey Owl	*Strix nebulosa*	Resident	Rare
Short-eared Owl	*Asio flammeus*	Breeder	Uncommon
Boreal Owl	*Aegolius funereus*	Resident	Uncommon
Northern Saw-whet Owl	*Aegolius acadicus*	Resident	Rare
Belted Kingfisher	*Megaceryle alcyon*	Breeder	Uncommon
Downy Woodpecker	*Picoides pubescens*	Resident	Uncommon
Hairy Woodpecker	*Picoides villosus*	Resident	Uncommon
American Three-toed	*Picoides tridactylus*	Resident	Uncommon

TABLE 3.4.5-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Woodpecker			
Black-backed Woodpecker	*Picoides arcticus*	Resident	Rare
Northern Flicker	*Colaptes auratus*	Breeder	Uncommon
Olive-sided Flycatcher [e]	*Contopus cooperi*	Breeder	Rare
Western Wood-Pewee	*Contopus sordidulus*	Breeder	Uncommon
Alder Flycatcher	*Empidonax alnorum*	Breeder	Uncommon
Hammond's Flycatcher	*Empidonax hammondii*	Breeder	Common
Say's Phoebe	*Sayornis saya*	Breeder	Rare
Northern Shrike	*Lanius excubitor*	Resident	Uncommon
Horned Lark	*Eremophila alpestris*	Breeder	Rare
Tree Swallow	*Tachycineta bicolor*	Breeder	Common
Violet-green Swallow	*Tachycineta thalassina*	Breeder	Common
Bank Swallow	*Riparia riparia*	Breeder	Common
Cliff Swallow	*Petrochelidon pyrrhonota*	Breeder	Uncommon
Barn Swallow	*Hirundo rustica*	Breeder	Uncommon
Gray Jay	*Perisoreus Canadensis*	Resident	Uncommon
Steller's Jay	*Cyanocitta stelleri*	Resident	Common
Black-billed Magpie	*Pica hudsonia*	Resident	Common
Common Raven	*Corvus corax*	Resident	Common
Black-capped Chickadee	*Poecile atricaillus*	Resident	Common
Boreal Chickadee	*Poecile hundsonicus*	Resident	Uncommon
Red-breasted Nuthatch	*Sitta Canadensis*	Resident	Rare
Brown Creeper	*Certhia Americana*	Resident	Uncommon
Winter Wren	*Troglodytes troglodytes*	Resident	Uncommon
American Dipper	*Cinclus mexicanus*	Resident	Common
Golden-crowned Kinglet	*Regulus satrapa*	Resident	Uncommon
Ruby-crowned Kinglet	*Regulus calendula*	Breeder	Common
Arctic Warbler	*Phylloscopus borealis*	Breeder	Common
Northern Wheatear	*Oenanthe oenanthe*	Breeder	Rare
Townsend's Solitaire	*Myadestes townsendi*	Breeder	Rare
Gray-cheeked Thrush	*Catharus minimus*	Breeder	Uncommon
Swainson's Thrush	*Catharus ustulatus*	Breeder	Uncommon
Hermit Thrush	*Catharus guttatus*	Breeder	Common
American Robin	*Turdus migratorius*	Breeder	Common
Varied Thrush	*Ixoreus naevius*	Breeder	Common
American Pipit	*Anthus rubescens*	Breeder	Common
Bohemian Waxwing	*Bombycilla garrulous*	Resident	Uncommon
European Starling	*Sturnus vulgaris*	Resident	Rare
Orange-crowned Warbler	*Vermivora celata*	Breeder	Common
Tennessee Warbler	*Vermivora peregrine*	Visitant	Rare
Yellow Warbler	*Motacilla flava*	Breeder	Uncommon
Yellow-rumped Warbler	*Dendroica coronate*	Breeder	Common
Townsend's Warbler	*Dendroica townsendi*	Breeder	Common

TABLE 3.4.5-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Blackpoll Warbler	*Dendroica striata*	Breeder	Rare
Northern Waterthrush	*Seiurus noveboracensis*	Breeder	Uncommon
Wilson's Warbler	*Wilsonia pusilla*	Breeder	Common
American Tree Sparrow	*Spizella arborea*	Breeder	Rare
Chipping Sparrow	*Sipzella passerine*	Breeder	Rare
Savannah Sparrow	*Passerculus sandwichensis*	Breeder	Common
Song Sparrow	*Melospiza melodia*	Resident	Common
Fox Sparrow	*Passerella iliaca*	Breeder	Common
Lincoln's Sparrow	*Melospiza lincolnii*	Breeder	Common
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Breeder	Common
White-crowned Sparrow	*Zonotrichia leucophrys*	Breeder	Uncommon
Dark-eyed Junco	*Junco hyemalis*	Breeder	Common
Lapland Longspur	*Calcarius lapponicus*	Breeder	Rare
Smith's Longspur [e]	*Calcarius pictus*	Breeder	Rare
Snow Bunting	*Plectrophenax nivalis*	Breeding	Rare
Red-winged Blackbird	*Agelaius phoeniceus*	Breeder	Rare
Rusty Blackbird [e]	*Euphagus carolinus*	Resident	Rare
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	Breeder	Uncommon
Pine Grosbeak	*Pinicola enucleator*	Resident	Uncommon
White-winged Crossbill	*Loxia leucoptera*	Resident	Uncommon
Common Redpoll	*Acanthis flammea*	Resident	Common
Hoary Redpoll	*Acanthis homemanni*	Nonbreeding	Rare
Pine Siskin	*Carduelis pinus*	Resident	Common

Sources: Armstrong 2008; AKNHP 2014a

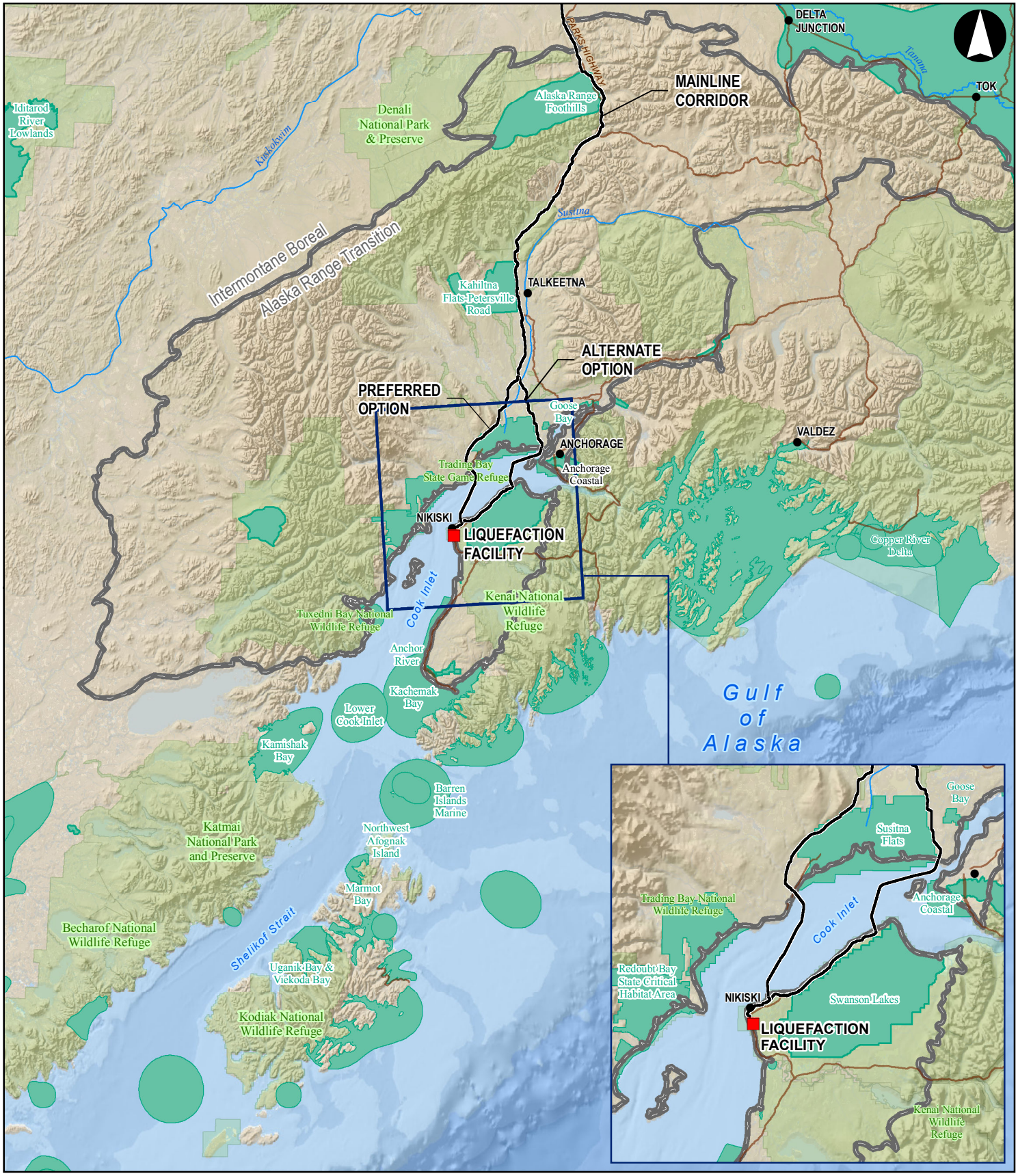
[a] Status: Resident, year-round resident; Breeder, breeding species (migratory); Migrant, nonbreeder traveling; Nonbreeding, overwintering species; Visitant, outside its normal range.

[b] Relative Abundance: Common, certain to be seen or heard in suitable habitat; Uncommon, locally distributed or occurring in low numbers; Rare, species occurs regularly in region but in very small numbers, sighting likelihood poor; Occasional, seen a few times in a 5-year period; Accidental, seen once to twice and may not be seen again.

[c] Species of High Concern or Highly Imperiled according to the Alaska Shorebird Group: Alaska Shorebird Conservation Plan II (ASG 2008)

[d] ESA listed, candidate, or proposed species (USFWS, 2014a)

[e] Bird of Conservation Concern (USFWS, 2008)



VICINITY MAP

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Ecoregion Boundary
- State and Federal Conservation Lands
- Important Bird Area

0 12.5 25 50 75 100 Miles

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IMPORTANT BIRD HABITATS IN THE ALASKA RANGE TRANSITION ECOREGION OF THE ALASKA LNG PROJECT

FIGURE 3.4.5-3

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_5-3 Important Bird Habitats in the Alaska Range Transition Ecoregion of the Alaska LNG Project.mxd

Alaska Range Ecoregion Birds

The Alaska Range Ecoregion contains steep mountains covered with glaciers, rocky slopes, and ice fields. Vegetation is sparse, with dwarf shrub communities dominating windswept areas, and willow, birch, and alder shrub communities occurring on lower slopes and valley bottoms (ADF&G, 2006). About 7 percent of this ecoregion is wetlands.

Cliffs and alpine habitats of this ecoregion provide ideal habitat for nesting raptors, including golden eagles, gyrfalcon, and peregrine falcon. Shorebirds, such as American golden plover, surfbird, least sandpiper and Baird's sandpiper, and the passerine Smith's longspur nest in alpine tundra habitats. Migratory Says phoebe, horned lark, northern wheatear, American pipit, Lapland longspur, snow bunting and gray-crowned rosy finch, as well as resident willow ptarmigan and rock ptarmigan, also nest in the alpine tundra (NPS, 2014).

Cook Inlet Basin Ecoregion Birds

The Cook Inlet creates this ecoregion influencing the climate and adding maritime character. Gently sloping lowlands contain numerous small lakes and wetlands, as well as mixed forested upland habitats. Wetland habitats range from low scrub bogs to wet graminoid marshes (ADF&G, 2006).

The diverse habitats found in this ecoregion support divers bird communities. Shorebirds and waterfowl inhabit the numerous lakes, ponds and wetlands. Trumpeter swans, red-necked grebes, common and Pacific loons, green-winged teal, northern pintail, and common and Barrow's goldeneye commonly nest on lakes and ponds in the region. Many landbirds migrate, breed, or reside within the region. Common nesting passerines include alder flycatcher, tree swallow, violet-green swallow, bank swallow, ruby-crowned kinglet, hermit thrush, American robin, varied thrush, yellow-rumped warbler, orange-crowned warbler, fox sparrow, white-crowned sparrow, and dark-eyed junco. Common resident birds include black-capped chickadee, black-billed magpie, common raven, boreal chickadee, great horned owl, and willow ptarmigan.

Cook Inlet supports large numbers of breeding or migrating shorebirds including western sandpipers, dunlins, rock sandpipers, long- and short-billed dowitchers, and Hudsonian godwits (ADF&G, 2006). Colonial nesting seabirds such as black-legged kittiwakes and common murres nest along Cook Inlet shores (ADF&G, 2006). The numerous salmon runs that occur in the ecoregion attract bald eagles and common ravens.

The Cook Inlet Basin Ecoregion supports the entire populations of some birds. Nearly the entire population of Wrangell Island Snow Geese migrates across the mouth of the Kenai River and Trading Bay each spring and the entire population of tule greater white-fronted geese nests in the boreal forest wetlands on the western side of Upper Cook Inlet (ADF&G, 2006; AKNHP, 2014a; Densmore et al., 2006). Concentrations of molting and nesting Tule geese also occur in Redoubt Bay, Trading bay, and Susitna Flats (AKNHP, 2014a).

3.4.5.3 Marine Bird Habitats

Marine waters within the Project area include the coastal Beaufort Sea, Cook Inlet and Shelikof Strait. These areas are important to migratory birds. The Beaufort Sea is inhabited by large numbers of waterfowl, especially seaducks, during the summer months for breeding, molting, migration, and

foraging. The Cook Inlet Region is an important wintering area for many seabirds, including murres, gulls, kittiwakes, cormorants, murrelets, and puffins. Lower Cook Inlet is one of the most productive areas in Alaska for seabirds, with 2.2 million seabirds foraging in the area in July 1992 (Piatt, 1994; cited in ADNR, 2014). Shallow coastal habitats are particularly important for seabirds at sea, as these areas have high densities of forage fish. Shelikof Strait is important to migrating and overwintering waterfowl and nesting seabirds.

Liquefaction Facility

Within the Liquefaction Facility Project area, Audubon (2014) has designated several global IBAs in or near marine waters in the Cook Inlet region including (Figure 3.4.5-3):

Cook Inlet

Kachemak Bay Global IBA

The Kachemoak Bay Global IBA occurs in the Kachemak Bay Critical Habitat Area. This area supports great concentrations of birds during spring and fall migration, when large flocks of geese, ducks, and shorebirds rest, feed, and stage in the bay and its associated wetlands. Fox River Flats at the head of the bay has the highest concentration of migrating birds. Islands in Outer Kachemak Bay and nearby waters provide habitat for important seabird rookeries for tufted puffins, horned puffins, pigeon guillemots, black-legged kittiwakes, glaucous-winged gulls, and common murres. Over 90 percent of the overwintering seabird and waterfowl populations in of Lower Cook Inlet occur in Kachemak Bay. The head of the bay provides important migrating and overwintering habitat for the threatened Steller's eider. This area was identified as a global IBA for the following species: Kittlitz's murrelet, white-winged scoter, black scoter, pelagic cormorant, and marbled murrelet.

Lower Cook Inlet Global IBA

The Lower Cook Inlet Global IBA occurs in pelagic open-water habitat. This IBA was identified for its importance to glaucous-winged gulls. An estimated 9,445 nonbreeding glaucous-winged gulls regularly use this area.

Kamishak Bay Global IBA

The Kamishak Bay Global IBA occurs in the Western Cook Inlet-Shelikof Strait area. This bay was designated as an IBA for the glaucous-winged gull. An estimated 9,460 breeding glaucous-winged gulls occur here regularly (Audubon, 2014).

Barren Islands Colonies State IBA

The Barren Islands Colonies State IBA contains 6 seabird colonies comprising 14 seabird species and an estimated 401,308 birds (Audubon, 2014). Large numbers of pelagic cormorant, glaucous-winged gull, black-legged kittiwake, tufted puffin, and fork-tailed storm-petrel nest on these islands.

Tuxedni National Wildlife Refuge

The Tuxedni Wilderness Area of the Alaska Maritime National Wildlife Refuge consists of two islands at the mouth of Tuxedni Bay on the southwestern side of Cook Inlet. The largest seabird colony in Cook Inlet is found on these islands. These islands were originally established as a refuge for seabirds, bald eagles, and peregrine falcons in 1909. Other species protected in this Wilderness Area include large colonies of seabirds, black-legged kittiwakes, horned puffins, common murres, pigeon guillemots, and glaucous-winged gulls, leatherback sea turtles, Steller's sea lions, bowhead whales, humpback whales, Steller's eiders, lynx, and otters.

Tuxedni Bay IBA

Located within the Tuxedni National Wildlife Refuge, Tuxedni Bay IBA supports up to 20 percent of the 1.2 million shorebirds using western Cook Inlet intertidal areas. Large numbers of western sandpipers use the bay during spring migration. Scoters concentrate in this area for molting and feeding during summer and fall. Species of conservation concern include: black scoter, black oystercatcher, black turnstone, surfbirds, and whimbrels.

Interdependent Facilities

In addition to the Cook Inlet region IBAs listed above that would also occur near the Mainline corridor (Figure 3.4.5-3), Audubon (2014) has designated a global IBA in or near marine waters in the Beaufort Sea region (Figure 3.4.5-1).

Beaufort Sea Nearshore Global IBA

The Beaufort Sea Nearshore Global IBA occupies pelagic open-water habitat. This IBA is located in the Beaufort-Chukchi Coastal - Shelf Ecoregion within the Beaufort Sea. The area was identified as an IBA for glaucous gulls and long-tailed ducks. It contains an estimated breeding population of 19,990 glaucous gulls and a molting population of 293,157 long-tailed ducks.

3.4.5.4 Raptors

Raptors present in the Project area include the osprey, bald eagle, northern harrier, northern goshawk, sharp-shinned hawk, rough-legged hawk, golden eagle, American kestrel, merlin, Swainson's hawk, Western and Harlans's red-tailed hawk, American and Arctic peregrine falcons, and the gyrfalcon. Owls that are known to be present in the Project area include the great horned owl, great grey owl, northern hawk owl, snowy owl, short-eared owl, boreal owl, and saw-whet owl. Although none of these species are currently listed as threatened or endangered under the ESA, raptors are of special concern to resource managers and regulatory agencies. These birds are also protected under the Migratory Bird Treaty Act (MBTA), 16 U.S.C. §§ 703-712, as amended and bald and golden eagles are specifically afforded additional protection under the Bald and Golden Eagle Protection Act (BGEPA). A draft Avian Protection Plan is included in Appendix E.

The Project area is located within important raptor nesting habitats. The Project is aligned with several other pipeline and utility corridors constructed or proposed during the past 32 years, and extensive biological surveys, including location and identification of raptor nest sites, have been conducted in the vicinity of the Project area over the past 30 years. Raptor nest surveys were conducted during planning,

construction, and reauthorization of the TAPS, which the Mainline parallels from Prudhoe Bay to Delta Junction. These surveys were conducted in 1979 and periodically from 1993 to 2002. In 2001, an aerial survey was conducted to identify raptor nests along the proposed Alaska Gas Producers Pipeline Team route, which corresponds with the Mainline for most of its length in Alaska. The Alaska Gas Producers Pipeline Team report also included a compilation of data from previous nest identification efforts completed by Ritchie, Timm, White and others (Ritchie and Palmer, 2002). Craig and Hamfler (2003) conducted cliff-nesting raptors surveys in the Dalton Highway Management Unit from 1999 through 2003. Additional raptor surveys were conducted for the Alaska Pipeline Project in 2012. Periodic nest surveys have also been conducted by resource agencies on discrete sections of the Project area between 1991 through 2003 (Timm and Johnson, 2006); however, data from the most recent agency- conducted surveys have not yet been released.

Some tree-nesting owls, merlins and American kestrels and ground-nesting raptor species, including the northern harrier, snowy owl, and short-eared owl were not included in the surveys. Several tree and cliff-nesting raptor species exhibit strong nest fidelity and return year after year to the same nesting area or structure. For this reason, nest surveys that have been previously conducted were used to determine the locations of nesting sites relative to the Project area.

Cliff-nesting raptors are sparsely distributed in uplands and along river courses south of Atigun Pass (Ritchie and Palmer, 2002). Peregrine falcon nests are widespread throughout the Project area, while golden eagle nests are more common south of Atigun Pass in the cliff habitat of the mountains and bald eagle nests are most common south of the Alaska Range. Available raptor nest data including cliff-nesting and tree-nesting raptors will be summarized in Table 3.4.5-4 in subsequent drafts of this report. Available data on bald and golden eagle nest within 0.5 miles of Project components will be summarized in Table 3.4.5-5 in subsequent drafts of this report.

TABLE 3.4.5-4

Accumulative Raptor Nests Identified within Study Corridor[a] for Summer Construction Spreads

Spread AMPs	Bald Eagle	Northern Goshawk	Red-tailed Hawk	Golden Eagle	Peregrine Falcon	Gyrfalcon	Great Horned Owl	Other[b]	Total
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TOTAL									

Sources:

[a] Define Study Corridor using this footnote

[b] Unidentified nests were included in the "Other" category.

TABLE 3.4.5-5

Eagle Nests within 0.5 Mile of the Project Centerline

Common Name		Approximate Mainline Milepost		Summer/Winter Construction
TBD		TBD		TBD

3.4.5.5 Birds of Conservation Concern

Migratory Bird Treaty Act (MBTA)

Migratory birds include bird species that nest in the U.S. and Canada during the summer and migrate south to warmer regions of the U.S., Mexico, Central and South America, and the Caribbean for the winter. The Project is located on the northern limits of the Pacific and Central flyways, which are important corridors for migratory birds during both spring and fall. Consequently, numerous migratory birds may occur within the Project area.

The MBTA, enacted in 1918, protects migratory birds within the US. Under provisions of the MBTA, except as authorized by the USFWS, it is illegal to pursue, hunt, take, capture, kill migratory birds, or attempt to take, capture, kill, or possess them. It is also illegal to offer for sale, export, import, or transport any migratory bird, part (i.e., feathers), nest, or egg of such birds. (16 USC § 703). The lead federal agency for the Project, FERC, finalized a Memorandum of Understanding (MOU) with the USFWS in March 2011, which includes commitments related to migratory birds and their habitat. Additional federal guidance relevant to the MBTA and the conservation of migratory bird populations includes Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853, (January17, 2001); a December 2008 MOU between the USFWS and USFS; and an August 2010 MOU between the USFWS and the BLM.

Bald and Golden Eagle Protection Act (BGEPA)

The BGEPA provides additional protection to bald and golden eagles, and their nests. It also prohibits the take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 USC § 668[a]).

Many migratory birds, including raptor species, can be sensitive to disturbance when nesting and roosting depending on site-specific conditions, including terrain, presence of trees, unrestricted line of sight, and adaption to development. Vegetation from the construction areas will be removed in the winter or during other parts of the year when the migratory birds are not nesting and roosting, prior to the planned construction season, such as trenching and pipeline installation. This removal avoids potential disturbance to nesting species due to construction activities.

Fish and Wildlife Conservation Act (USFWS Birds of Conservation Concern)

The 1988 amendment to the Fish and Wildlife Conservation Act mandates that the USFWS "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973." The overall goal of the ESA is to accurately identify the migratory and nonmigratory bird species (beyond those already designated as federally threatened or endangered) that represent the highest conservation priorities of the USFWS. Bird species considered for inclusion on lists in this Resource Report include nongame birds, gamebirds

without hunting seasons, subsistence-hunted nongame birds in Alaska, and ESA candidate, proposed endangered or threatened, and recently delisted species.

Nineteen bird species in the Project area are currently designated as Birds of Conservation Concern (USFWS, 2008). These include red-throated loon, yellow-billed loon, horned grebe, peregrine falcon, lesser yellowlegs, solitary sandpiper, upland sandpiper, whimbrel, Hudsonian godwit, bar-tailed godwit, red knot (*Calidris canutus roselaari*), rock sandpiper, dunlin (*Calidris alpine arcticola*), buff-breasted sandpiper, short-billed dowitcher, arctic tern, olive-sided flycatcher, Smith's longspur, and rusty blackbird (Table 3.4.5-6; USFWS, 2008).

TABLE 3.4.5-6

USFWS Birds of Special Concern Potentially Occurring in the Project Area

Common Name	Ecoregions	Potential Habitat
Red-Throated Loon [b]	Beaufort Coastal Plain, Brooks Foothills, Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Freshwater lakes and ponds
Yellow-Billed Loon [b]	Beaufort Coastal Plain; marine waters	Large freshwater lakes in the Arctic tundra of Alaska on the Beaufort Coastal Plain
Horned Grebe [b]	Kobuk Ridges and Valleys, Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range	Small to medium shallow ponds and marshes with emergent vegetation and open water
Spectacled Eider [a]	Beaufort Coastal Plain; marine waters	Sedge meadow tundra, shallow ponds and lakes (refer to Section 3.5)
Steller's Eider [a]	Beaufort Coastal Plain; marine waters	Coastal tundra adjacent to ponds with lake basins; edges of low-centered near ponds with emergent vegetation (refer to Section 3.5)
Bald Eagle [c]	Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Mature forests near large bodies of water; beaches; mudflats
Golden Eagle [c]	Entire Project area	Mountain, bluffs in the foothill, along rivers
Peregrine Falcon [b]	Every ecoregion in the Project area	Various open habitats especially near mountains
Lesser Yellowlegs [b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Muskeg and freshwater marshes in open boreal forests and forest-tundra transition habitats
Solitary Sandpiper [b]	Kobuk Ridges and Valleys, Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Wooded wetlands in muskeg bogs, spruce forests and deciduous riparian woodlands
Upland Sandpiper [b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Extenstive open tracts of short grassland habitat; peatlands; scattered woodlands near timberline
Eskimo Curlew [a]	Brooks Foothills	Arctic tundra and open grasslands
Whimbrel [b]	Beaufort Coastal Plain, Brooks Foothills, Brookes Range, Kobuk Ridges and Valleys, Tanana-Kuskokwim Lowlands, Alaska Range; Cook Inlet Basin.	Wet, flat, dwarf shrub ridges and steep slopes; open tundra; beaches, marshes, estuaries;, flooded fields
Hudsonian Godwit [b]	Alaska Range; Cook Inlet Basin	Open wet meadow or bogs intermixed with forest; beaches, tidal mudflats
Bar-Tailed Godwit [b]	Beaufort Coastal Plain	Arctic tundra
Red Knot [b]	Beaufort Coastal Plain; Cook Inlet Basin	Beaches and tidal flats in northern Alaska
Rock Sandpiper [b]	Cook Inlet Basin	Low elevation heath tundra; montane

TABLE 3.4.5-6

USFWS Birds of Special Concern Potentially Occurring in the Project Area

Common Name	Ecoregions	Potential Habitat
		subarctic tundra; open coastal mudflats
Dunlin [b]	Beaufort Coastal Plain; Cook Inlet Basin	Moist wet tundra with ponds; coastal estuaries, bays, and seasonal wetlands
Buff-Breasted Sandpiper [b]	Beaufort Coastal Plain	Alaskan tundra close to water
Short-Billed Dowitcher [b]	Cook Inlet Basin	Muskegs; sedge meadow, sedge-hummock, bogs in floodplains; open coastal mudflats and ponds.
Arctic Tern [b]	Entire Project area	Open terrain near water; barrier beaches; glacial moraines; marshes, bogs and grassy meadows; tidal flats
Olive-Sided Flycatcher [b]	Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Bogs, shrublands, open forests
Smith's Longspur [b]	Brooks Foothills; Brooks Range Kobuk Ridges and Valleys; Alaska Range	Moist tussock meadows in alpine valleys, dry ridge tundra
Rusty Blackbird [b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Open spruce forests and woodlands

Source: USFWS, 2008; AKNHP, 2014a

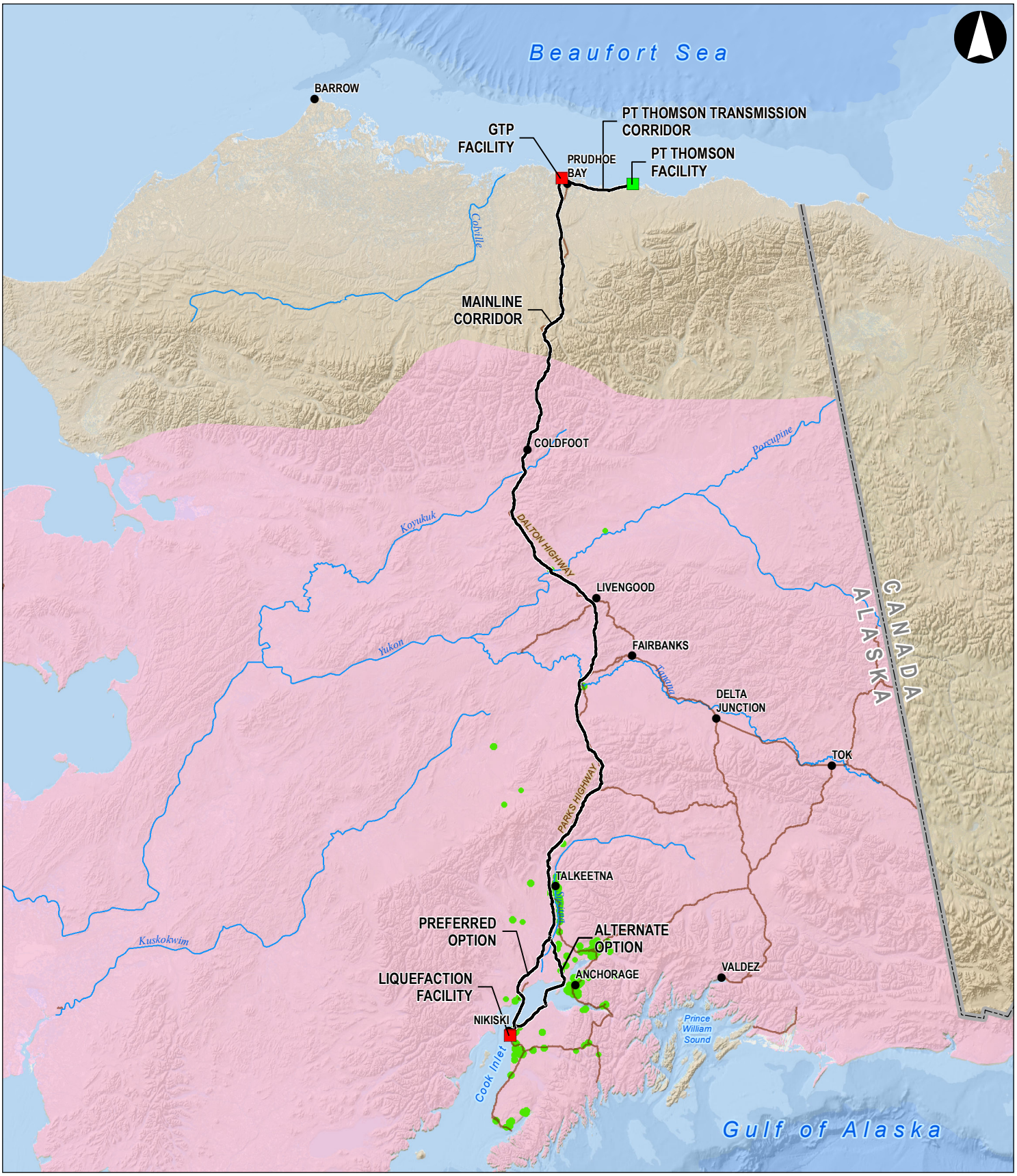
[a] ESA listed, candidate, or proposed species (refer to Section 3.5 for more detail)

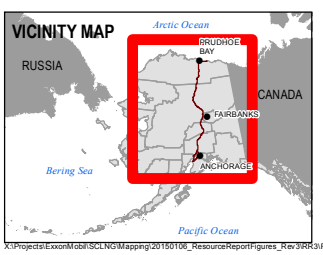
[b] USFWS Bird of Conservation Concern

[c] Species protected by BGEPA

3.4.6 Amphibians and Reptiles

No terrestrial reptiles are present in the Project area. One amphibian, the wood frog (*Lithobates sylvatica*), is present in the Project area from Anaktuvuk Pass at the crest of the Brooks Range south throughout Interior and Southcentral Alaska (Figure 3.4.6-1). Wood frogs use diverse vegetation types from grassy meadows to open forests, muskeg and tundra. They hibernate under the snow in depressions in forest litter (AKNHP, 2014b). After they emerge from dormancy wood frogs migrate up 600 feet to breeding pools, where they breed explosively in early spring in permanent or ephemeral water (AKNHP, 2014b). Juveniles may disperse from 1,000 to 4,000 feet from natal ponds (AKNHP, 2014b). The population size and trends in Alaska are unknown, but is considered to be stable to slightly declining. Numerous reports from the Kenai Peninsula, Anchorage Bowl, and Talkeetna indicate wood frogs are no longer present at historical breeding sites (AKNHP, 2014b).





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Wood Frog Collection
- Project Corridor
- Major Highways
- Major Rivers
- Wood Frog Range

0 40 80 160 Miles

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WOOD FROG RANGE AND COLLECTION RECORDS WITHIN THE PROJECT AREA

FIGURE 3.4.6-1

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_6-1 Wood Frog Range and Collection Records within the Project Area.mxd

3.4.7 Terrestrial and Aquatic Invertebrates

Invertebrates are a diverse group of animals that occur in terrestrial, freshwater, and marine habitats. Alaska supports a diversity of terrestrial and aquatic invertebrates that serve important ecosystem functions in food webs and energy networks throughout all of the ecoregions crossed by the Project. In general most taxa represented within North America occur in Alaska, although because of harsh climatic conditions and glacial history invertebrate fauna are generally less diverse.

Alaska has no federal or state-listed terrestrial invertebrates. Common insects include flies, mosquitoes, beetles, moths, butterflies, wasps and bees. Knowledge of the status of terrestrial invertebrates in Alaska is limited, but two potentially rare groups have been identified: the western bumble bee (*Bombus occidentalis*) and land snails in arctic and boreal habitats (ADF&G, 2006). In addition, the conservation status of a butterfly, the Eskimo arctic (*Oeneis alpina*), has been evaluated (McClory and Gotthardt, 2006a).

Common freshwater aquatic invertebrates or aquatic larval stages of terrestrial invertebrates include water fleas, fairy shrimp, midges, black flies, dragonflies, damselflies, mayflies, stoneflies, caddisflies, clams, mussels, and snails. Freshwater aquatic invertebrates provide important nutritional support for freshwater and anadromous fisheries and aquatic and terrestrial food webs and are important indicators for monitoring water quality. Mayflies/stoneflies/caddisflies or Ephemeroptera/Plecoptera/Trichoptera (EPT) populations are highly sensitive to heavy metals, organic pollutant contamination, and sedimentation and turbidity. This group transfers primary productivity to many vertebrates including waterbirds and fishes. Nonbiting midges and their aquatic or terrestrial larvae are critical to aquatic and terrestrial food webs on Alaska's North Slope (Huryn and Hobbie, 2012).

Alaska's Comprehensive Wildlife Conservation Plan featured invertebrates potentially occurring within the project area with conservation status where known are listed in Table 3.4.7-1 (ADF&G, 2006).

TABLE 3.4.7-1

Alaska's Comprehensive Wildlife Conservation Plan Featured Invertebrates Potentially Occurring in the Project Area

Common Name	Scientific Name	Facility	Habitat	Global Rank	State Rank
Eskimo Arctic (butterfly)	*Oeneis alpine*	Mainline – Brooks Range foothills, Anaktuvuk Pass to Dalton Highway	Wet grassy tundra and taiga bogs	G3G4	S3
Treeline Emerald (dragonfly)	*Somatochlora sahlbergi*	Mainline –to Delta Junction, GTP, PTTL	Ponds, small lakes edge of shrub tundra, fens and bogs	G4	S3S4
Yukon Floater (freshwater mollusk)	Anodonta berigiana	Mainline (HUC 8) Upper Kenai Peninsula (19020302) Anchorage (19020401) Lower Susitna River (19020505) Cook Inlet (19020800)	Lakes, ponds, slow-moving streams with sand and gravel substrate, 3 feet deep	G4	S3S4
Lugworm (marine)	*Abarenicola pacifica*	Marine Terminal, Mainline, Upper Cook Inlet	Muddy sand in shallow bays near	GNR	S4S5
Baltic Macoma (marine clam)	*Macoma balthica*	Marine Terminal, Mainline, GTP – Offshore West Dock,	Intertidal mud or silt, pelagic larvae, Beaufort Sea and Upper Cook Inlet	G5	S5
Sitka Periwinkle (marine snail)	*Littorina sitkana*	Marine Terminal, Mainline	Intertidal, protected bays and saltmarsh	G5	S5

TABLE 3.4.7-1

Alaska's Comprehensive Wildlife Conservation Plan Featured Invertebrates Potentially Occurring in the Project Area

Common Name	Scientific Name	Facility	Habitat	Global Rank	State Rank
Arrow Worm (marine)	*Sagitta elegans* [*Parasagitta elegans*]	Marine Terminal, Mainline, GTP – Offshore West Dock	Nearshore coastal waters; Beaufort, Chukchi, Bering seas, Gulf of Alaska, Lower Cook Inlet	G5	S5

Sources: ADF&G, 2006; Jansen and Gotthardt, 2005; Gotthardt and Jansen, 2006; McClory and Gotthardt, 2005a, b, 2006a, b; NatureServe, 2014

3.4.7.1 Liquefaction Facility

Intertidal invertebrate sampling in middle and Upper Cook Inlet during August and September 2000 found that the number and scaled biomass of large macrofauna in sediments and on rocks generally decreased with increasing latitude (Lees et al., 2013). Commonly observed invertebrates from Kalifornsky Beach north included the Baltic macoma *Macoma balthica* (7 of 9 sites), the barnacle *Semibalanus balanoides* (5 of 9 sites), and the isopod *Saduria entomon* (4 of 9 sites; Table 3.4.7-2; Lees et al., 2013). No invertebrates were found on Middle Ground Shoals (Lees et al., 2013). Houghton et al. (2005a) sampled benthic invertebrates using different methods over multiple seasons at Point Woronzof and Point MacKenzie in Upper Cook Inlet and found crustaceans including the shrimp *Crangon franciscorus* and the amphipod *Lagunogammarus setosus* were the most abundant (Table 3.4.7-2). Lees et al. (2013) concluded that the distribution and abundance of macroinfauna in Upper Cook Inlet are driven by a complex interrelationship of tidal currents and wave action, turbidity, suspended and deposited nutrients, sediment texture and stability, larval settlement and recruitment success, and predation. Two primary factors are the massive loads of silt transported from river systems and the extreme tidal currents (Lees et al., 2013). Tidal currents influence erosion, ice gouging, sediment texture, and concentrations of organics, resulting in mixing of intertidal sediments within depth of a foot on shoals (Lees et al., 2013). Intertidal infauna from sites in Upper Cook Inlet during August and September 2000 are listed in Table 3.4.7-3.

Subtidal benthic infauna sampling in waters of varying depth near and north of the Forelands in Upper Cook Inlet was completed in August 2008 (Table 3.4.7-4; CIRCAC, 2010). A total of 22 taxa were found at stations in Upper Cook Inlet, with abundance ranging from 0 to 111 animals, primarily (93 percent) annelids (Table 3.4.7-4; CIRCAC, 2010). This sampling resulted in collections of previously undescribed species in Upper Cook Inlet including new polychaetes *Leitoscoloplos* sp. N1 (Station north of West Forlands), *Aphelochaeta* nr. *tigrina* (Station 46), and a new nemertean *Tubulanus* sp. A (Station 79 and 46; CIRCAC, 2010). No non-indegenous species were collected in Upper Cook Inle.; The closest non-idigenous species were collected at the northern end of Kalgin Island: the polychaete *Microclymene caudata* from Japan, and the anemone *Halcampa* cf. *duodecimcirrata* from the north Atlantic Ocean (CIRCAC, 2010).

TABLE 3.4.7-2

Middle and Upper Cook Inlet Intertidal Invertebrate Summary

Group	Taxa[a]	West Side Cook Inlet				East Side Cook Inlet						
		Beluga River SW[b]	Nikolai Creek[b]	West Foreland North[b]	West Foreland South[b]	Point MacKenzie (KA 16)[c]	Point Woronzof (KA 13)[c]	Chickaloon Bay[b]	Moose Point[b]	Bishop Creek Beach[b]	Boulder Point[b]	Kalifornsky Beach[b]
Annelida: Polychaeta	*Abarenicola pacifica*	S	0	0	0			0	0	0	0	42.4
Annelida: Polychaeta	*Laonnates* sp. (?)	0	A	0	0			A	0	0	0	0
Annelida: Polychaeta	*Neanthes limnicola*					0.1	0.1					
Annelida: Polychaeta	Sabellidae (unknown)	0	0	0	0			0	0	0	0	S
Arthropoda: Amphipoda	*Anisogammarus pugettensis*	0	0	S	0			0	0	0	S	0
Arthropoda: Amphipoda	Gammarid amphipod	0	0	0	C			0	0	0	0	0
Arthropoda: Amphipoda	*Lagunogammarus setosus*					0.4	21.6					
Arthropoda: Amphipoda	*Onisimus* sp.					0	0.9					
Arthropoda: Cirripedia	*Semibalanus balanoides*	0	0	1.4	S			0	S	0	S	C
Arthropoda: Decapoda	*Crangon* sp.	0	0	S	0	9.4	2.2	0	0	0	0	0
Arthropoda: Decapoda	*Crangon franciscorum*					61.6	33.9					
Arthropoda: Decapoda	*Crangon nigricauda*					2.1	1.7					
Arthropoda: Diptera	Chironomid	0	0	0	0			0	S	C?	0	0
Arthropoda: Isopoda	*Saduria entomon* (?)	C	0	S	S?	0.1	1.7	0	S	0	0	0
Arthropoda: Mysida	*Mysis litoralis*					<0.1	0.1					
Arthropoda: Mysida	*Neomysis rayii*					7.3	4.1					
Arthropoda: Mysida	*Neomysis mercedis*					0.8	0.1					
Cnidaria: Anthozoa	*Urticina crassicornis*	0	0	0	0			0	0	0	C	S
Cnidaria: Hydrozoa	Campanulariidae (unknown)	0	0	0	S			0	S	0	0	0
Cnidaria: Hydrozoa	Corynidae (unknown)	0	0	0	0			0	0	0	0	C
Echinoderm	Asteroidea (unknown)	0	0	0	0			0	0	0	0	C

TABLE 3.4.7-2

Middle and Upper Cook Inlet Intertidal Invertebrate Summary

Group	Taxa[a]	West Side Cook Inlet				East Side Cook Inlet						
		Beluga River SW[b]	Nikolai Creek[b]	West Foreland North[b]	West Foreland South[b]	Point MacKenzie (KA 16)[c]	Point Woronzof (KA 13)[c]	Chickaloon Bay[b]	Moose Point[b]	Bishop Creek Beach[b]	Boulder Point[b]	Kalifornsky Beach[b]
Mollusca: Bivalvia	*Macoma balthica*	A	S	S	A	X	0	461.3	0	S	0	2.4
Mollusca: Bivalvia	*Yoldia* sp.	0	0	0	0			0	0	0	0	X
Mollusca: Gastropoda	*Beringius kennicottii*	0	0	S	0			0	0	0	0	0
Mollusca: Gastropoda	*Littorina sitkana*	0	0	S (YOY)	0	0	<0.1	0	S	0	0	0
Mollusca: Gastropoda	Lottiidae (unknown)	0	0	0	0			0	S	0	0	0
Mollusca: Gastropoda	*Nucella lima*	0	0	0	0			0	0	0	0	C
Mollusca: Gastropoda	*Onchidoris bilamellata*	0	0	0	0			0	0	0	0	A
Mollusca: Gastropoda	*Volutharpa ampullacea*	0	0	0	0			0	0	0	0	C

Sources: Lees et al., 2013, Table 3-4 (all sites except Point Woronzof and Point MacKenzie); Houghton et al., 2005a, Table B-1 (Point Woronzof and Point MacKenzie)

[a] Where a ? appears within a taxa there may be a question on identification.

[b] Lees et al., 2013: Quantity based on 0.25 square meter, qualitative based on visual observations.
Qualitative abundance: S = Sparse, C = Common, A = Abundant, X = Observed, YOY = Young of Year

[c] Houghton et al. 2005a: catch per unit effort for beach seine, X = Observed

TABLE 3.4.7-3

Middle and Upper Cook Inlet Intertidal Infauna Summary

		West Side Cook Inlet				East Side Cook Inlet			
Group	**Taxa[a]**	**Beluga River SW**	**Nikolai Creek**	**West Foreland North**	**West Foreland South**	**Chickaloon Bay**	**Moose Point**	**Bishop Creek Beach**	**Kalifornsky Beach**
Annelida: Polychaeta	*Abarenicola pacifica*	0	0	0	0	0	0	0	0.4
Annelida: Polychaeta	*Capitella capitat*	0	0.2	0	0	0	0	0	0
Annelida: Polychaeta	*Dipolydora caulleryi*	0	0.2	0	0	0	0	0	0
Annelida: Polychaeta	*Eteone longa*	0.2	0.2	0	5.2	0.2	0	0	0
Annelida: Polychaeta	*Leitoscopoplos pugettensis*	0	0	0.2	0	0.2	0	0	0
Annelida: Polychaeta	*Nephtys longosetosa*	0	0	0	0	0	0	0	0.2
Annelida: Polychaeta	*Pygospio elegans*	0	0	0	2	0	0	0	0
Annelida: Polychaeta	*Scolelepis squamata*	0	0	0	0	0	0.2	0	0.6
Arthropoda: Amphipoda	*Grandifoxus acanthinus*	0	0	0.2	0	0	0	0	0
Arthropoda: Amphipoda	*Potoporeia femorata*	0	0	0	0	0	0	0.2	0
Arthropoda: Decapoda	*Crangon alaskensis*	0	0	0	0	0	0	0.2	0
Mollusca: Bivalvia	?*Montacuta* sp.	0	0	0	0.2	0	0	0	0
Mollusca: Bivalvia	*Macoma balthica*	2.6	1.4	0	53	86	0	0.6	0.4

[a]Source: Lees et al., 2013, Table 3-7
Average abundance in core samples

TABLE 3.4.7-4

Upper Cook Inlet Subtital Benthic Infauna Summary[a]

				Annelids		Arthropods		Mollusks		Other		Total	
Station	**Depth**	**Diversity**	**CI Side**	**Taxa**	**Abund**	**Taxa**	**Abund**	**Taxa**	**Abund**	**Taxa**	**Abund**	**Taxa**	**Abundance**
67	7.0	0	W	0	0	0	0	0	0	0	0	0	0
79	16.6	0	W	0	0	0	0	0	0	0	0	0	0
79a	2.2	1.311	W	1	3	2	3	0	0	1	3	4	9
51	6.2	1.035	W	6	111	0	0	0	0	0	0	6	111
100	0.9	0.693	W	2	2	0	0	0	0	0	0	2	2
7	22.7	NA	W	0	0	0	0	0	0	0	0	0	0
69	6.9	1.470	W	6	48	0	0	1	1	0	0	7	49
48	1.7	1.099	W	3	3	0	0	0	0	0	0	3	3
32	2.9	1.334	W	7	50	0	0	0	0	0	0	7	50
46	10.7	0.562	W	1	3	0	0	0	0	1	9	2	12
60	6.0	0.637	E	2	3	0	0	0	0	0	0	2	3
16	24.6	0	E	0	0	0	0	0	0	0	0	0	0
16a	17.3	0	E	1	1	0	0	0	0	0	0	1	1
59	18.9	0	E	0	0	0	0	0	0	0	0	0	0
Total					**224**		**3**		**1**		**12**		**240**

[a]Source: CIRCAC, 2010, Tables 2.2-1, 6.3-1, and 6.3-9

Station – location identifier, Depth – adjusted for tides in meters, CI Side (Cook Inlet Side) – W = west or E = east, Taxa – number of taxa, Abund – abundance as number of individuals per sample

3.4.7.2 Interdependent Facilities

Beaufort Sea

Interdependent Facilities in the Beaufort Sea include modifications to Offshore West Dock in support of the GTP. Marine soft-bottom habitats in nearshore waters of the Beaufort Sea, such as those near West Dock, support benthic communities of microalgae, bacteria, polychaete and oligochaete worms, small mollusks, and amphipods (Broad et al,. 1979). Oligochaete worms and midge (chironomid) larvae appear to be able to survive in the bottom-fast ice zone (Broad et al., 1979). Polychaete worm and clam abundance typically increase with depth from the nearshore bottom-fast ice zone at 0 to6 feet (Broad et al., 1978). Invertebrate abundance and distribution data for the nearshore arctic coast indicate that polychaete worms and small mollusks are the predominant infaunal organisms, while isopods, nemerteans, and benthic amphipods are the predominate epifaunal invertebrates (Broad et al., 1978). Offshore in Stefansson Sound, mud and silt substrates are interrupted with sporadic boulders and cobble that support arctic kelp beds (Barnes and Reimnitz, 1974) referred to as the Boulder Patch (Dunton and Schonberg, 2000).

Houghton (2012) presented and summarized past and recent surveys of benthic infauna and epifauna at the Dock Head (DH) 2 expansion area, the barge channel area, and the dredge disposal area. Results of infauna sampling were similar to previous programs in the vicinity with generally low abundance of animals and dominance of mobile crustaceans at shallow stations typical of areas affected by bottom-fast ice (Table 3.4.7-5). Infaunal density and biomass were geater in the disposal area than in the dredge area primarily due to a greater abundance of larger polychaetes and bivalve mollusks. The polychaete *Ampharete vega* was the most abundant animal at 8 of 9 sample stations and was the most abundant single species in the infauna. More abundant and diverse infaunal communities were typical in deeper waters beyond the bottom-fast ice zone, but where the bottom may occasionally be disturbed by ice keels. Epibenthic invertebrates sampled by trawls in the dredge disposal and reference areas included 25 invertebrate taxa (Table 3.4.7-6), dominated numerically by the mysid shrimp *Mysis littoralis* with biomass dominated by the large isopod *Saduria entomon*. The stations sampled were representative of conditions throughout much of Stefansson Sound outside of the areas with hard bottom known as the Boulder Patch (Houghton, 2012).

TABLE 3.4.7-5

West Dock Dredge Channel and Dredge Disposal Area Infauna Summary

			Disposal Area					
	Dredge Area (*n* = 3)		Proposed Site (*n* = 5)		Reference (*n* = 4)		Combined (*n* = 9)	
Infauna Group	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
Macroinfauna (retained on 1.0 millimeter screen)								
Annelida	1,037	3.9	5,296	58.8	4,861	40.9	5,103	50.8
Crustacea	235	6.3	504	38.1	176	6.5	358	24.1
Mollusca	198	0.5	1,704	119.5	1,565	112.9	1,642	116.6
Other Taxa	37	0.1	14.8	0.1	120.4	5.9	62	2.7
All Taxa	1,506.2	10.8	7,518.5	216.5	6,722.2	166.2	7,164.6	194.1
Megainfauna (retained on 6.0 millimeter screen)								
Annelida	17	0.3	176	8.0	78	3.8	132	6.1

TABLE 3.4.7-5

West Dock Dredge Channel and Dredge Disposal Area Infauna Summary

	Dredge Area (*n* = 3)		Disposal Area					
			Proposed Site (*n* = 5)		Reference (*n* = 4)		Combined (*n* = 9)	
Infauna Group	**Density**	**Biomass**	**Density**	**Biomass**	**Density**	**Biomass**	**Density**	**Biomass**
Crustacea	16	15.8	12	11.8	9	3.5	11	8.1
Mollusca	2	1.2	104	37.9	36	18.6	74	29.3
Other Taxa	1	0.0	2.2	0.2	4.6	0.1	3	0.2
All Taxa	36.6	17.4	293.8	57.9	127.3	26.0	219.8	43.8

Source: Houghton, 2012, Table 15 (Note: rows for disposal and reference sites mislabelled in Table 15)
n – sample size
Density – Number of individuals per square meter
Biomass – wet weight, grams per square meter

TABLE 3.4.7-6

West Dock Dredge Disposal Area Epibenthic Inverbebrate Summary

Group	Taxa	Description	Effort
Annelida: Polychaeta	*Eunoe nodosa*		0.01
Annelida: Polychaeta	Orbiniidae		0.01
Annelida: Polychaeta	Spionidae		0.01
Annelida		*Subtotal*	*0.03*
Arthropoda: Amphipoda	*Acanthostephaeia behringienses*		0.11
Arthropoda: Amphipoda	Amphipoda		1.00
Arthropoda: Amphipoda	*Atylus carinatus*		0.09
Arthropoda: Amphipoda	*Caprella* sp.		0.01
Arthropoda: Amphipoda	*Gammaracanthus loricatus*		0.05
Arthropoda: Amphipoda	*Gammarus wilkitzkii*		0.01
Arthropoda: Copepoda	Calanoida A		0.11
Arthropoda: Copepoda	Calanoida B		0.02
Arthropoda: Euphausiidae	Euphausiidae	Krill	0.01
Arthropoda: Isopoda	*Saduria entomon*		4.20
Arthropoda: Isopoda	*Saduria sabini*		0.01
Arthropoda: Mysida	Mysida		0.01
Arthropoda: Mysida	*Mysis litoralis*		6.18
Arthropoda: Nymphonidae	*Nymphon brevitarse*		0.06
Crustacea		*Subtotal*	*11.87*
Mollusca: Bivalvia	Bivalvia	Clam	0.01
Mollusca		*Subtotal*	*0.01*

TABLE 3.4.7-6

West Dock Dredge Disposal Area Epibenthic Inverbebrate Summary

Group	Taxa	Description	Effort
Chaetognatha	*Sagitta elegans* [*Parasagitta elegans*]	Arrow worm	0.03
Cnidaria: Anthozoa	Anthozoa	Anemone	0.01
Cnidaria: Hydrozoa	Hydrozoa	Jellyfish	0.01
Cnidaria: Hydrozoa	*Tubularia indivisa*		0.01
Ctenophora	Ctenophora	Comb jellies	0.02
Nemertea	Nemertinea		0.01
Unknown	Egg cases (unknown)		0.34
Other Taxa		*Subtotal*	*0.43*
Total			**12.32**

Source: Houghton, 2012, Table 10
Effort = catch per 100 square meters using an otter trawl; column does not total due to rounding - total from Table 10

Cook Inlet

Interdependent Facilities in Cook Inlet include the Mainline route across Upper Cook Inlet to the Kenai Peninsula. Lees et al. (2013) found the sand beachface and mud flat south of the Beluga River near where the Mainline would enter Cook Inlet was a moderately productive site with the clam Baltic macoma (*Macoma balthica*) abundant, and lugworms (*Abarenicola pacifica*) common in the lower intertidal muddy sediments (Table 3.4.7-2). Tracks on the surface of sediments and young isopods (*Saduria* ?*entomon*, using notation from Lees et al., 2013) were common on the sandy lower reaches of the beachface (Table 3.4.7-2; Lees et al., 2013). Infauna at this site also included the polychaete *Eteone longa* (Table 3.4.7-3; Lees et al., 2013). Lees et al. (2013) sampled the shoreline at Boulder Point where the Mainline would exit Upper Cook Inlet and found the site was a mix of sediment sizes from sand to cobbles separated from the beachface by a well-defined intertidal sand bar. Productivity appeared low with sparse amphipods (*Anisogammarus pugettensis*) under boulders and barnacle (*Semibalanus balanoides*) on boulders (Table 3.4.7-2; Lees et al., 2013). Large sea anemones (*Urticina crassicornis*) occurred in protected crevices between large boulders, and were large enough to represent overwintering populations (Table 3.4.7-2; Lees et al., 2013).

Benthic infauna samples in subtidal sediments were dominated by polychaete worms in Upper Cook Inlet as discussed above (Table 3.4.7-4; CIRCAC, 2010). No non-indigenous marine invertebrates have been documented in Upper Cook Inlet (CIRCAC, 2010).

3.4.8 Sensitive Wildlife Resources and Habitat Areas

3.4.8.1 Areas of Critical Environmental Concern

At various locations along the Mainline corridor Areas of Critical Environmental Concern (ACEC) have been designated which are managed by the Arctic and Central Yukon area field offices of the BLM (Figure 3.4.8-1). Between the area south of TAPS Pump Station 3 and the Yukon River along the Dalton

Highway, the Project area is within the BLM Utility Corridor. The utility corridor is comprised of an "inner" and "outer" corridor and the majority of the Mainline, and its Aboveground Facilities would be located in the inner corridor.

Various nonenergy transportation activities are restricted within the inner corridor, and with few exceptions, the area is primarily devoted to energy transportation. These exceptions include ACECs, where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards. Generally, development activities and future energy transportation systems are allowed (BLM, 1989).

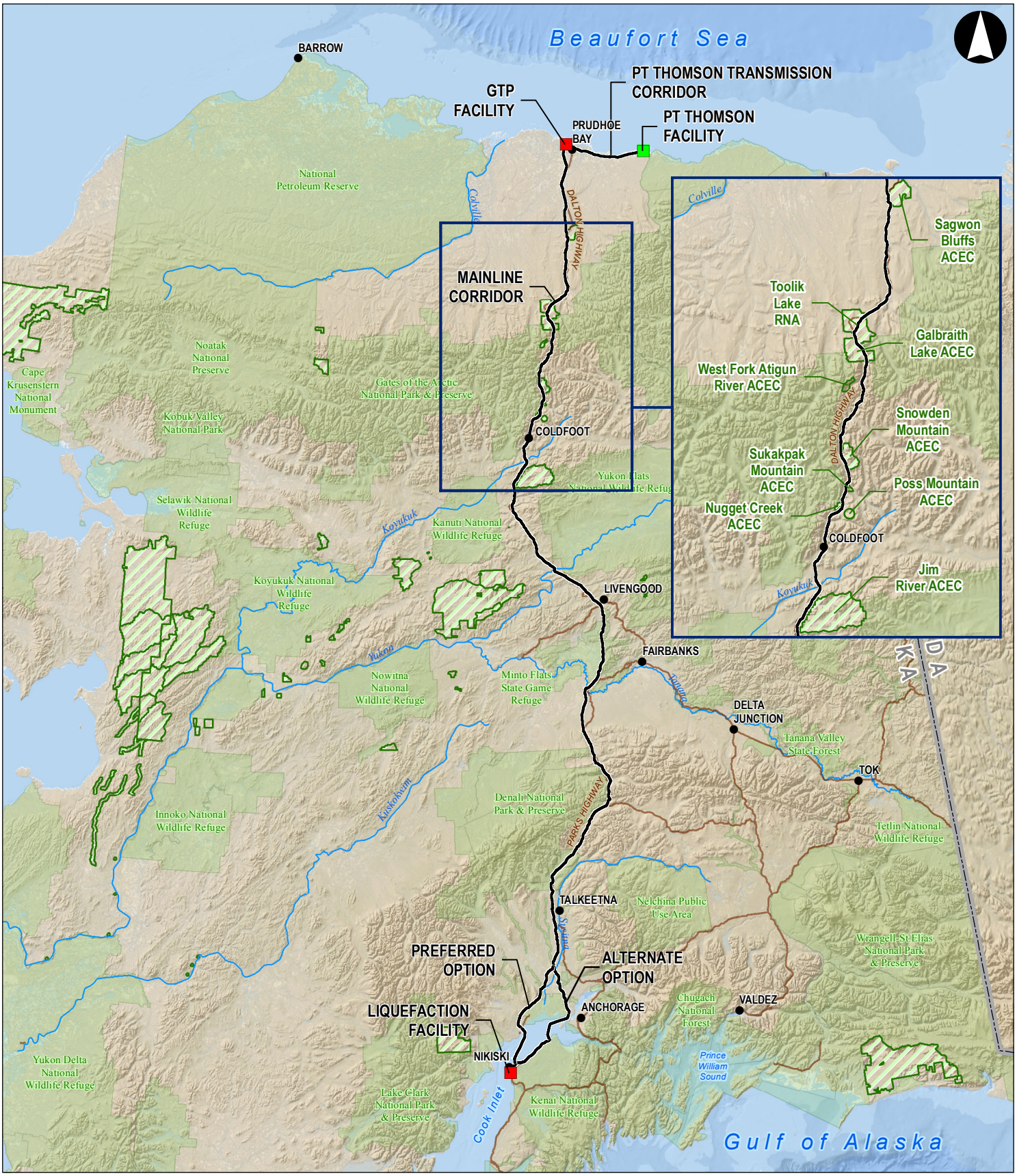
The Mainline corridor would cross two ACECs: the Toolik Lake Research Natural Area (RNA) and the Galbraith Lake Outstanding Natural Area (ONA) (Figure 3.4.8-1).

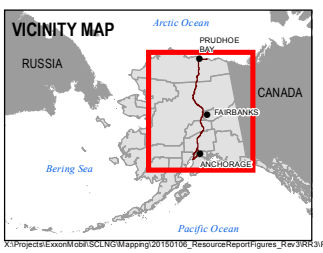
The Toolik Lake RNA will be crossed by the Mainline corridor for about 10.5 miles The Toolik Lake RNA is an 82,800-acre parcel that is located within the inner utility corridor. This RNA was established to protect a natural lake and tundra biome, habitats crucial to species listed as threatened, endangered, candidate or sensitive by the USFWS and the State of Alaska. The Area is used extensively for Arctic natural resources research. (BLM, 1989a).

The Galbraith Lake ONA will be crossed by the Mainline corridor for about 11.5 miles.

This ONA was established to protect historic and cultural resources, Dall sheep lambing areas and mineral licks, and scenic value, geology, and paleontological resources. The Galbraith Lake ONA encompasses Galbraith Lake, three large drainages that discharge into the lake, and the Atigun River valley and the sides of the valleys. Vegetation in this ACEC is predominately dwarf shrub and dwarf shrub-lichen. The foothills east of Galbraith Lake are valuable to sheep early in the spring, both as a lambing area and spring foraging area, particularly for the nursing ewes. The Galbraith Lake ONA contains four known lambing areas. Sheep use the west- and south-facing slopes on the eastern side of the Atigun River valley near Atigun Gorge during the spring as lambing-nursery areas. Vegetation in this area emerges earlier in the spring in these areas, providing an abundant food source.

BLM representatives have observed up to 200 sheep on Black Mountain, a site where early vegetation growth is prevalent. As summer progresses, seasonal movements of sheep to higher elevations occur, including movements out of the ACEC. Winter range covers much of the high ridges of the ACEC.





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Areas of Critical Environmental Concern
- State and Federal Conservation Lands

0 35 70 140 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_8-1 Areas of Critical Environmental Concern.mxd

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SCALE:	1:6,000,000		
DATE:	2015-01-09	SHEET:	1 of 1

AREAS OF CRITICAL ENVIRONMENTAL CONCERN

FIGURE 3.4.8-1

Alaska LNG

3.4.8.2 National Wildlife Refuges, State Game Refuges, and State Critical Habitat Areas

National Wildlife Refuges and Preserves

Liquefaction Facility

Kenai National Wildlife Refuge

The Kenai National Wildlife Refuge (NWR) consists of nearly 2 million acres of diverse habitats and wildlife on the Kenai Peninsula (Figure 3.4.8-2). This NWR is the most visited in Alaska. The alpine tundra, wetlands, and boreal forests are home to a variety of species including moose, bears, wolves, trumpeter swans, and salmon. The Refuge was initially established to protect the Kenai moose. The Refuge now exists to protect the variety of wildlife and habitats and to promote scientific research, environmental education, and recreation.

The Liquefaction Facility will be located west of the western boundary of this NWR.

Interrelated Facilities

Arctic National Wildlife Refuge

The Arctic NWR is the most northern and one of the largest refuges within the NWR System. Including large, contiguous tracts of the Beaufort Coastal Plain, Arctic foothills, and portions of the Brooks Range, the Arctic NWR supports diverse and abundant wildlife populations. This refuge provides important habitat for calving caribou, breeding waterbirds and shorebirds, year-round habitat for Dall sheep, and hunting grounds for wolves and ermine.

The Project would pass within 0.25 mile of the Arctic NWR at at Galbraith Lake in the Brooks Range (Figure 3.4.8-2). The Point Thomson Unit borders the Refuge but all Interrelated Facilities will to be located west of the boundary. No Project components will be located in the Arctic NWR.

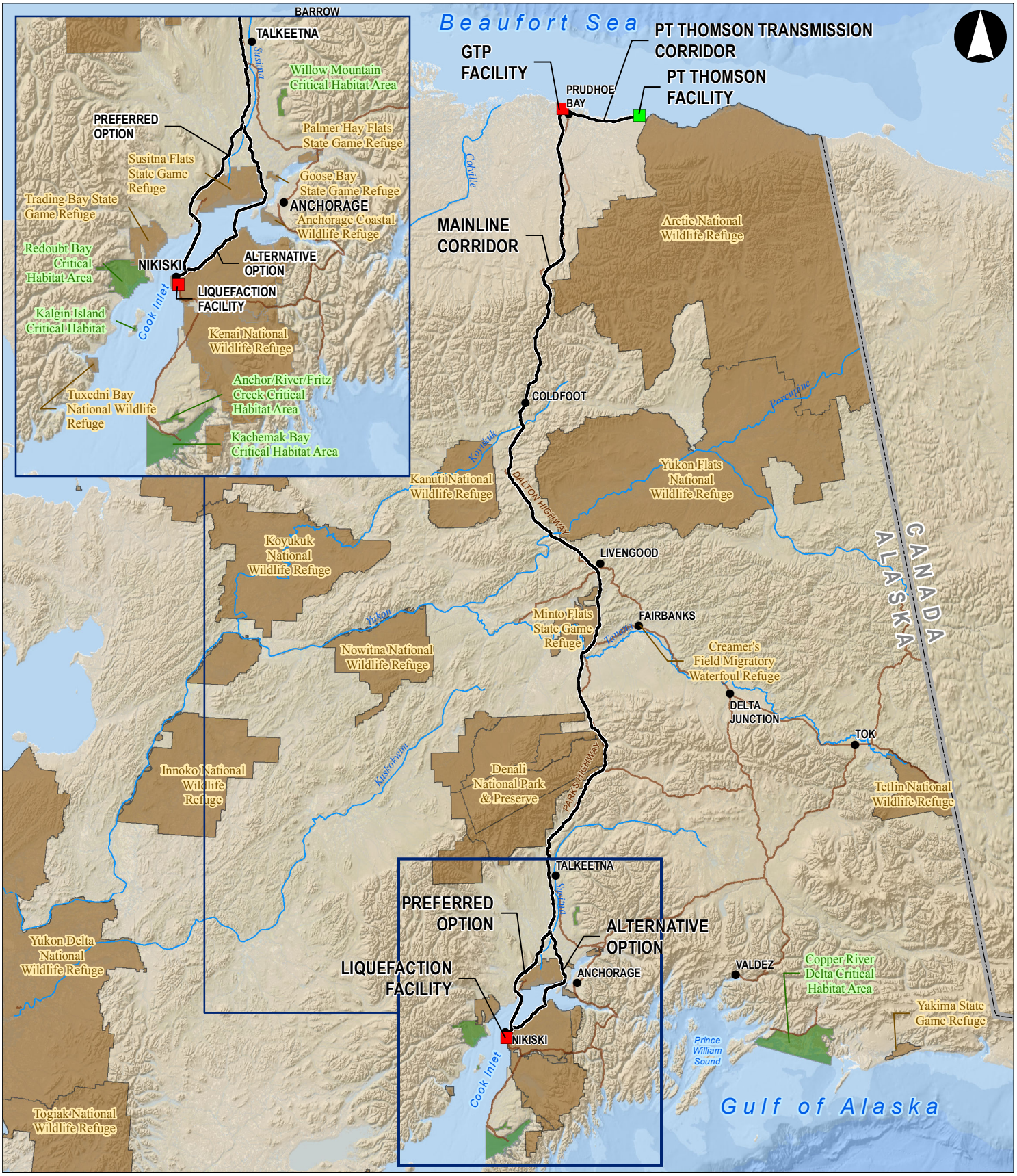
Yukon Flats National Wildlife Refuge

The third largest conservation area in the NWR System, the 9 million-acre Yukon Flats NWR (Figure 3.4.8-2), contains a vast wetland basin that provides one of the greatest breeding areas for waterfowl in North America. As many as 2 million ducks nest here annually. Game animals such as moose, caribou, and sheep are found in relatively low numbers throughout the Refuge, but furbearer resources are abundant, including beaver, fox, lynx, marten, muskrat, otter, weasel and wolverine.

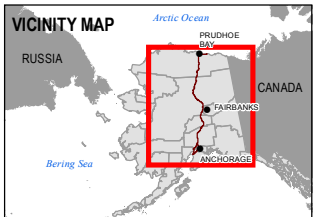
The Mainline corridor will pass approximately five miles west of the Yukon Flats NWR. No Project components will be located in the Refuge.

Kanuti National Wildlife Refuge

The Kanuti NWR is located approximately 22 miles to the west of the Project corridor on the southern slope of the Brooks Range (Figure 3.4.8-2). The Refuge was primarily established for its rich and diverse waterfowl habitats. Brown and black bear, several wolf packs, moose, wolverine, beavers, American



VICINITY MAP



LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- State Refuge Area
- State Critial Habitat Area

0 35 70 140 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_8-2 National Wildlife Refuges, State Game Refuges, and State Critical Habitat Areas for Wildlife.mxd

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NATIONAL WILDLIFE REFUGES, STATE GAME REFUGES, AND STATE CRITICAL HABITAT AREAS FOR WILDLIFE

FIGURE 3.4.8-2

Alaska LNG

marten, and mink occupy the boreal forests and wetland habitats within the Refuge. Caribou from the Western Arctic and Ray Mountain herds occasionally winter here.

No Project components will be located within the Kanuti NWR. However, the Mainline corridor will cross several rivers that are tributaries to streams within the Refuge, including the Middle and South forks of the Koyukuk River and Jim River.

Denali National Park and Preserve

Denali National Park and Preserve is located along the Mainline corridor north of Talkeetna in Interior Alaska (Figure 3.4.8-2). The Park was designated nearly a century ago as the world's first national park established for the conservation of wildlife. Denali covers 6 million acres of wild land from low-elevation taiga forests to high alpine tundra and snow-capped mountains of the Alaska Range including North America's tallest peak, Mount McKinley. There is a diversity of wildlife that includes 39 species of mammals, 169 species of birds, and 650 species of vascular plants. Caribou from the Denali herd occur within the Park.

The Mainline will follow the Parks Highway along the eastern border of Denali National Park and Preserve.

Kenai National Wildlife Refuge

The Kenai NWR is described above for the Liquefaction Facility. The Mainline will be constructed along the northwestern boundary of the Kenai NWR.

Alaska State Game Refuges (SGRs)

Interrelated Facilities

Minto Flats State Game Refuge

The Minto Flats State Game Refuge encompasses 500,000 acres of wetland in Interior Alaska. The Refuge provides excellent habitat for waterfowl, big game, and furbearers. More than 150,000 ducks and one of the largest breeding populations of trumpeter swans in North America nest here annually. The Refuge is also an important spring and fall staging area, particularly for geese and swans.

The Mainline corridor will be located along the eastern border of the Minto Flats State Game Refuge and will cross the southeastern tip of the Refuge within the existing right-of-way of the Parks Highway.

Goose Bay State Game Refuge

Goose Bay State Game Refuge consists of wetland habitats on the western side of Upper Cook Inlet. The Refuge provides important spring and fall resting and staging areas for waterfowl, geese and swans during migration. Over 20,000 geese, especially Canada and snow geese, use the Refuge each spring. A moose calving concentration area occurs in the shrub habitat along the inland portion of the Refuge.

No Project components will be located within this Refuge.

Susitna Flats State Game Refuge

The Susitna Flats State Game Refuge, located on the western side of Cook Inlet between the Beluga River and Point MacKenzie, is known for the spring and fall concentration of migrating waterfowl, geese, and shorebirds that occur here. As many as 100,000 waterfowl use the Refuge for resting and staging during migration. Tule geese, a subspecies of the greater white-fronted goose nest on the Refuge. Moose, brown and black bear, beaver, mink, otter, muskrat, coyote, and wolf occur on the Refuge. Beluga whale concentrate in an area extending from the Little Susitna River to the Beluga River in late May and June to calve, breed, and feed on the large runs of eulachon fish returning to spawn in the Susitna River.

The Mainline corridor will be located along either the western or eastern boundary of this Refuge prior to crossing Cook Inlet to reach the Kenai Peninsula.

Anchorage Coastal Wildlife Refuge

The Anchorage Coastal Wildlife Refuge on the eastern side of Cook Inlet consists of extensive tidal flats, marsh communities, and alder-bog forests for 16 miles from Point Woronzof to Potter Creek. Peak numbers of ducks, geese, swans, and shorebirds occur in the Refuge during spring and fall migration. Moose and muskrats commonly occur on the refuge, coyotes, least weasels, snowshoe hares, mink, lynx, river otters, and black and brown bear are less frequently seen.

No Project components will be located within this Refuge.

Trading Bay State Game Refuge

Trading Bay State Game Refuge is located on the western side of Cook Inlet, south of the proposed route for the Mainline will cross Cook Inlet. The large expanse of low relief wetlands and associated tidal flats that comprise this Refuge provide critical spring feeding, summer nesting, and fall staging habitat for thousands of ducks, geese, swans, and cranes. The Refuge also provides important wintering habitat for approximately 500 moose. The Noaukta Slough supports high numbers of black and brown bears feeding on returning salmon.

The Mainline will cross Cook Inlet within about 15 miles of the Refuge at is closest point. No Project components will be located within this Refuge.

State of Alaska Critical Habitat Areas (CHAs)

Liquefaction Facility

Redoubt Bay Critical Habitat Area

Redoubt Bay CHA is located west of the Liquefaction Facility on the western side of Cook Inlet encompasses the low lying expanse of wetlands and riparian habitats across the Inlet from the Liquefaction Facility. This CHA provides spring and fall feeding and resting habitats for hundreds of thousands of waterfowl, geese, and swans. Several tens of thousands of ducks also nest in this area. Wetlands of the Redoubt Bay CHA provide important moose overwintering habitat and brown bears frequent intertidal drainages on the outer flats when salmon return to spawn.

Interrelated Facilities

Willow Mountain Critical Habitat Area

Willow Mountain CHA is located about 13 miles east of the Mainline corridor in the Talkeetna Mountain Range. This area supports some of the largest concentrations of moose in the state. Frequently seen birds include ravens, ptarmigan, raptors, songbirds and dippers. A small number of caribou occur in the higher elevations of this area.

Redoubt Bay Critical Habitat Area

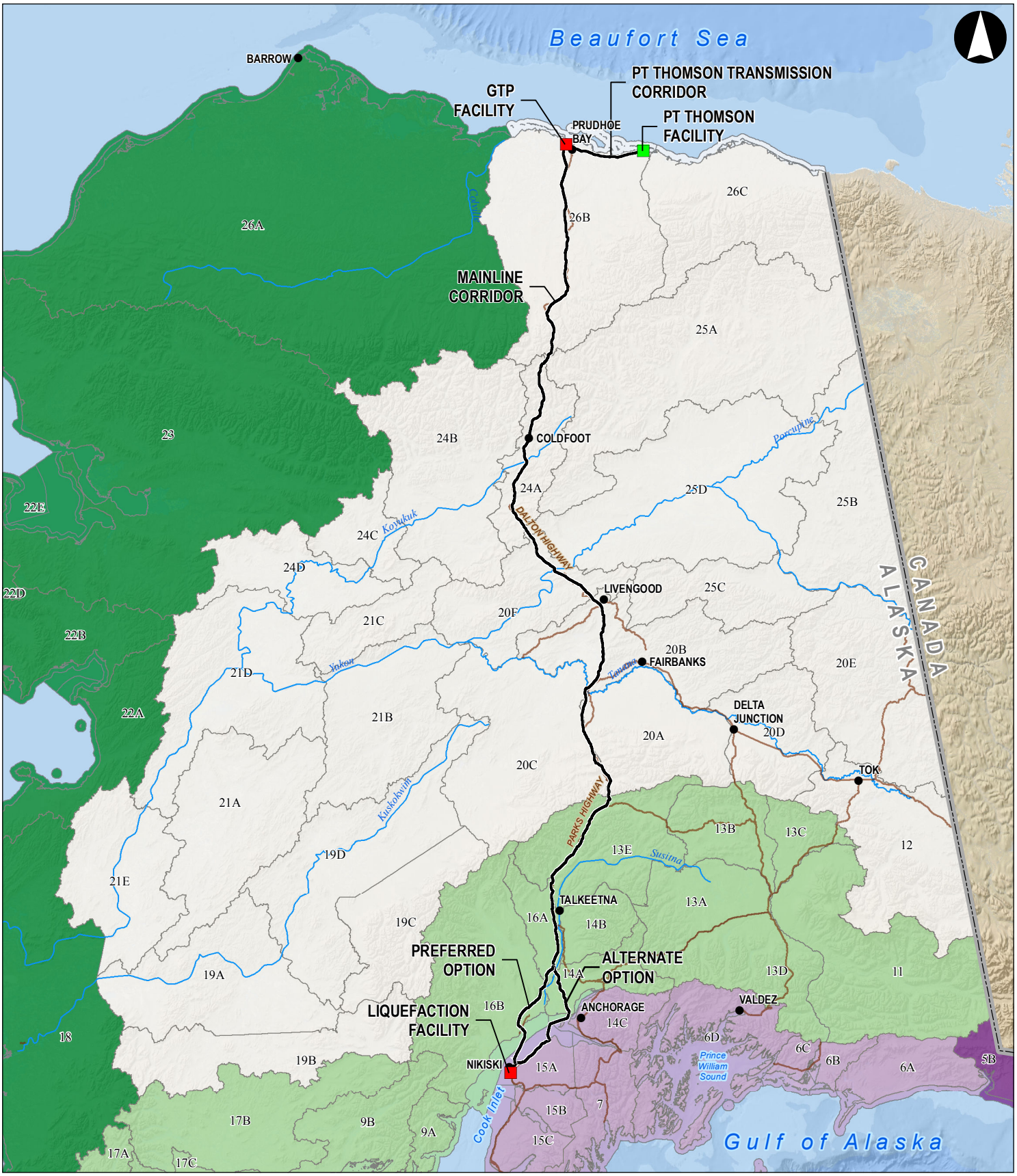
Redoubt Bay CHA, described above, is located north of the Mainline corridor on the western side of Cook Inlet.

3.4.9 Alaska Game Management Units

Twenty-six GMUs were established pursuant to 5 AAC 92.450 as the framework for management and control of hunting by ADF&G through regulations specific to each GMU. The GMUs assist in managing large mammal populations, based on biologically relevant characteristics such as population density or herd distributions. Each GMU has specific regulations that describe the restrictions and instructions that apply for each subunit, including the seasons when hunting is allowed, what permits are required, where specific hunting is permitted, how many animals may be harvested each season, types of hunting that are permitted, and who is allowed to hunt. This information is subsequently used to frame the big game hunting seasons and regulations, bag limits per species, and appropriate hunting restrictions within each GMU. Additionally, the Dalton Highway Corridor Management Area consists of those portions of GMUs 20 and 24 through 26 extending 5 miles from either side of the Dalton Highway (Figure 3.4.9-1).

3.4.10 Potential Construction Impacts and Mitigation Measures

The construction and operation of the Project has the potential to directly and indirectly impact wildlife resources. A general summary of potential impacts to wildlife resources from construction of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report will identify site-specific impacts to wildlife resources crossed by the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed plans and measures, including any site-specific measures.



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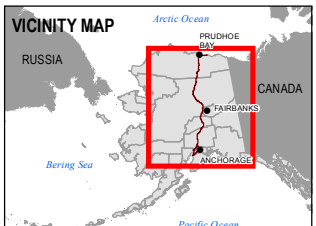

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers

Game Management Units

- I - Southeast
- II - Central
- III - Interior
- IV - Central (rural)
- V - Western Arctic

0 35 70 140 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_4_9-1 State Game Management Units.mxd

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STATE GAME MANAGEMENT UNITS

FIGURE 3.4.9-1

Alaska LNG

3.4.11 Potential Operational Impacts and Mitigation Measures

A general summary of potential impacts to wildlife resources from operation of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report will identify site-specific impacts to wildlife resources crossed, or in the vicinity of, the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed mitigation measures, including site-specific measures.

3.5 THREATENED, ENDANGERED, AND SPECIAL-STATUS SPECIES

3.5.1 Federally Listed, Proposed Threatened and Endangered, or Candidate Species

FERC is the lead federal agency for the evaluation of anticipated impacts of the Project on listed species.

The ESA at Section 7(a)(2) obligates each federal agency to consult with NMFS and/or the USFWS to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. Consultation is usually initiated by the federal action agency or its designated non-federal representative when it determines that an action it is considering may affect a threatened or endangered species or its critical habitat. The results of the consultation are presented in a biological opinion by the resource agency (i.e. NMFS or USFWS). If NMFS and/or USFWS determine the federal action is consistent with the requirements of Section 7(a)(2), they will issue an incidental take statement, which specifies the impact of the level of incidental take anticipated and provides recommendations for reasonable prudent measures that may be necessary to avoid or minimize potential impacts. In addition to ESA protection, migratory birds are federally protected by the MBTA, and marine mammals are federally protected by the MMPA.

The USFWS and NMFS review and maintain listings of candidate species that may require protection under the ESA. Section 7(a)(4) of the ESA requires federal agencies to confer with NMFS and/or USFWS on any action which is likely to jeopardize the continued existence of a species proposed for listing or result in the destruction or adverse modification of critical habitat that is proposed for designation. The results of a conference are presented by NMFS and/or USFWS in a conference opinion, which may be adopted as a biological opinion when/if a final listing rule or critical habitat designation rule is implemented. Section 7(a)(4) does not require a limitation on commitment of resources as described in subsection 7(d).

Eight federally listed species and 1 candidate for listing were identified by the NMFS and the USFWS as potentially occurring in the Project area (NMFS, 2014a; USFWS, 2014a). Table 3.5.1-1 summarizes these species, their ranges, and seasonal occurrence. One previous candidate, the yellow-billed loon, was recently determined not to warrant protection under the ESA. The previous listing as

TABLE 3.5.1-1.

Federally Listed and Proposed Threatened, Endangered, and Candidate Species Potentially Occurring in the Alaska LNG Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat	Status
MARINE MAMMALS – National Marine Fisheries Service					
Bowhead Whale	*Balaena mysticetus*	GTP	May–October	Chukchi and Beaufort Seas; shelf waters	Endangered
Cook Inlet beluga Whale	*Delphinapterus leucas*	Marine Terminal, Mainline	Year-round, spring to fall in upper inlet	Cook Inlet; associated with salmon runs, river deltas	Endangered
Ringed Seal, Arctic subspecies	*Pusa (Phoca) hispida hispida*	GTP	Year-round, mostly winter and spring	Bering, Chukchi and Beaufort seas; shelf waters, ice–associated	Threatened
Steller Sea Lion, Western DPS	*Eumetopias jubatus*	Marine Terminal	Year-round; summer in Bering Sea	Gulf of Alaska, Cook Inlet, Bering Sea; coastal	Endangered
MARINE MAMMALS – US Fish and Wildlife Service					
Northern Sea Otter, Southwest Alaska DPS	*Enhydra lutris kenyoni*	Marine Terminal	Year-round	Gulf of Alaska, Cook Inlet; coastal	Threatened
Pacific Walrus	*Odobenus rosmarus divergens*	GTP	July–October	Bering, Chukchi, and Beaufort seas; shelf and coastal, ice–associated	Candidate
Polar Bear	*Ursus maritimus*	Mainline, GTP, PBTL, PTTL	Year-round, mostly winter and spring	Beaufort Sea, Arctic Coastal Plain; land, nearshore, sea ice	Threatened
Terrestrial Mammals – US Fish and Wildlife Service					
Wood Bison	*Bison bison athabascae*	Mainline	Year-round	Minto Flats, Yukon Flats	Threatened - NEP
Birds – US Fish and Wildlife Service					
Steller's Eider	*Polysticta stelleri*	Marine Terminal , Mainline, GTP, PBTL, PTTL	May–October	Arctic Coastal Plain, coastal Chukchi and Beaufort Sea waters nesting and migration, coastal Cook Inlet waters in winter	Threatened
Spectacled Eider	*Somateria fischeri*	Mainline, GTP, PBTL, PTTL	May–October	Arctic Coastal Plain, coastal Chukchi and Beaufort Sea waters nesting and migration	Threatened

Sources: NMFS, 2014a; USFWS, 2014a

threatened for the bearded seal[3] has been invalidated. The Project could potentially affect 6 listed and 1 candidate marine mammals (bowhead whale, Cook Inlet beluga whale, ringed seal, Steller sea lion, northern sea otter, polar bear, and Pacific walrus), 1 listed terrestial mammal (wood bison), and 2 listed seaducks (spectacled eider and Steller's eider). Wood bison have been classified as experimental, non-essential populations in Alaska and are managed under special rules that are less restrictive than normal respect to "takings."

3.5.1.1 Liquefaction Facility

ESA-listed marine mammals, birds, and fish that occur in Cook Inlet near the Liquefaction Facility include Cook Inlet beluga whales, Steller sea lion, and northern sea otter (Table 3.5.1-1). These listed animals are described below, with additional information on occurrence in association with Project facilities provided at the end of each description.

Cook Inlet Beluga Whale

Cook Inlet beluga whales are one of five stocks of beluga whales identified in Alaska. The Cook Inlet DPS was listed as endangered in October 2008 (73 FR 62919) due to population declines caused by overharvest during the mid-1990s. A conservation plan was developed that described life-history and habitat requirements and identified threats that included subsistence harvest, pollution, predation, disease, contamination, fisheries interactions, vessel traffic, small stock size, restricted summer range, and habitat alteration (NMFS, 2008).

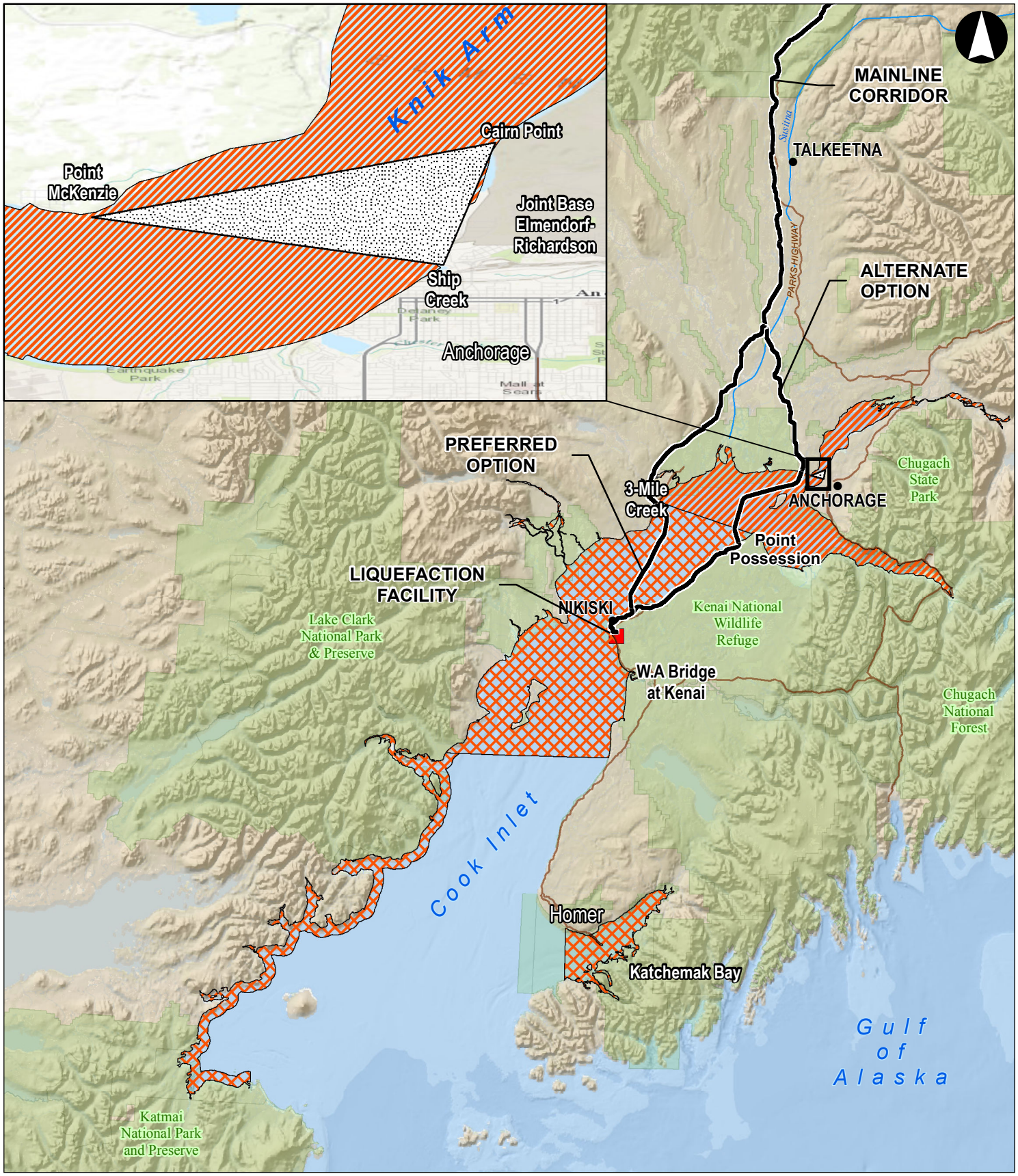
In April 2011, NMFS designated critical habitat for Cook Inlet beluga whales (76 FR 20180) in two specific areas of Cook Inlet:

- Area 1. All marine waters of Cook Inlet north of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) connecting to Point Possession (61°02.1′ N., 150°24.3′ W.), including waters of the Susitna River south of 61°20.0′ N., the Little Susitna River south of 61°18.0′ N., and the Chickaloon River north of 60°53.0′ N.

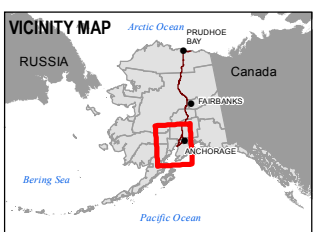
- Area 2. All marine waters of Cook Inlet south of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) to Point Possession (61°02.1′ N., 150°24.3′ W.) and north of 60°15.0′N., including waters within 2 nautical miles seaward of MHW along the western shoreline of Cook Inlet between 60°15.0′ N. and the mouth of the Douglas River (59°04.0′ N., 153°46.0′ W.); all waters of Kachemak Bay east of 151°40.0′ W.; and waters of the Kenai River below the Warren Ames bridge at Kenai, Alaska (Figure 3.5.1-1).

Primary constituent elements include prey resources and access to prey, good water quality, and an acoustic environment that will not result in abandonment of habitat. The waters of Joint Base Elmendorf-Richardson and the Port of Anchorage were excluded from the designation under the provision of Section 4(b)(2) of the ESA.

[3] The bearded seal listing was invalidated by Federal Court. US District Court Memorandum Decision: Alaska Oil and Gas Association, State of Alaska and North Slope Borough vs. Department of Commerce, National Marine Fisheries Service, July 2014. NMFS filed notice of appeal September 2014.



VICINITY MAP



LEGEND

- Project Facility
- Project Corridor
- Major Highways
- Major Rivers
- Critical Habitat Exclusion
- Critical Habitat Area
- Critical Habitat Area
- State and Federal Conservation Lands

0 10 20 40 Miles

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COOK INLET BELUGA WHALE DESIGNATED CRITICAL HABITAT

FIGURE 3.5.1-1

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-1 Cook Inlet Beluga Whale Designated Critical Habitat.mxd

During the open-water months in Upper Cook Inlet (north of the forelands), beluga whales are typically concentrated near river mouths (Rugh et al., 2010). The winter distribution of this stock is not well known; however, evidence exists that some whales may inhabit Upper Cook Inlet year-round (Hansen and Hubbard, 1999; Rugh et al. 2004; Hobbs et al., 2005). Satellite tags from 10 whales tagged from 2000 through 2002 transmitted through the fall, and of those, three tags deployed on adult males transmitted through April and late May. None of the tagged beluga moved south of Chinitna Bay on the western side of Cook Inlet. A review of all marine mammal surveys conducted in the Gulf of Alaska from 1936 to 2000 discovered only 31 beluga sightings among 23,000 marine mammal sightings, indicating that very few belugas occur in the Gulf of Alaska outside of Cook Inlet (Laidre et al., 2000 cited in Allen and Angliss, 2014).

Beluga whales may be affected by noise from construction activities and interaction with vessels during construction and operation of the facilities. Likely effects include disturbance and temporary displacement for localized areas due to noise and presence of construction equipment. Most of these activities will take place south and west of the Forelands where whales are less abundant, particularly in the spring and summer months when they are foraging in the upper Inlet in estuaries and river mouths in and near Knik Arm. Reports of vessel strikes involving beluga whales are rare; most small cetaceans are adept at avoiding vessels, particularly large commercial vessels that tend to proceed and steady speeds on predictable courses.

Steller Sea Lion – Western DPS

The Steller sea lion was listed throughout its range as a threatened species in 1990 because of significant population declines of 63 percent since 1985, and 82 percent since 1960 (55 FR 49204). Potential reasons for the declines that have been identified include marine habitat regime change that lowered the carrying capacity of the environment; competition for prey with other predators and commercial fisheries; and predation by sharks and killer whales. Sea lions are a subsistence resource. NMFS has addressed effects of competition with commercial fisheries through intra-agency ESA consultations on federal fishery management plans. In 1997, NMFS reclassified Steller sea lions as two DPSs under the ESA based on genetic studies and phylogeographic analyses from across the sea lion's range (62 FR 24345). The western DPS includes those animals found west of Cape Suckling Alaska (144^{o}W) through Prince William Sound and Cook Inlet, along the Alaska Peninsula, through the Aleutian Islands and Bering Sea, to the Kuril Islands, Sea of Okhotsk and to the northern coast of Japan. The western DPS was listed as endangered and the eastern DPS was listed as threatened. In November 2014, NMFS determine that the eastern DPS was recovered and it was delisted (78 FR 66140). In 1993, critical habitat was designated for the Steller sea lion that includes a 20 nautical mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air and aquatic zones (58 FR 45269, Figure 3.5.1-2). Portions of the southern reaches of the Lower Cook Inlet are designated as critical habitat including those near the mouth of the Inlet.

Steller sea lions exist along vessel transit corridors and some will be exposed to tugs towing construction barges and LNG carriers calling at Nikiski. Tugs towing constructions barges originating outside of Alaska will likely transit in regularly used commercial traffic lanes along Southeast Alaska, across the Gulf of Alaska, to either Cook Inlet or through Unimak Pass into the Bering Sea and north into the Chukchi Sea and terminating at West Dock near Prudhoe Bay in the central Alaskan Beaufort Sea. Vessels entering Cook Inlet will pass near rookery sites at Sugarloaf and Marmot Island and several haulout sites in the in the Barren Islands located between Stevens and Kennedy Entrances to the Inlet (Figure 3.5.1-2). LNG carriers calling at Nikiski will pass near these same areas. Tugs towing

construction barges to West Dock will likely transit near rookery and haul out sites on the Shumagin Islands, Atkins Island, and Ugamak Island, and transit through the eastern portion of the Bogoslof foraging area in the Bering Sea. Effects of vessel traffic include disturbance associated with vessel noise, vessel strikes, and spills.

A few individual Steller sea lions may rarely venture into upper Cook Inlet. Likely effects of the project to Steller sea lions include disturbance of animals from passing vessels. Vessels entering Cook Inlet, transiting Shelikof Strait, or passing through Unimak Pass should be able to avoid the 3-mile exclusion zones designated around sea lion rookeries and haulout locations. Interactions between animals at sea and vessels are unlikely as pinnipeds are adept at avoiding vessels particularly vessels underway on a steady course and speed. Sea lions would avoid construction areas, particularly during pile driving.

Critical habitat is not likely to be affected by construction or operation of the Liquefaction Facility. A release of oil or fuel from a vessel or vehicle could result in localized effects including the fouling of beaches used for pupping and hauling out. This however, would be an unlikely event.

Northern Sea Otter, Southwest Alaska DPS

The Alaska subspecies of the northern sea otter (*Enhydra lutris kenyoni*) ranges from southeast Alaska through the Aleutian Islands. Within this range, three stocks have been identified based on morphological and some genetic differences between the southwestern and Southcentral Alaska stocks, and physical barriers to movement across the upper and the lower portions of Cook Inlet (Figure 3.5.1-3; 70 FR 46366). The southwest DPS, which includes sea otters along the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Barren, Kodiak, and Pribilof islands, was listed as a threatened in August 2005 (70 FR 46366) due to substantial observed population declines. The cause of the overall decline is not known with certainty, but the weight of evidence points to increased predation, most likely by the killer whales (USFWS, 2013). Other threats include infectious disease, biotoxins, contaminants, oil spills, food limitations, bycatch in commercial fisheries, subsistence harvest, loss of habitat, and illegal take, although most of these are considered of low to moderate importance for recovery (USFWS, 2013). In October 2009, the USFWS designated critical habitat for the southwestern Alaska DPS of the northern sea otter. The designated critical habitat encompasses 5,855 square miles of shallow coastal waters from Attu Island in the Aleutians to Redoubt Point in Cook Inlet (74 FR 51988). The essential elements of critical habitat include shallow, rocky areas less than 6.6 feet deep; nearshore waters that provide protection or escape from marine predators within 328.1 feet from the mean high tide line; kelp forests that provide protection from marine predators in waters less than 65.6 feet deep; and prey resources within these areas in sufficient quantity and quality to support sea otter's energetic requirements. Critical habitat is divided into 5 habitat units, which correspond to the five management units for the DPS (Figure 3.5.1-3; 74 FR 51988). Effects of the Project on sea otters could include disturbance of animals from passing vessels, although vessels would transit offshore and in waters deeper than those typically use by sea otters. Interactions between sea otters and vessels would be unexpected.

STELLER SEA LION RANGE AND CRITICAL HABITAT IN THE NORTH PACIFIC OCEAN

FIGURE 3.5.1-2

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Haulouts
- Rookeries
- Project Corridor
- Major Highways
- Major Rivers
- Western Steller Sea Lion DPS
- Eastern Steller Sea Lion DPS
- Critical Habitat Area

0 45 90 180 Miles

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Map may not represent full species range.
Only includes areas within NMFS Alaska region.

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VICINITY MAP

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-2 Steller Sea Lion Range and Critical Habitat in the North Pacific Ocean.mxd

The southwest DPS is distributed throughout most of its former range, but at low densities in most areas. Designated critical habitat in Unit 5 Kodiak, Kamishak, and Alaska Peninsula is located along the western shoreline of lower Cook Inlet (Figure 3.5.1-3). Sea otters occur throughout the Project area from Redoubt Point in Cook Inlet along the southwestern shore, through Kamishak Bay, around the Kodak Island group, including the Barren Islands in the entrance to Cook Inlet, and west along the Alaska Peninsula to Unimak Pass. Typically they are found in shallow, rocky reef waters, were adequate forage exists, and kelp forests provide cover. The Marine Terminal will be constructed outside of the designated shoreline critical habitat in Unit 5. Critical habitat would not be affected by construction or operation of the Marine Terminal.

Steller's Eiders

The Alaska-breeding population of Steller's eiders was listed as threatened under the ESA in 1997 because of a substantial decrease in their nesting range and the increased vulnerability of the remaining breeding population to extirpation (62 FR 31748). The USFWS designated critical habitat for Steller's eiders in 2001 that includes breeding habitat on the Yukon Kuskokwim Delta; molting habitat in marine waters of Kuskokwim Shoals in northern Kuskokwim Bay, and Seal Islands, Nelson Lagoon, and Izembek Lagoon on the northern side of the Alaska Peninsula (Figure 3.5.1-4; 66 FR 8850). Alaska-breeding Steller's eiders are one of three breeding populations of Steller's eiders; the other two populations breed in arctic Russia. Threats identified for the Alaska-breeding population include shooting, ingestion of lead shot, disturbance and loss of breeding habitat, and predation in terrestrial habitats; bottom trawl fishing in critical habitat; and mining and offshore oil and gas development in molting, wintering or staging areas (USFWS, 2009b).

Most Pacific Steller's eider populations winter in marine waters off Alaska and migrate in spring along the Bristol Bay coast of the Alaska Peninsula across Bristol Bay toward Cape Pierce, continuing northward along the Bering Sea coast (Larned, 2012). During migration eiders linger to feed at the\ mouths of lagoons and other productive habitats (Larned, 2012). Most Steller's eiders then cross the Bering Strait to breeding grounds in Russia, with a smaller number continuing north to the Beaufort Coastal Plain to breed (Larned, 2012). In May and June, the North Slope breeding population migrates to coastal areas of the Beaufort Coastal Plain along the Eastern Chukchi and Western Beaufort Seas, where Steller's eiders nest on tundra habitats. More recently, nesting on the Beaufort ACP has been limited to the vicinity of Barrow (Quakenbush et al,. 2002). Although the historic nesting range of this population overlaps with the Project and Steller's eiders have been observed at Prudhoe Bay during the breeding season, nesting Steller's eiders have not been documented at Prudhoe Bay (Quakenbush et al., 2002).

Interannual disparity is wide in the number of breeding pairs returning and the number of offspring produced (Obritschkewitsch and Ritchie, 2008); eiders may not breed when lemming numbers are low due to increased predation (Quakenbush and Suydam, 1999). Quakenbush et al. (2004) found that most Steller's eiders nesting near Barrow use edges of low-centered polygons near ponds with emergent vegetation, particularly those with sedges and pendant grass (*Arctophila fulva*). Eggs hatch from early July to early August, following an incubation period of approximately 24 days (Quakenbush et al., 2004). Broods are raised in nearby freshwater, often within 0.5 mile of their nest sites. Ducklings fledge 32 to 37 days after hatching, and once fledged, depart with the females to marine waters.

NORTHERN SEA OTTER RANGE AND SOUTHWEST DPS CRITICAL HABITAT UNITS

FIGURE 3.5.1-3

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Sea Otter Range

Sea Otter Critical Habitat Units

- Unit 1 - Western Aleutian
- Unit 2 - Eastern Aleutian
- Unit 3 - South Alaska Peninsula
- Unit 4 - Bristol Bay
- Unit 5 - Kodiak, Kamishak, Alaska Peninsula

0 40 80 160 Miles

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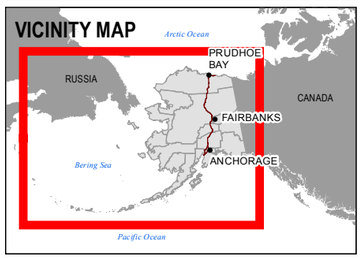
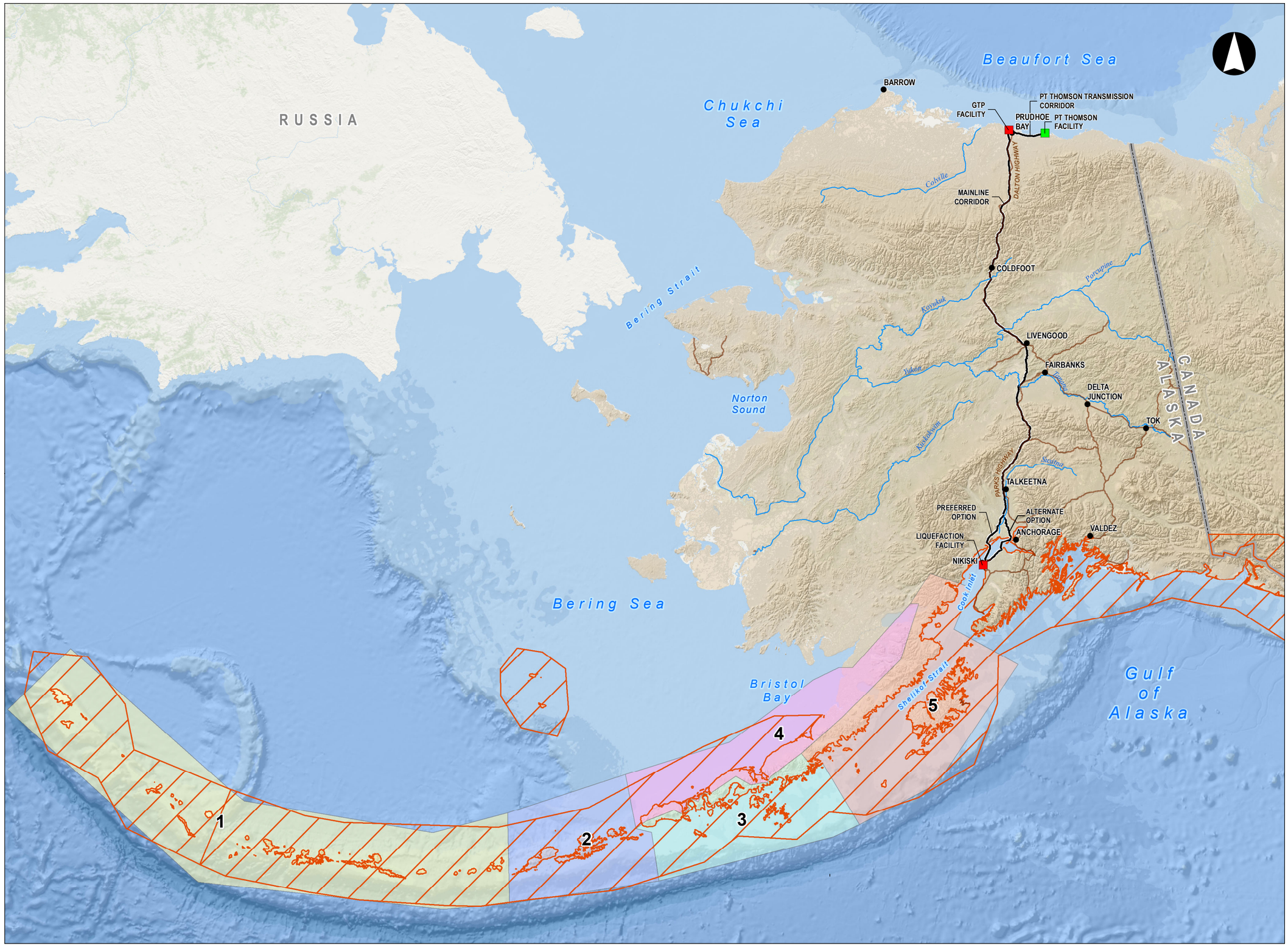
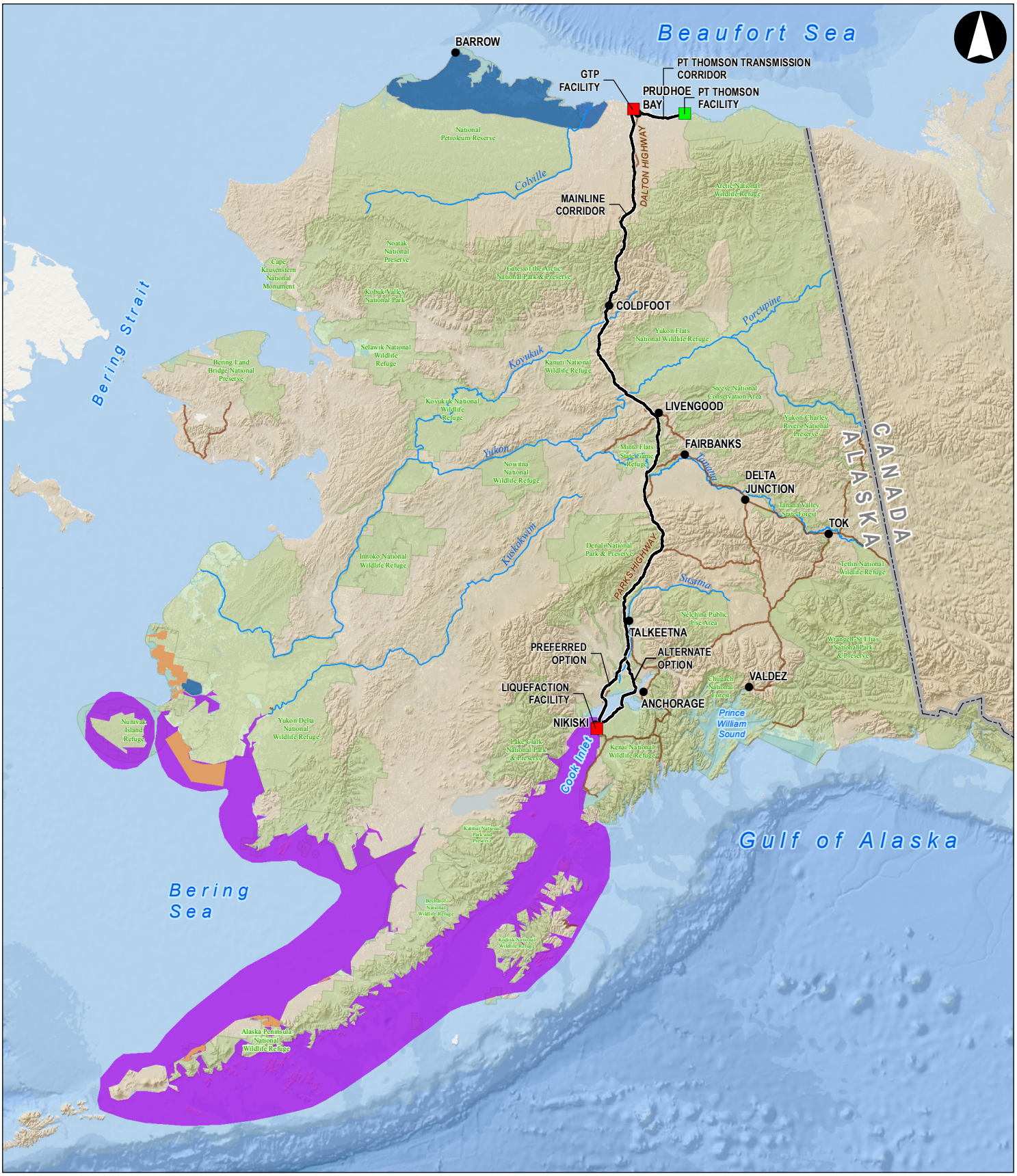




X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-3 Northern Sea Otter Range and Southwest DPS Critical Habitat Units.mxd



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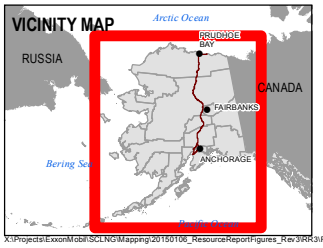

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Critical Habitat
- Current Breeding Range
- Molting and Winter Range
- State and Federal Conservation Lands

0 50 100 200 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-4 Steller's Eider Seasonal Range and Critical Habitat.mxd

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STELLER'S EIDER SEASONAL RANGE AND CRITICAL HABITAT

FIGURE 3.5.1-4

Alaska LNG

Following nesting in high Arctic Russia and Alaska, most Steller's eiders migrate to southwest Alaska, including Lower Cook Inlet. Steller's eiders occasionally occur across the nearshore marine waters of the Beaufort Sea to the Canadian border (Quakenbush et al., 2002). On the Alaska Peninsula, nonbreeding subadults begin arriving in mid-July and peak in early August (Fredrickson, 2001). Nonbreeding and post-breeding birds use the nearshore zone of the northeastern Chukchi Sea and large lakes around Barrow for molting and summering, and a few occasionally occur as far east as the US-Canada border (Quakenbush et al., 2002). Molting patterns are similar to those of spectacled eiders. Females molt after the nesting season and males return to molting areas in nearshore marine waters after breeding in late June or July (Fredrickson, 2001). Adults begin arriving in mid-August and peak in mid-September in lagoons off the Alaska Peninsula (Fredrickson, 2001). Very few Steller's eiders occur in upper Cook Inlet near the proposed Marine Terminal on the eastern shore of Cook Inlet near Nikiski. Steller's eiders winter in Lower Cook Inlet arriving as early as mid-July and remaining through late-April, with highest numbers occurring in January or February (Figure 3.5.1-5; Larned, 2006).

Steller's eiders were observed 25 percent of the time in eastern Cook Inlet between the nearshore area of Anchor Point to 25 kilometers north of Ninilchik (Larned, 2006), south of the Marine Terminal. In western Cook Inlet, Steller's eiders were most abundant in the extensive shoals from Douglas Bay to Bruin Bay, a shoal 12 kilometers southeast of Bruin Bay, and the mouth of Iniskin Bay (Figure 3.5.1-5). LNG carriers and construction barge traffic to and from the Marine Terminal would follow recommended guidelines and procedures for operating in Cook Inlet (U.S. Coast Pilot 9, and guidelines and directives of the Captain of the Port); Steller's eiders generally use habitats close to shore.

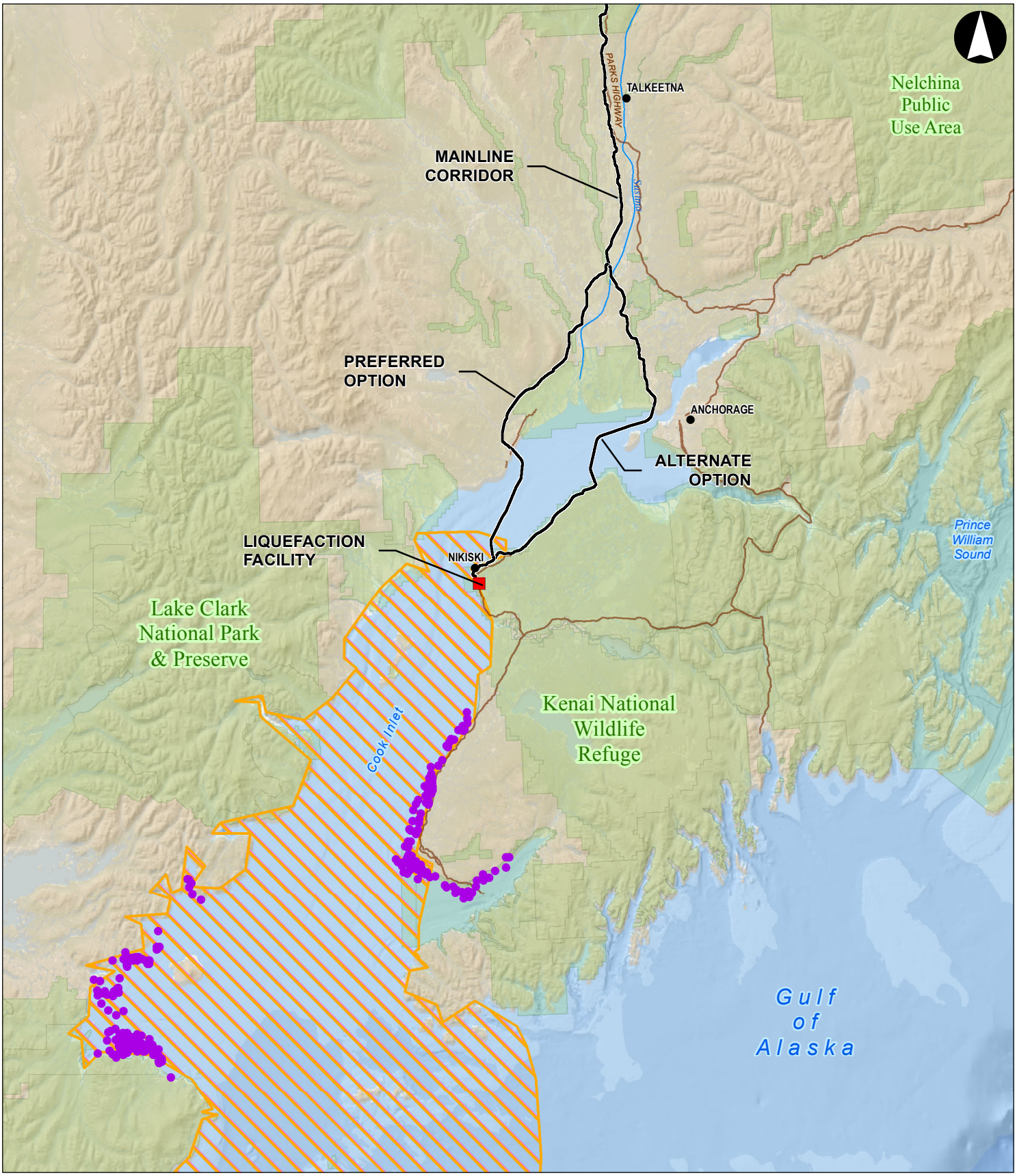
3.5.1.2 Interdependent Facilities

ESA listed marine mammals, terrestrial mammals, and birds that would only occur near Project Interdependent Facilities or along marine vessel routes through the Bering, Chukchi, and Beaufort seas to Prudhoe Bay include the following: bowhead whale, ringed seals, Pacific walrus, polar bear, wood bison, and spectacled eiders (Table 3.5.1-1). Steller's eiders nest on the coastal plain and would potentially migrate through the Prudhoe Bay area, but they also overwinter in lower Cook Inlet.

Bowhead Whale

Bowhead whales are an important subsistence resource for Alaska Native communities and were listed as endangered in 1970 because of concern over population declines (35 FR 8491). Bowhead whales in Alaska waters belong to the Western Arctic stock (also called the Bering–Chukchi–Beaufort Sea stock; Allen and Angliss, 2014). Critical habitat has not been designated for bowhead whales.

Bowhead whales overwinter in the central and western Bering Sea (Rugh et al., 2003). As sea-ice begins to retreat in April, bowhead whales begin migrating north to the Chukchi and Beaufort seas (Figure 3.5.1-6). Most bowhead whales continue to migrate eastward into the Beaufort Sea from April through mid-June and remain at summer foraging grounds until late August or early September before migrating westward again toward the Bering Sea (Rugh et al., 2003; Hannay et al., 2013).



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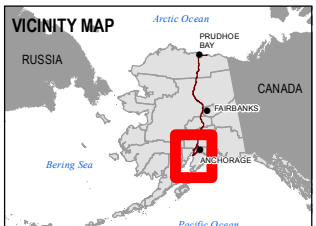

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Steller's Eider Observations
- Project Corridor
- Major Highways
- Major Rivers
- Molting and Winter Range
- State and Federal Conservation Lands

0 12.5 25 50 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-5 Steller's Eider Fall and Winter Distribution in Cook Inlet.mxd

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STELLER'S EIDER FALL AND WINTER DISTRIBUTION IN COOK INLET

FIGURE 3.5.1-5

Alaska LNG

APPROXIMATE DISTRIBUTION OF THE WESTERN ARCTIC STOCK OF BOWHEAD WHALES WITH FALL MIGRATION ROUTES

FIGURE 3.5.1-6

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers

Fall Migration Routes

- Identified Migration Route
- Possible Migration Route
- Western Arctic Bownhead Whale Stock

0 40 80 160 Miles

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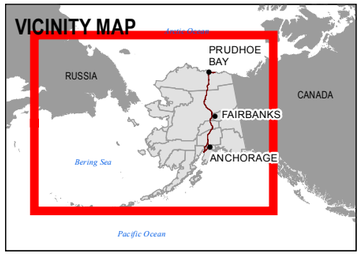

RUSSIA
Chukchi Sea
Beaufort Sea
Bering Strait
Bering Sea
Norton Sound
Bristol Bay
Gulf of Alaska
Cook Inlet
Shelikof Strait
BARROW
GTP FACILITY
PRUDHOE BAY
PT THOMSON TRANSMISSION CORRIDOR
PT THOMSON FACILITY
Colville
MAINLINE CORRIDOR
COLDFOOT
DALTON HIGHWAY
Koyukuk
Porcupine
LIVENGOOD
FAIRBANKS
Yukon
Tanana
DELTA JUNCTION
TOK
CANADA
ALASKA
Kuskokwim
PARKS HIGHWAY
Susitna
TALKEETNA
PREFERRED OPTION
ALTERNATE OPTION
ANCHORAGE
VALDEZ
LIQUEFACTION FACILITY
NIKISKI

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-6 Approximate Distribution of the Western Arctic Stock of Bowhead Whales with Fall Migration Routes.mxd

Bowhead whales are common in the Beaufort Sea on a seasonal basis with an overall density estimate of 6.0 bowhead whales/1,000 square miles during open-water season surveys in 2007 (Ireland et al., 2009). Bowhead whales could be disturbed by noise associated with construction activities at Offshore West Dock. These effects are likely to be transitory and minor in nature as the migration routes are off shore of the construction site and noise is likely to be muffled by the coastal islands.

Ringed Seal – Arctic Subspecies

Ringed seals in Alaska waters belong to the Alaska stock, which comprises the portion of the arctic subspecies *Phoca hispida hispida* that occurs within the Bering, Chukchi, and Beaufort seas (Allen and Angliss, 2014). Ringed seals are an important subsistence resource. The arctic subspecies was listed as threatened because ice projection models predict a reduction in sea ice habitat in the latter half of the century and snow production models predict a reduction in snow accumulation, which could compromise the ability of the seals to construct subnivean lairs (77 FR 76706). The reduction in available suitable ice habitat is expected to result in adverse demographic effects. Critical habitat has not been designated for this subspecies. On December 3, 2014 the NMFS announced their proposal to designate critical habitat for the arctic ringed seal to include marine waters from the coastline to the U.S. Exclusive Economic zone in the northern Bering, Chukchi, and Beaufort seas (79 FR 71714).

Throughout their range, ringed seals have an affinity for ice-covered waters and are well adapted to occupying both shorefast and pack ice (Kelly, 1988). They remain in contact with ice most of the year and use it as a platform for pupping and nursing in late winter to early spring, for molting in late spring to early summer, and for resting at other times of the year, although land haulouts may be increasingly used because of increases in summer sea ice retreat. In Alaskan waters, during winter and early spring, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort seas (Figure 3.5.1-7). They occur as far south as Bristol Bay in years of extensive ice coverage but generally are not abundant south of Norton Sound except in nearshore areas (Frost, 1985).

Ringed seals are expected to occur near West Dock year-round.

Pacific Walrus

On February 10, 2011, the USFWS announced a 12-month finding on a petition to list the Pacific walrus (*Odobenus rosmaurs*) as endangered or threatened and to designate critical habitat under the ESA, as amended (76 FR 7634). After review of all the available scientific and commercial information, the USFWS determined that listing the Pacific walrus as endangered or threatened was warranted; but listing was precluded by higher priority species and the Pacific walrus was added to the candidate list (76 FR 7634). As a candidate for listing, the Pacific walrus receives no protection under the ESA, although walruses are protected under the MMPA. Pacific walruses are managed by the USFWS under the MMPA, with co-management agreements between USFWS and the Eskimo Walrus Commission, the Bristol Bay Native Association's Qayassiq Walrus Commission, and the State of Alaska allowing for and monitoring subsistence harvest. Walrus are an important subsistence resource especially for Chukchi Sea communities with an estimated annual subsistence harvest of 6,713 animals per year (Allen and Angliss, 2014).

APPROXIMATE COMBINED SUMMER AND WINTER DISTRIBUTION OF RINGED SEALS

FIGURE 3.5.1-7

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Ringed Seal Distribution

0 40 80 160 Miles

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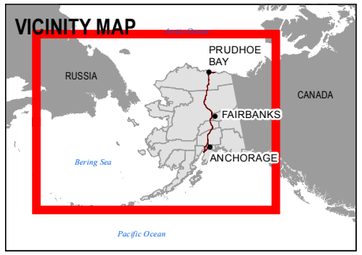

RUSSIA
Beaufort Sea
Chukchi Sea
BARROW
GTP FACILITY
PRUDHOE BAY
PT THOMSON TRANSMISSION CORRIDOR
PT THOMSON FACILITY
Colville
MAINLINE CORRIDOR
COLDFOOT
DALTON HIGHWAY
Koyukuk
Porcupine
LIVENGOOD
FAIRBANKS
Yukon
Tanana
DELTA JUNCTION
TOK
CANADA
ALASKA
Kuskokwim
PARKS HIGHWAY
Susitna
TALKEETNA
PREFERRED OPTION
ALTERNATE OPTION
ANCHORAGE
VALDEZ
LIQUEFACTION FACILITY
NIKISKI
Cook Inlet
Norton Sound
Bering Strait
Bering Sea
Bristol Bay
Shelikof Strait
Gulf of Alaska

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-7 Approximate Combined Summer and Winter Distribution of Ringed Seals.mxd

Pacific walrus range throughout the Bering and Chukchi seas, occasionally moving into the Beaufort Sea (Figure 3.5.1-8). Walruses are associated with the pack-ice edge, but they also use shoreline haulouts on islands and remote coastlines during summer ice-free periods. In the winter, Pacific walruses use the Bering Sea pack ice, especially in the area near and south of St. Lawrence Island (Garlich-Miller et al., 2011). In the summer (May or June), most females and calves migrate north with retreating sea ice into the Chukchi Sea. Males occasionally move into the Chukchi Sea, but more commonly migrate south to haulouts in Bristol Bay or the Gulf of Anadyr, in Russia (Garlich-Miller et al. 2011). When the extent of sea ice expands southward in the fall, Pacific walruses return to their winter range in the pack ice of the Bering Sea. Pacific walruses rarely occur in the Beaufort Sea during summer months; Ireland et al. (2009) reported an overall estimated density of 1.5 walruses/1,000 mi^2 in the Beaufort Sea during vessel-based surveys in 2007. Walruses are observed most commonly in the Beaufort Sea during August and September, primarily in nearshore and shelf waters north and northeast of Point Barrow (Jay et al., 2012).

Walrus occur throughout the Bering and Chukchi seas and may be encountered by vessels in transit to West Dock in Prudhoe Bay (Aerts et al., 2008). Walrus are unlikely to be plentiful, but a few individuals could occur near West Dock at Prudhoe Bay.

Polar Bear

Polar bears were listed by the USFWS as a threatened species throughout their range in May 2008 (73 FR 28212) because their principal habitat, sea ice, is declining. USFWS found that the decline is expected to continue for the foreseeable future and this loss threatens the polar bear throughout all of its range. Polar bears are also protected under the MMPA. In December 2010, the USFWS designated more than 187,000 mi^2 of offshore barrier islands, terrestrial denning areas, and offshore sea-ice as critical habitat for the threatened polar bear under the ESA (75 FR 76086). This critical habitat designation was subsequently vacated by the federal District Court of Alaska and, subject to a pending appeal, is not in effect. Polar bears are a subsistence resource.

Polar bear distribution and movements are tied to seasonal sea ice dynamics, such that their range is limited to areas covered in sea ice for much of the year (Stirling et al., 1999). Habitat use changes seasonally with the formation, advance, movement, retreat, and melt of sea ice (Schliebe et al., 2008). During winter and spring, nondenning polar bears tend to concentrate in areas of ice with pressure ridges, at floe edges, and on drifting seasonal ice at least 8 inches thick (Schliebe et al., 2006). They use mostly shallow water areas on active ice with shear zones and leads (Durner et al., 2004). Mating usually occurs from March to late May or early June, when both sexes are active on the sea ice. During the pupping season of ringed seals in the spring, polar bears move into the landfast ice zone to hunt. In late summer and early autumn, they move to multiyear ice as the pack ice retreats (Durner et al., 2004; Ferguson et al., 2000). Pack ice is the primary summer habitat for Alaska polar bears. Polar bears in the southern Beaufort Sea gather to feed at the butchering sites of harvested bowhead whales (e.g., Barter Island [Kaktovik], Cross Island, Barrow). Polar bear densities across the Alaskan central Beaufort Sea coast tend to be highest near Kaktovik in September and between Oliktok Point and the western border of the Arctic National Wildlife Refuge in October (Figure 3.5.1-9).

APPROXIMATE COMBINED SUMMER AND WINTER DISTRIBUTION OF PACIFIC WALRUS

FIGURE 3.5.1-8

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Pacific Walrus Distribution

0 40 80 160 Miles

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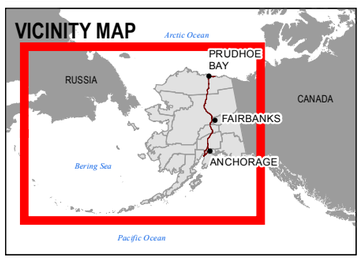
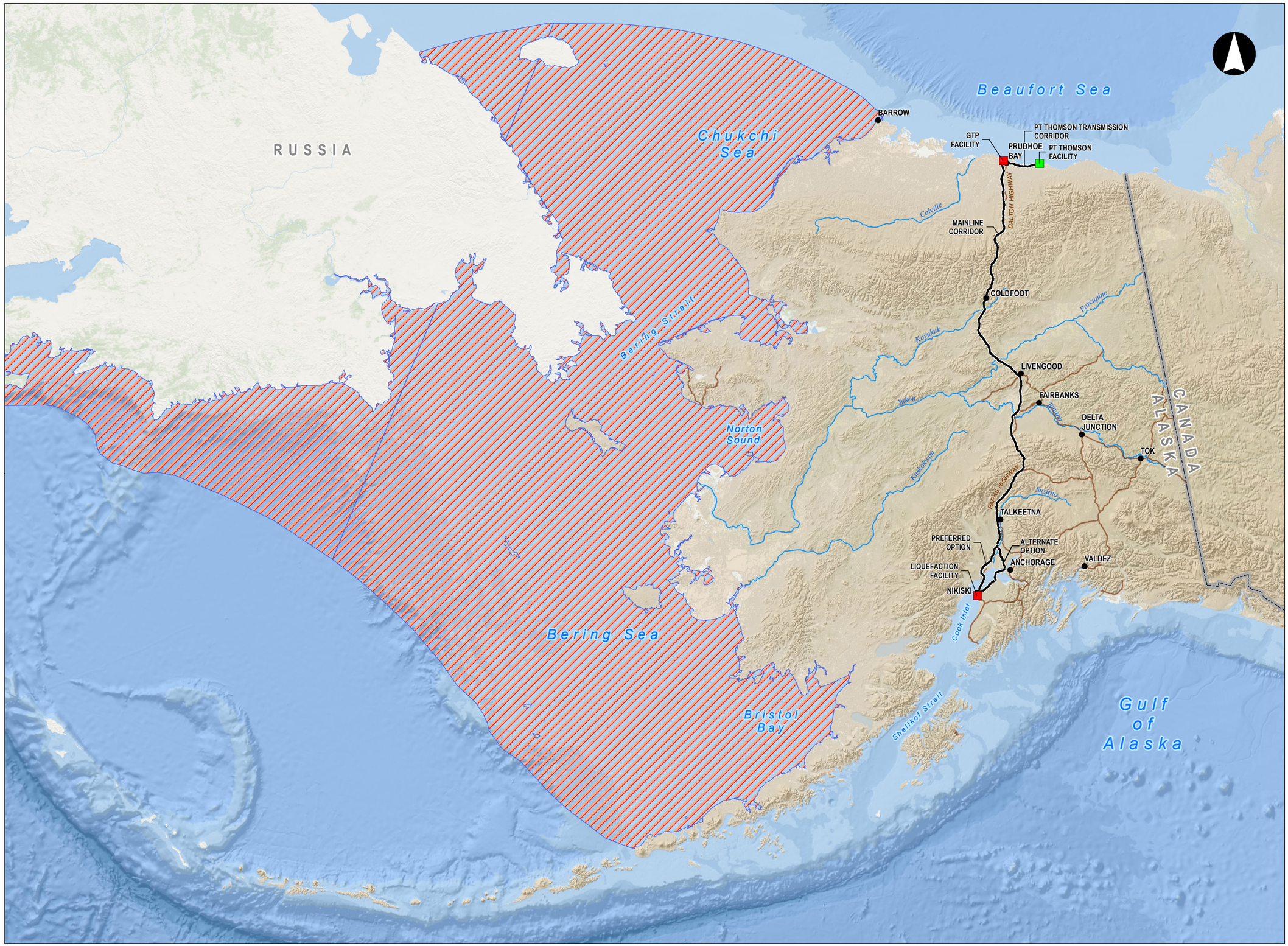
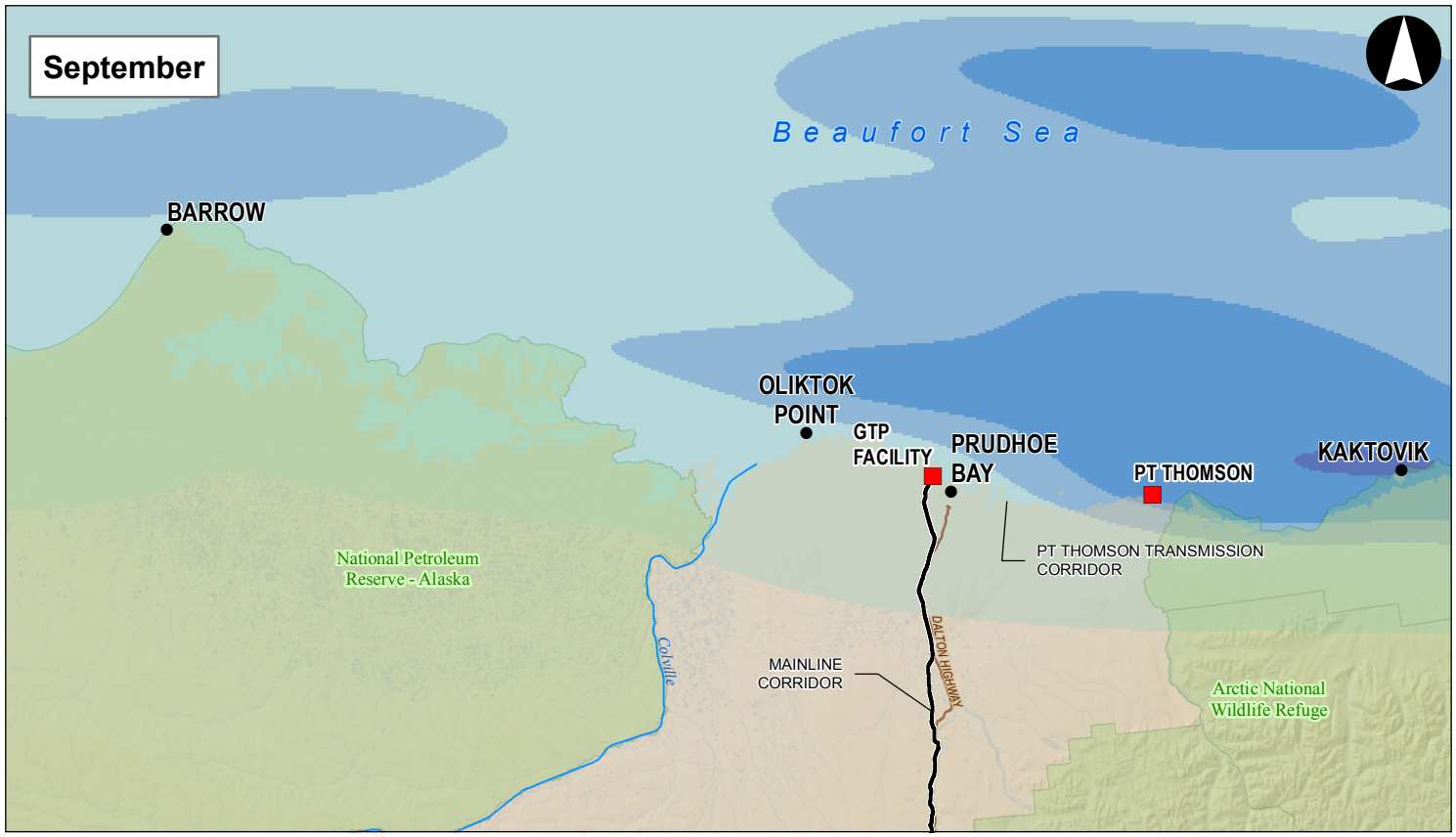
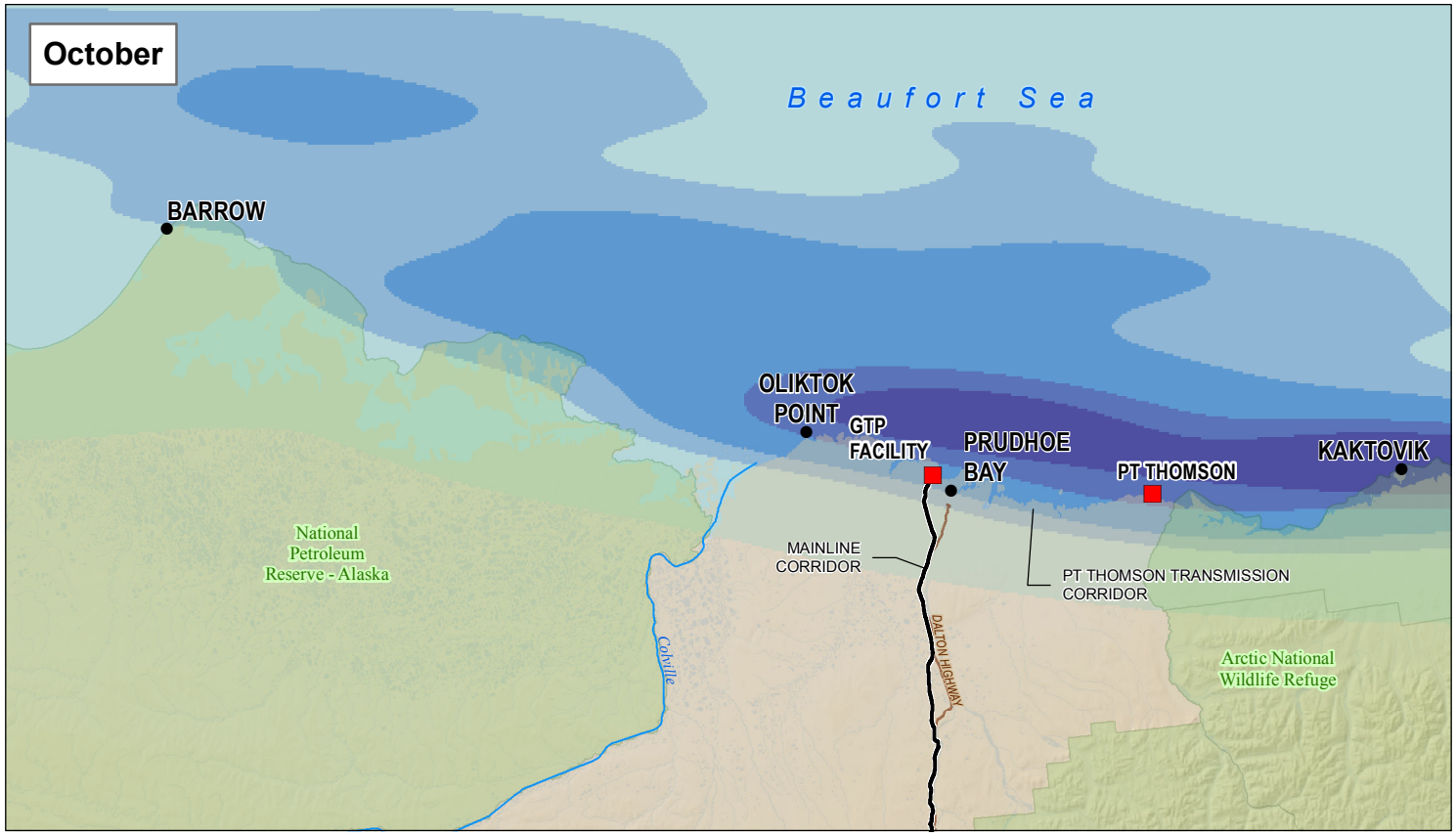




X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-8 Approximate Combined Summer and Winter Distribution of Pacific Walrus in US and Russian Territorial Waters.mxd





LEGEND

- Alaska LNG Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- State and Federal Conservation Lands

Relative Density of Female Polar Bears (animals per km²)

- 0.00001 - 0.005
- 0.005 - 0.010
- 0.011 - 0.025
- 0.026 - 0.040
- 0.041 - 0.065

0 15 30 60 Miles

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RELATIVE FEMALE POLAR BEAR DENSITY DURING SEPTEMBER AND OCTOBER

FIGURE 3.5.1-9

Alaska LNG

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-9 Relative Female Polar Bear Density During September and October.mxd

Adult male and nonpregnant female polar bears remain active all year, using temporary dens as shelter during severe weather. Most pregnant female polar bears of the southern Beaufort Sea stock construct and enter dens in mid-November where they hibernate and give birth (Amstrup, 2000). Dens are excavated in compacted snow drifts on the pack ice or on coastal banks (barrier islands and mainland bluffs), river or stream banks, and other areas with at least 4 feet of vertical topographic relief that accumulate snow drifts (Durner et al., 2001, 2003, 2006). Dens are found most frequently near the edges of stable sea ice on the shoreward side of barrier islands, onshore in drifts along the coastline, and, to a lesser extent, along river or stream banks (Durner et al., 2003). Female polar bears do not necessarily return to the same den, but females tend to den on the same type of substrate (pack ice or land) from year to year and may return to the same general area (Amstrup and Gardner, 1994; Schliebe et al., 2006; Fischbach et al., 2007). Cubs remain with the females for about two-and-a-half years before weaning (DeMaster and Stirling, 1981; Amstrup et al., 2000). Presence and age of the cubs affects female polar bear distribution and movements, as does the availability of ice suitable for hunting (Amstrup et al,. 2000).

An analysis of den locations used by collared polar bears between 1985 and 2005 has documented shifts in den distributions from pack ice to land primarily in response to reduction in sea ice extent and delay in freeze-up northern Alaska (Fischbach et al., 2007). The proportion of dens located on drifting pack ice decreased from 62 percent (1985-1994) to 37 percent (1998-2004) with proportionately fewer dens on pack ice in the western Beaufort Sea (Fischbach et al., 2007). Terrestrial areas with the appropriate configuration for accumulating snow drifts large enough for polar bear dens have been mapped across much of the Arctic Coastal Plain portion of the Project area (Durner et al., 2001, 2003, 2006). These areas with documented polar bear den sites are shown in Figure 3.5.1-10.

Polar bears are more likely to move through the Arctic Coastal Plain (ACP) portion of the Project area in fall and winter, when bears are present along the entire Beaufort Sea coast from Demarcation Point to Point Barrow, although polar bears can occur within this area year-round. The PTTL would be constructed in a region that has supported previous polar bear den sites. The GTP is surrounded by areas with ridges and bluffs that could provide den habitat; however, this area contains infrastructure and human activity that would make it unsuitable for polar bear denning. Gestating and subsequently post-parturient females can be present in dens (although not obvious) from late November through early April (Amstrup, 2000).

Wood Bison

Wood bison are one of the two subspecies of North American bison; they are larger, have a more pronounced hump, a forelock, and reduced chaps and beard compared to the plains bison (*Bison bison bison*) which have been reintroduced in Alaska beginning with establishment of the Delta Herd in 1928 (ADF&G, 2013a; Bruning, 2012). The Alaska Department of Fish and Game plans to reintroduce wood bison into one or more areas including Yukon Flats, Minto Flats, and the lower Innoko/Yukon River area from the captive breeding herd at the Alaska Wildlife Conservation Center at Portage, Alaska (Figure 3.5.1-11; ADF&G, 2013a). In May 2014, USFWS issued a final rule designating reintroduced wood bison as a nonessential experimental population (79 FR 26175). Within the Nonessential Experimental

POLAR BEAR DEN SITES AND POTENTIAL DENNING HABITAT IN THE PROJECT AREA

FIGURE 3.5.1-10

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Polar Bear Maternal Den Sites 1910-2010
- Project Corridor
- Potential Denning Habitat
- Major Highways
- Major Rivers

0 1.5 3 6 Miles

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VICINITY MAP

Cross Island

Beaufort Sea

GTP FACILITY

PRUDHOE BAY

PT THOMSON

PT THOMSON TRANSMISSION CORRIDOR

MAINLINE CORRIDOR

DALTON HIGHWAY

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-10 Polar Bear Den Sites and Potential Denning Habitat in The Project Area.mxd

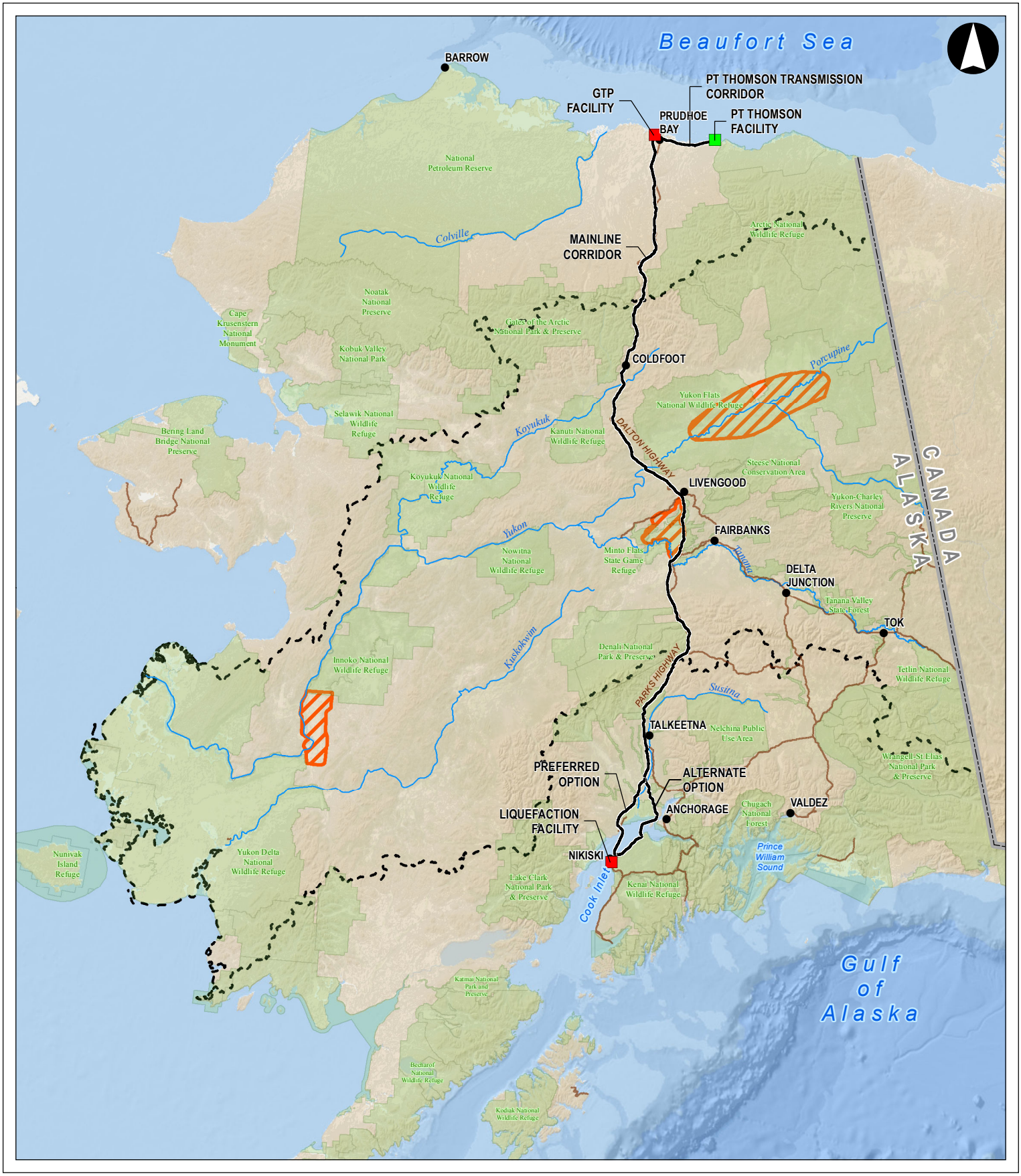
Population (NEP) area and outside of national parks or wildlife refuges reintroduced wood bison would be considered a proposed species under ESA 10(j), within the national parks or wildlife refuge system they are protected as a threatened species. The Mainline corridor would cross through the defined NEP area and near the proposed Minto Flats reintroduction site in the (Figure 3.5.1-11). Project construction and operation may coincide with wood bison reintroductions and a conference (Minto Flats: 86 percent state-owned Minto Flats State Game Refuge, 14 percent privately owned) or consultation (Yukon Flats: 63 percent federally owned Yukon Flats National Wildlife Refuge, 32 percent privately owned, 4 percent state-owned) with USFWS would be required (ADF&G, 2013a). The wood bison NEP establishment rule allows for incidental take that may occur from oil and gas development and pipelines within the NEP area (79 FR 26175).

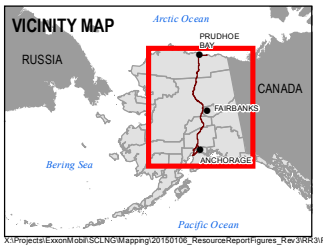
Spectacled Eider

Spectacled eiders were listed as threatened throughout their range under the ESA in May 1993 as a result of severely declining populations in western Alaska, and possible declining populations in northern Alaska and eastern Russia (58 FR 27474). The USFWS established a recovery plan for spectacled eiders in 1996 (USFWS, 1996). In 2010 a review of the species was completed that evaluated potential threats to recovery (USFWS, 2010c). Ongoing threats on the breeding ground are thought to include lead contamination, illegal harvest, and predation (USFWS, 2010c). Spectacled eiders spend a majority of their life cycle in marine habitats, but little information on current threats is available; future threats identified include climate change and offshore oil spills (USFWS, 2010c). Critical habitat was designated in 2001 for nesting on the Yukon-Kuskokwim Delta; for molting in Norton Sound and Ledyard Bay; and for wintering south of St. Lawrence Island (Figure 3.5.1-12; 66 FR 9146).

As illustrated in Figure 3.5.1-12, spectacled eiders nest on tundra habitats on Alaska's ACP and western Alaska, molt in coastal areas of the Chukchi and Bering seas, and winter in polynyas in the Bering Sea. The ACP breeding population departs from wintering areas in the Bering Sea following spring leads and openings in the Bering and Chukchi seas, arriving on the Beaufort Coastal Plain from late-May to early June (Petersen et al., 2000). Telemetry data indicate that spring migrant spectacled eiders remain within 50 kilometers from shore with first arrival on June 10 (Sexson et al., 2011).

Established pairs migrate together to nesting grounds generally located within 12 miles from the coast where they use a variety of tundra habitat types (Petersen et al., 2000). Nests are generally constructed by the female and average 3 feet from water with many nests in on shorelines, islands, or peninsulas (Petersen et al., 2000). Spectacled eider breeding density based on 2009 to 2012 aerial breeding waterfowl surveys is shown in Figure 3.5.1-13. Comparison of the 2009-2012 to previous density surfaces (Stehn et al. 2012) shows consistent moderate use of areas south and east of Prudhoe Bay, and southwest of Tigvariak Island (Figure 3.5.1-13). The female incubates the eggs for an average of 24 days and hatching begins in early July (Petersen et al., 2000). Broods are reared near water where they feed on invertebrates along pond edges (Petersen et al., 2000).





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- State and Federal Conservation Lands
- Wood Bison Nonessential Experimental Population Area
- Wood Bison Proposed Reintroduction Sites

0 45 90 180 Miles

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-11 Wood Bison Nonessential Experimental Population Area and Reintroduction Sites.mxd

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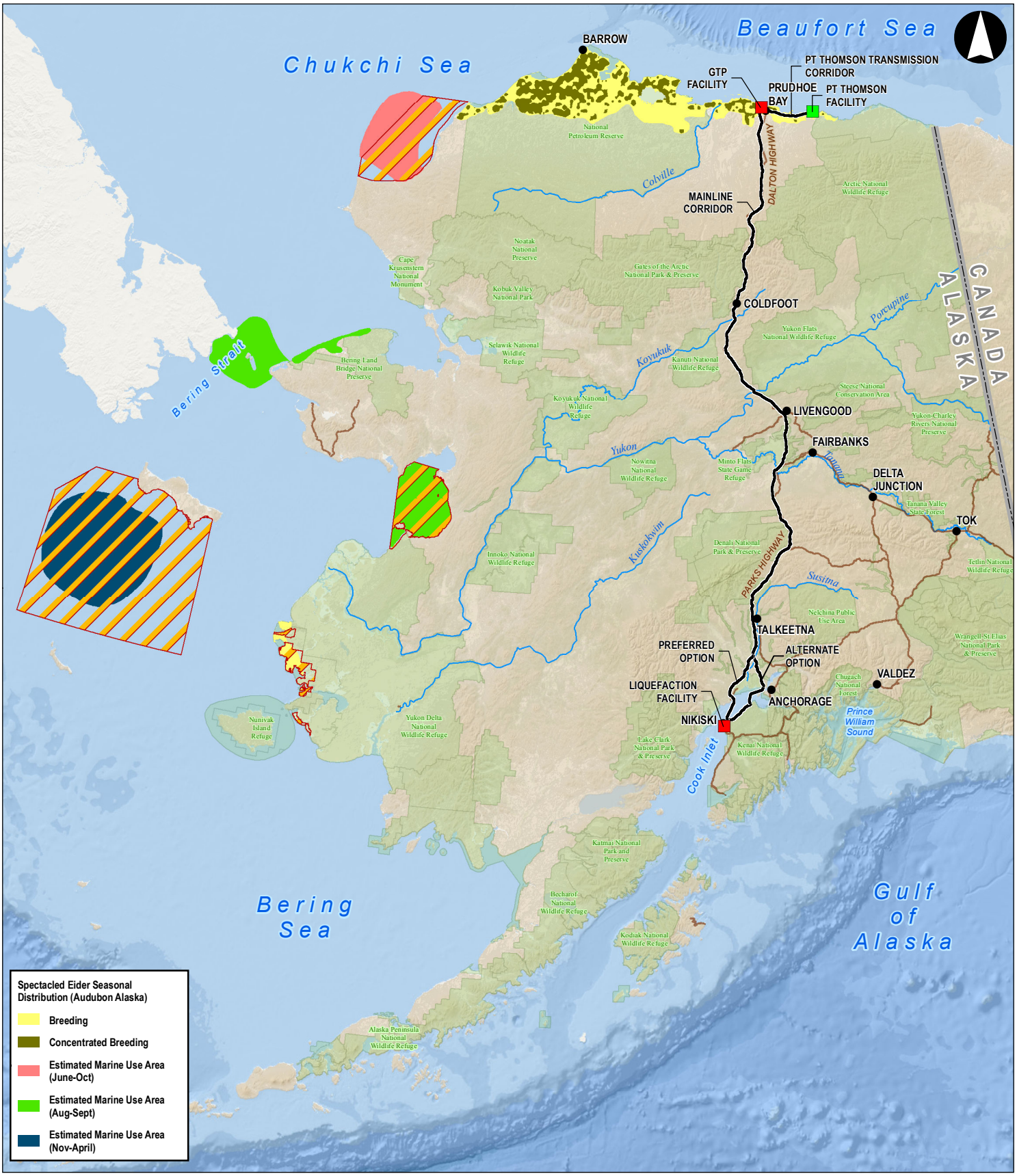
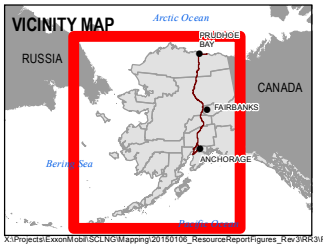
WOOD BISON NONESSENTIAL EXPERIMENTAL POPULATION AREA AND REINTRODUCTION SITE

FIGURE 3.5.1-11

Alaska LNG



VICINITY MAP



X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-12 Range and Seasonal Distribution of Spectacled Eiders.mxd

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- Critical Habitat of Spectated Eider
- State and Federal Conservation Lands

0 50 100 200 Miles

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RANGE AND SEASONAL DISTRIBUTION OF SPECTACLED EIDERS

FIGURE 3.5.1-12

Alaska LNG

SPECTACLED EIDER BREEDING PAIR DENSITY BASED ON 2009-2012 AERIAL BREEDING PAIR SURVEYS

FIGURE 3.5.1-13

Alaska LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Project Corridor
- Major Highways
- Major Rivers
- State and Federal Conservation Lands

Spectacled Eider - USFWS (2009-2012)
Est. Birds Per Sq Kilometer

- 0.000 - 0.028
- 0.028 - 0.111
- 0.011 - 0.236
- 0.236 - 0.425
- 0.426 - 1.647

0 2 4 8 Miles

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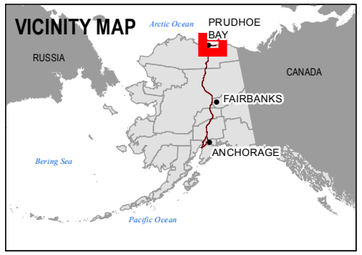
VICINITY MAP



Beaufort Sea

GTP FACILITY

Purdhoe Bay

PT THOMSON TRANSMISSION CORRIDOR

Tigvariak Island

PT THOMSON FACILITY

PRUDHOE BAY

MAINLINE CORRIDOR

DALTON HIGHWAY

Arctic National Wildlife Refuge

X:\Projects\ExxonMobil\SCLNG\Mapping\20150106_ResourceReportFigures_Rev3\RR3\Figure 3_5_1-13 Spectacled Eider Breeding Pair Density Based on 2009-2012 Aerial Breeding Pair Surveys.mxd

After breeding, males move to nearshore marine waters in late June where they undergo a complete molt of their flight feathers. Nesting females remain on the coastal tundra until late August to early September and then congregate to molt. Spectacled eiders breeding in arctic Alaska primarily molt in Ledyard Bay, where males arrive in late June and remain through mid-October. Nonbreeding females or those with failed nests arrive in molting areas in late July, while successfully breeding females arrive in late August and stay through October. Movement between nesting and molting areas takes several weeks; the eiders make several stops along the Beaufort and Chukchi Sea coasts. Concentrations of migrant spectacled eiders along the central Beaufort Sea included areas near West Dock, Harrison Bay, and Smith Bay (Sexson et al., 2011). After molting, eiders travel to their wintering areas where they remain from October through March (Figure 3.5.1-13).

3.5.2 Special-Status Species

3.5.2.1 BLM-Sensitive and Watch List Species

In implementing its obligations under the FLPMA the BLM designates sensitive species and implements measures to conserve certain species and their habitats on BLM land. All federally designated candidate, proposed, and delisted species within the 5 years following their delisting are conserved as BLM-sensitive species. BLM is not obligated to conserve federally designated critical habitat once the proposal to de-list becomes final or the habitat is no longer designated as critical. The Liquefaction Facility would not be located on BLM managed lands. Interdependent Facilities would cross lands managed by BLM.

Tables 3.5.2-1, 3.5.2-2, and 3.5.2-3 list the mammals, fish, and birds with potential to occur in the Project area that BLM has identified as sensitive on BLM-managed lands or that are on the watch list, which may occur on BLM-managed lands, but have not been documented.The Alaskan hare, included as a sensitive mammal on BLM's list for BLM-managed lands, occurs in western Alaska outside of the Project area.

TABLE 3.5.2-1

BLM Sensitive and Watch List Mammals Potentially Occurring in the Project Area

Common Name	Ecoregion	Presence in Project Area
Osgood's Arctic Ground Squirrel[a]	Beaufort Coastal Plain, Brooks Foothill, Brooks Range	Unconfirmed: Potentially present in dry Arctic tundra, bluffs, rocky slopes and mountainous habitats
Alaska Tiny Shrew[a]	Brooks Foothill, Brooks Range, Ray Mountains;	Unknown: Habitat preference unknown
Kenai Marten[a]	Cook Inlet Basin	Kenai Peninsula

Sources: BLM, 2010; AKNHP, 2014a; ADF&G, 2014d

[a] Alaska BLM Sensitive Species

[b] Alaska BLM Sensitive Species Watch List

One of the four BLM sensitive or watch list fish may occur in the Project area (Table 3.5.2-2). The Alaskan brook lamprey is listed throughout its range in Alaska and may potentially occur in several ecoregions crossed by the Mainline.

TABLE 3.5.2-2

BLM Sensitive and Watch List Fish Potentially Occurring in the Project Area

Common Name	Ecoregion	Presence in Project Area
Alaskan Brook Lamprey[a]	Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Rivers on the Kenai peninsula, Chatanika and Chena rivers.

Sources: BLM, 2010; AKNHP, 2014a; ADF&G, 2014d

[a] Alaska BLM Sensitive Species

[b] Alaska BLM Sensitive Species Watch List

Nineteen birds are included on the BLM sensitive or watch list. Of these, 16 are potentially found in the Project area (Table 3.5.2-3). BLM listed loons and shorebirds that primarily occur in the wetlands and tidal flats of the Beaufort Coastal Plain and Cook Inlet Basin Ecoregions, whereas listed passerines may occur in all ecoregions south of the Brooks Range. Murrelets only occur in the Cook Inlet Basin Ecoregion.

TABLE 3.5.2-3

BLM Sensitive and Watch List Birds Potentially Occurring in the Project Area

Common Name	Ecoregion	Potential Habitat
Yellow-billed Loon[a]	Beaufort Coastal Plain; marine waters	Freshwater lakes in the Arctic tundra of Alaska on the Beaufort Coastal Plain
Red-throated Loon[b]	Beaufort Coastal Plain, Brooks Foothills, Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Freshwater lakes and ponds
Red Knot[a]	Beaufort Coastal Plain; Cook Inlet Basin	Beaches and tidal flats in northern Alaska
Buff-Breasted Sandpiper[b]	Beaufort Coastal Plain	Alaskan tundra close to water
Hudsonian Godwit[b]	Alaska Range; Cook Inlet Basin	Open wet meadow or bogs intermixed with forest; beaches, tidal mudflats
Bar-Tailed Godwit[b]	Beaufort Coastal Plain	Arctic tundra
Golden Eagle[a]	Entire Project area	Mountain, bluffs in the foothill, along rivers
Short-eared Owl[a]	Entire Project area	Arctic tundra, bogs in interior
Trumpeter Swan[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Freshwater lakes and wetlands in the Interior
Olive-Sided Flycatcher[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Bogs, shrublands, open forests
Blackpoll Warbler[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Riparian shrub thickets and/or early successional spruce forests
Rusty Blackbird[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Open spruce forests and woodlands
Townsend's Warbler[b]	Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Open and closed spruce forest

TABLE 3.5.2-3

BLM Sensitive and Watch List Birds Potentially Occurring in the Project Area

Common Name	Ecoregion	Potential Habitat
Gray-Cheeked Thrush[b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Shrublands, woodlands, and dwarf forests
Marbled Murrelet[a]	Cook Inlet Basin; Marine waters	Pristine old growth forest; marine waters
Kittlitz's Murrelet[a]	Cook Inlet Basin; Marine waters	Coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains near glaciers; marine waters

Sources: BLM, 2010; AKNHP, 2014a

[a] Alaska BLM Sensitive Species

[b] Alaska BLM Sensitive Species Watch List

3.5.2.2 State-Sensitive Species

Endangered Species

The ADF&G is responsible for determining and maintaining a list of endangered species in Alaska under AS 16.20.190. The state endangered species list currently includes two birds (short-tailed albatross and Eskimo curlew) and three marine mammals (blue whale, humpback whale, and right whale).

The Eskimo curlew is a large shorebird that formally migrated through eastern and northwestern Canada from wintering areas in South America to nest on the arctic tundra. The Eskimo curlew no longer occurs in Alaska, and the Project would have no effect on the Eskimo curlew. The other state-listed endangered species do not occur in the Project area.

Species of Special Concern

As of August 15, 2011, the ADF&G no longer maintains a Species of Special Concern list (ADF&G, 2014e). The list has not been reviewed and revised since 1998 and is no longer considered to be in effect. ADF&G currently uses the Alaska Wildlife Action Plan to assess the needs of species with conservation concerns and to prioritize conservation actions and research (ADF&G, 2014e). The Alaska Wildlife Action Plan uses the Alaska Species Ranking System to determine which species are in most need of conservation and prioritize how to best meet the needs of Alaska's wildlife (ADF&G, 2006; Gotthardt et al., 2012).

3.5.3 Potential Construction Impacts and Mitigation Measures

Potential construction impacts to federally-listed species will be evaluated during development of an Applicant-prepared Biological Assessment (BA) in consultation with NMFS and USFWS. Other federal agencies will review the BA once FERC has completed the draft BA with NMFS and USFWS.

A general summary of potential impacts to listed and sensitive species from construction of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report and the Applicant-prepared BA will identify potential site-specific impacts to listed and sensitive species from construction of the (1) Liquefaction

Facility and (2) Interdependent Facilities. Included will be a discussion of proposed conservation measures, including site-specific measures.

3.5.4 Potential Operational Impacts and Mitigation Measures

Potential operational impacts to federally-listed species will be evaluated during development of an Applicant-prepared Biological Assessment (BA) in consultation with NMFS and USFWS. Other federal agencies will review the BA once FERC has completed the draft BA with NMFS and USFWS.

A general summary of potential impacts to listed and sensitive species from operation of projects similar to this Project is provided in Appendix F. This Appendix also includes a summary of the types of plans, as examples, that can be developed to address potential impacts. As additional Project details become available, a subsequent draft of this Resource Report and the Applicant-prepared BA will identify potential site-specific impacts to listed and sensitive species from operation of the (1) Liquefaction Facility and (2) Interdependent Facilities. Included will be a discussion of proposed conservation measures, including site-specific measures.

3.6 CUMULATIVE IMPACTS

A discussion on the cumulative impacts of the Project, in concert with other reasonably foreseeable projects, will be provided in a subsequent draft of this Resource Report, following incorporation of Project-specific environmental data collected in 2014 and 2015.

3.7 REFERENCES

35 FR 8491. 1970. Wildlife and Fisheries/Conservation of Endangered Species and Other Fish or Wildlife, Rules and Regulations. Department of the Interior, Fish and Wildlife Service. pp. 8491-8498.

55 FR 49204. 1990. Listing of Steller Sea Lions as Threatened Under the Endangered Species Act, Final Rule. Department of Commerce, National Marine Fisheries Service, pp. 49204-49241.

58 FR 27474. 1993. Endangered and Threatened Wildlife and Plants: Final Rule to List Spectacled Eider as Threatened, Final Rule. Department of Interior, Fish and Wildlife Service. pp. 27474-27480.

58 FR 45269. 1993. Designated Critical Habitat/ Steller Sea Lion, Final Rule. Department of Commerce, National Marine Fisheries Service. pp. 45269-45285.

62 FR 24345. 1997. Threatened Fish and Wildlife/ Change in Listing Status of Steller Sea Lions Under the Endangered Species Act, Final Rule. Department of Commerce, National Marine Fisheries Service. pp. 24345-24355.

62 FR 31748. 1997. Endangered and Threatened Wildlife and Plants; Threatened Status for the Alaska Breeding Population of the Steller's Eider, Final Rule. Department of the Interior, Fish and Wildlife Service. pp. 31748-31757.

66 FR 8850. 2001. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Alaska-Breeding Population of the Steller's Eider, Final Rule. Department of the Interior, Fish and Wildlife Service. pp. 8850-8884.

66 FR 9146. 2001. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Spectacled Eider, Final Rule. Department of Interior, Fish and Wildlife Service. pp. 9146-9185.

70 FR 46366. 2005. Endangered and Threatened Wildlife and Plants/Determination of Threatened Status for the Southwest Alaska Distinct Population Segment of the Northern Sea Otter (*Enhydra lutris kenyoni*), Final Rule. Department of the Interior, Fish and Wildlife Service. pp.46366-46386.

73 FR 12024. 2008. Endangered and Threatened Species; Endangered status for North Pacific and North Atlantic Right Whales, Final Rule. Department of Commerce, National Oceanic and Atmospheric Administration. Pp.12024-12030.

73 FR 28212. 2008. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Polar Bear (*Ursus maritimus*) Throughout Its Range, Final Rule. Fish and Wildlife Service, Interior. pp. 28212-28303.

73 FR 62919. 2008. Endangered and Threatened Species/ Endangered Status for the Cook Inlet Beluga Whale, Final Rule. Department of Commerce, National Marine Fisheries Service. pp. 62919-62930.

74 FR 51988. 2009. Endangered and Threatened Wildlife and Plants/ Designation of Critical Habitat for the Southwest Alaska Distinct Population Segment of the Northern Sea Otter, Final Rule. Department of the Interior, Fish and Wildlife Service. pp. 51988-52012.

75 FR 76086. 2010. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Polar Bear (*Ursus maritimus*) in the United States, Final Rule. Fish and Wildlife Service, Interior. pp. 76086-76137.

76 FR 7634. 2011. Endangered and Threatened Wildlife and Plants/12-Month Finding on a Petition to List the Pacific Walrus as Endangered or Threatened, Notice of 12-month Petition Finding. Department of Interior, Fish and Wildlife Service. pp. 7634-7679.

76 FR 20180. 2011. Endangered and Threatened Species/ Designation of Critical Habitat for Cook Inlet Beluga Whale, Final Rule. Depart of Commerce, National Marine Fisheries Service. pp. 20180-20214.

77 FR 76706. 2012. Endangered and Threatened Species/ Threatened Status for the Arctic, Okhotsk, and Baltic Subspecies of the Ringed Seal and Endangered Status for the Ladoga Subspecies of the Ringed Seal, Final Rule. Department of Commerce, National Marine Fisheries Service. pp. 76706-76738.

77 FR 76740. 2012. Endangered and Threatened Species/ Threatened Status for the Beringia and Okhotsk Distinct Population Segments of the *Erignathus barbatus nauticus* Subspecies of the Bearded Seal, Final Rule. Department of Commerce, National Marine Fisheries Service. pp. 76740-76768.

78 FR 66140. 2013. Endangered and Threatened Species; Delisting of the Eastern Distinct Population Segment of the Steller Sea Lion Under the Endangered Species Act; Amendment to Special Protection Measures for Endangered Marine Mammals. Final Rule. Department of Commerce, National Marine Fisheries Service. pp.66139-66199.

79 FR 26175. 2014. Endangered and Threatened Wildlife and Plants; Establishment of a Nonessential Population of Wood Bison in Alaska. Department of the Interior, Fish and Wildlife Service. pp. 26175 – 26188.

79 FR 71714. 2014. Endangered and Threatened Species; Designation of Critical Habitat for the Arctic Ringed Seal. Proposed Rule, Request for Comments. Department of Commerce, National Marine Fisheries Service. pp.71714-71729.

Abookire, A.A., J.F. Piatt, and B.L. Norcross. 2001. Juvenile groundfish habitat in Kachemak Bay, Alaska, during late summer. Alaska Fishery Research Bulletin 8(1):45-56.

Adams, L.G. 2013. Dynamics of the Denali Caribou Herd, Denali National Park, Alaska: Progress Report (October 2011 – September 2012). USGS-Alaska Science Center. Available online at HTTP://SCIENCE.NATURE.NPS.GOV/IM/UNITS/CAKN. Accessed October 22, 2014.

ADF&G (Alaska Department of Fish and Game). 1983. Volume 2, Adult anadromous fish studies, 1982. Susitna Hydro Aquatic Studies. Phase I1 Final Data Report. Alaska Department of Fish and Game. Anchorage, Alaska 239 p + appendices.

ADF&G (Alaska Department of Fish and Game). 1985. Alaska Habitat Management Guide. Southcentral Region, Volume II: Distribution, Abundance, and Human Use of Fish and Wildlife. Habitat Division, Juneau, Alaska

ADF&G (Alaska Department of Fish and Game). 1986a. Alaska Habitat Management Guide. Arctic Region. Volume II: Distribution, Abundance, and Human Use of Fish and Wildlife. Habitat Division, Juneau, Alaska.

ADF&G (Alaska Department of Fish and Game). 1986b. Alaska Habitat Management Guide. Western and Interior Region: Distribution, Abundance, and Human Use of Fish and Wildlife. Habitat Division, Juneau, Alaska.

ADF&G (Alaska Department of Fish and Game). 1992. Minto Flats State Game Refuge. Divisions of Habitat and Restoration and Wildlife Conservation. Fairbanks, Alaska. 58 pp.

ADF&G (Alaska Department of Fish and Game). 2002. Alaska aquatic nuisance species management plan. State of Alaska, Department of Fish and Game. Juneau, Alaska. 103 pp.

ADF&G (Alaska Department of Fish and Game). 2006. Our wealth maintained: A strategy for conserving Alaska's diverse wildlife and fish resources, -xviii + 824 p. Juneau, Alaska: Alaska Department of Fish and Game.

ADF&G (Alaska Department of Fish and Game). 2008. Wildlife Notebook Series. Available online at http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries. Accessed October 29, 2014.

ADF&G (Alaska Department of Fish and Game). 2011. Caribou management report of survey inventory activities, 1 July 2008 – 30 June 2010. Patricia Harper, Ed. Division of Wildlife Conservation, Juneau, Alaska. 354 pp.

ADF&G (Alaska Department of Fish and Game). 2013a. Environmental Assessment: Designation of Nonessential Experimental Population Status for Wood Bison in Interior Alaska. Prepared by the Alaska Department of Fish and Game in cooperation with the U.S. Fish and Wildlife Service.

ADF&G (Alaska Department of Fish and Game). 2013b. Trapper Questionnaire Statewide Annual Report, 1 July 2012-30 June 2013. Alaska Department of Fish and Game, Juneau, Alaska. Wildlife Management Report ADF&G/DWC/WMR-2013-5.

ADF&G (Alaska Department of Fish and Game). 2014a. Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes Arctic Region Resource Management, Region V, Habitat Division, Juneau, Alaska.

ADF&G (Alaska Department of Fish and Game). 2014b. Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes Interior Region Resource Management, Region VI, Habitat Division, Juneau, Alaska.

ADF&G (Alaska Department of Fish and Game). 2014c. Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes Southcentral Region Resource Management, Region II. Habitat Division, Juneau, Alaska.

ADF&G (Alaska Department of Fish and Game). 2014d. Species Profiles. Available online at http://www.adfg.alaska.gov/index.cfm?adfg=species.main. Accessed various dates 2014.

ADF&G (Alaska Department of Fish and Game). 2014e. State of Alaska Special Status Species. http://www.adfg.alaska.gov/index.cfm?adfg=specialstatus.main. Accessed October 30, 2014.

ADF&G (Alaska Department of Fish and Game). 2014f. Recent Rotenone Projects in Alaska. Available online at http://www.adfg.alaska.gov/index.cfm?adfg=rotenone.recentprojects. Accessed December 15, 2014.

ADNR (Alaska Department of Natural Resources). 2011. Strategic Plan for Invasive Weed and Agricultural Pest Management and Prevention in Alaska (2011 to 2016). Available online at http://dnr.alaska.gov/ag/Index/StrategicPlanInvasiveweedsandpests.pdf. Accessed October 30, 2011.

ADNR (Alaska Department of Natural Resources). 2014. Southwest Cook Inlet oil and gas exploration license: Written finding of the director. June 20, 2014

Aerts, L., M. Blees, S. Blackwell, C. Greene, K. Kim, D. Hannay and M. Austin. 2008. Marine mammal monitoring and mitigation during BP Liberty OBC seismic survey in Foggy Island Bay, Beaufort Sea, July-August 2008: 90-day report. LGL Rep. P1011-1. Rep. from LGL Alaska Research Associates Inc., LGL Ltd., Greeneridge Sciences Inc. and JASCO Research Ltd. for BP Exploration Alaska.

AKEPIC (Alaska Exotic Plant Information Clearinghouse database). 2014. Alaska Natural Heritage Program, University of Alaska, Anchorage. Available online at http://aknhp.uaa.alaska.edu/maps/akepic/. Accessed November 13, 2014.

AKNHP (Alaska Natural Heritage Program). 2014a. Animal Data Portal. University of Alaska, Anchorage. Available online at http://aknhp.uaa.alaska.edu/zoology/ Accessed September-November 2014.

AKNHP (Alaska Natural Heritage Program). 2014b.Conservation Status Report: *Lithobates sylvaticus*. 8 pp. Available online at http://aknhp.uaa.alaska.edu. Accessed October 1, 2014.

AKNHP (Alaska Natural Heritage Program). 2014c. Rare Vascular Plant List. University of Alaska, Anchorage. Available online at http://aknhp.uaa.alaska.edu/botany/rare-plant-species-information/. Accessed October 18, 2014.

Allen, B. M. and R. P. Angliss. 2014. Alaska marine mammal stock assessment. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center. July 2014. NMFS-AFSC-277.

Amstrup, S.C. 2000. Polar bear. Pages 133-157 in Truett, J.J. and S.R. Johnson, eds. The Natural History of an Arctic Oilfield: Development and the Biota. Academic Press, Inc. New York.

Amstrup, S.C., and C. Gardner. 1994. Polar bear maternity denning in the Beaufort Sea. Journal of Wildlife Management 58:1–10.

Amstrup, S.C., G.M. Durner, I. Stirling, N.J. Lunn, and F. Messier. 2000. Movements and distribution of polar bears in the Beaufort Sea. Canadian Journal of Zoology 78:948–66.

Andres, B. A. 1994. Coastal zone use by post-breeding shorebirds in northern Alaska. The journal of Wildlife Management 58 (2):206-213.

APSC (Alyeska Pipeline Service Company). Undated. Fish Stream Database for the Trans-Alaska Pipeline system. Anchorage, Alaska.

APSC (Alyeska Pipeline Service Company). 1993. Environmental Atlas of the Trans- Alaska Pipeline System. EA-119. 1st Ed., Anchorage, Alaska.

APSC (Alyeska Pipeline Service Company). 2002. Environmental Atlas of the Trans- Alaska Pipeline System. EA-119. 2nd Ed., Anchorage, Alaska. 84 pp.

ARCO Alaska (ARCO Alaska, Inc.), Anadarko Petroleum Corporation, and Union Texas Petroleum Alaska Corporation. 1997. Alpine Development Project Environmental Evaluation Document. Prepared by Parametrix, Inc., Kirkland, Wash., ABR, Inc., Michael Baker Jr., Inc., Robert Griffeth, MJM Research, John Lobdell, and Shannon and Wilson OCC for U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska.

Armstrong, R.H. 1996. Alaska's Fish: a Guide to Selected Species. Alaska Northwest Books, Anchorage, Alaska.

Armstrong, R.H. 2008. Guide to the Birds of Alaska, 5th edition. Alaska Northwest Books, Anchorage. 360 pp.

Arthur, S.M., and P.A. Del Vecchio. 2009. Effects of oil field development on calf production and survival in the Central Arctic herd. Alaska Department of Fish and Game. Federal Aid in Wildlife Restoration. Final Research Technical Report. Grants W-27-5 and W-33-1 through W-33-4. Project 3.46. Juneau, Alaska. 46 pp.

Arthur, S.M., and P.A. Del Vecchio. 2013. Population dynamics of muskoxen in northeastern Alaska. Alaska Department of Fish and Game, Final Wildlife Research Report ADF&G/DWC/WRR-2013-1, Project 10.10, Juneau, Alaska. 30 pp.

ASG (Alaska Shorebird Group). 2008. Alaska Shorebird Conservation Plan. Version II. Alaska Shorebird Group, Anchorage, AK. http://alaska.fws.gov/mbsp/mbm/shorebirds/plans.htm.

Audubon. 2014. Important Bird Areas of Alaska. Draft 18 August, 2014. Available online at http://netapp.audubon.org/IBA/State/US-AK. Accessed October 30, 2014.

Barnes, P. W. and E. Reimnitz. 1974. Sedimentary process on arctic shelves off the northern coast of Alaska. In: The Coast and Shelf of the Beaufort Sea. Reed, J.C., and Sater, J.E. (eds.). Arlington, VA: Arctic Institute of North America. 436-479.

Barrett, B.M., F.M. Thompson, and S.N. Wick. 1984. Report No. 1. Adult anadromous fish investigations: May-October 1983. Susitna River Aquatic Studies Program. Alaska Department of Fish and Game. Anchorage, Alaska 225 p + appendices.

Barrett, B.M., F.M. Thompson, and S.N. Wick. 1985. Report No. 6. Adult salmon investigations: May-October 1984. Susitna River Aquatic Studies Program. Alaska Department of Fish and Game. Anchorage, Alaska. 157 p + appendices.

Bartlett, L.D. 1992. Creel, escapement, and stock statistics for coho salmon on the Little Susitna River, Alaska, during 1991. Fishery Data Series NO. 92-24: Alaska Department of Fish and Game, Division of Sport Fish. Anchorage, Alaska. 110 p.

Bart, J., S. Brown, B. A. Andres, R. Platte, and A. Manning. 2012. North Slope of Alaska. Studies in Avian Biology 44:37–96.

Barten, N.L., R. T. Bowyer, and K.J. Jenkins. 2001. Habitat use by female caribou: tradeoffs associated with parturition. Journal of Wildlife Management 65:77-92.

Begich, R.N., and J.A. Pawluk. 2011. 2008-2010 Recreational fisheries overview and historical information for North Kenai Peninsula: fisheries under consideration by the Alaska Board of Fisheries, February 2011. Alaska Department of Fish and Game, Fishery Management Report No. 10-51, Anchorage.

Bendock, T.N. and J. Burr. 1984. Freshwater fish distributions in the Central Arctic Coastal Plain (Ikpikpuk River to Colville River). Alaska Department of Fish and Game, Sport Fish Division, Fairbanks, AK. 52p.

Bendock, T.N. and J.M. Burr. 1986. Arctic Area Trout Studies. Federal Aid in Fish Restoration and Anadromous Fish Studies, 1985-1986, Volume 27, Study T-7-1, Alaska Department of Fish and Game, Sport Fish Division, Juneau, AK. 75p.

Bertram, M.R. and M.T. Vivion. 2002. Moose mortality in eastern Interior Alaska. Journal of Wildlife Management 66(3): 747-756.

BLM (Bureau of Land Management). 1987a. Branch of Pipeline Monitoring Open File Report TAPS Fish Streams, Alaska State Office, Division of Minerals, Branch of Pipeline Monitoring, Anchorage, Alaska.

BLM (Bureau of Land Management). 1987b, Zones of Restricted Activity for Protection of Key Fish Areas along TAPS on Federally Administered Lands, Alaska State Office, Division of Minerals, Branch of Pipeline Monitoring, Anchorage, Alaska.

BLM (Bureau of Land Management). 1989. Utility Corridor Proposed Resource Management Plan and Final Environmental Impact Statement. BLM-AK-PT90-002-1610-060. Arctic District Office. Fairbanks, Alaska. Available online at https://www.blm.gov/epl-front-office/projects/lup/35315/44183/47566/Utility_Corridor_PRMP_FEIS_final_web.pdf. Accessed October 30, 2014.

BLM (Bureau of Land Management). 1998. Northeast National Petroleum Reserve- Alaska, Final Integrated Activity Plan/ Environmental Impact Statement, Vols. 1 and 2, U.S. Department of the Interior, Anchorage, Alaska. Available at http://www.blm.gov/ak/st/en/prog/planning/npra_general/ne_npra/ne_npr-a_1998_iap.html. Accessed October 30, 2014.

BLM (Bureau of Land Management). 2004. Alpine Satellite Development Plan Record of Decision. November 2004. BLM/AK/PL-05/002+3130+931. U.S. Department of the Interior, Bureau of Land Management. Available online at http://www.blm.gov/eis/AK/alpine/pdf/rod.pdf. Accessed December 5, 2014.

BLM (Bureau of Land Management). 2010. Alaska instruction memorandum No. AK-2010-018, BLM-Alaska revised sensitive species lists, May 18, 2010.

BLM (Bureau of Land Management). 2014. Supplemental Environmental Impact Statement for the Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth One Development Project. Prepared by U.S. Department of the Interior Bureau of Land Management Anchorage, Alaska.

Boertje, R. D. 1985. Seasonal activity of the Denali caribou herd, Alaska. Rangifer 5(2):32-42.

Boggs, K. T. V. Boucher, T. T. Kuo, D. Fehringer, and S. Guyer. 2012. Vegetation map and classification: Northern, Western, and Interior Alaska. Alaska Natural Heritage Program, University of Alaska Anchorage, Alaska. 88pgs.

Bolt, J.L., and L.J. Haldorson. 2003. Seasonal and geographic variation in juvenile pink salmon diets in the northern Gulf of Alaska and Prince William Sound. Transactions of the American Fisheries Society 132:1035-1052.

Boveng, P.L., J.L. Bengtson, T.W. Buckley, M.F. Cameron, S.P. Dahle, B.P. Kelly, B.A. Megrey, J.E. Overland, and N.J. Williamson. 2009. Status review of the spotted seal (*Phoca largha*). U.S. Department of Commerce, NOAA Technical Memorandum NMFS–AFSC–200.

Brewer, D., A. Diamond, E. J. Woodsworth, B. T. Collins, and E. H. Dunn. 2000. Canadian atlas of bird banding, Volume 1: doves, cuckoos, and hummingbirds through passerines, 1921–1995. Special Publication, Canadian Wildlife Service, Ottawa, Ontario, Canada. 395 pp.

Broad, A.C., H. Koch, D.T. Mason, G.M. Petri, D.E Schneider, and R.J. Taylor. 1978. Reconnaissance characterization of littoral biota, Beaufort and chukchi Seas. In: Environmental Assessment of the Alaskan Continental Shelf: Principal Investigators' Reports for the Year Ending March 1978. Boulder, CO: National Oceanic and Atmospheric Administration. 5:1-84.

Broad, A.C., A. Benedict, K.H. Dunton, H. Koch, D.T. Mason, D.E. Schneider, and S.V. Schonberg. 1979. Environmental Assessment of Selected Habitats in the Beaufort and Chukchi Seas Littoral System. In: Environmental Assessment of the Alaskan Continental Shelf: Principal Investigators' Reports for the Year Ending March 31, 1979. Boulder, CO: National Oceanic and Atmospheric Administration. 3:361-542.

Broad, A.C., H. Koch, D.T. Mason, D.M. Petri, D.E Schneider, and E.J. Taylor. 1981. Environmental Assessment of Selected Habitats in the Beaufort Sea Littoral System. Environmental Assessment of the Alaskan Continental Shelf: Principal Investigators' Reports for the Year Ending March 31, 1981 (Vol. 1). Boulder, CO and Anchorage, AK: USDOC, NOAA, OCSEAP and USDOI, BLM, pp. 401-620.

Brown, R.J. 2006. Humpback Whitefish *Coregonus pidschian* of the Upper Tanana River Drainage. Alaska Fisheries Technical Report No. 90. April 2006. U.S. Fish and Wildlife Service, Fairbanks, Alaska. 43 pp.

Brown, S., J. Bart, R. B. Lanctot, J. A. Johnson, S. Kendall, D. Payer, and J. Johnson. 2007. Shorebird abundance and distribution on the coastal plain of the Arctic Wildlife Refuge. Condor 109:1–14.

Bruning, D.L. 2012. Unit 20D bison. Pages 28-54 in Alaska Department of Fish and Game, P. Harper, editor. Bison management report of survey and inventory activities, 1 July 2009-20 June 2011. Species Management Report ADF&G/DWC/SMR-2012-1, Juneau, Alaska.

Busdosh, C.L. Beehler, G.A. Robilliard, and K.R. Tarbox. 1985. Distribution and Abundance of Kelp in the Alaskan Beaufort Sea near Prudhoe Bay. Arctic 38(1): 18-22.

Caikoski, J.R. 2011. Units 25A, 25B, 26D, and 26C caribou. Pages 251-270 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game. Project 3.0. Juneau, Alaska.

Caikoski, J.R. 2014. Memorandum: 2013 Surveys of the Porcupine Caribou Herd – parturition, post-calving and photocensus. February 5, 2014. Department of Fish and Game, Division of Wildlife Conservation, Fairbanks, Alaska.

Cameron, R.D., W.T. Smith, R.G. White, and B. Griffith. 2005. Central Arctic caribou and petroleum development: distributional, nutritional, and reproductive implications. Arctic 58(1):1-9.

Cameron, M.F., J.L. Bengtson, P.L. Boveng, J.K. Jansen, B.P. Kelly, S.P. Dahle, E.A. Logerwell, J.E. Overland, C.L. Sabine, G.T. Waring, and J.M. Wilder. 2010. Status review of the bearded seal

(*Erignathus barbatus*). U.S. Department of Commerce, NOAA Technical Memorandum No. NMFS-AFSC-211.

Cannon, T.C., B.A. Adams, D. Glass, and T. Nelson. 1987. Fish distribution and abundance. Endicott Environmental Monitoring Program, 1985. Volume 6. Prepared by Envirosphere Company for Alaska District U.S. Army Corps of Engineers, Anchorage, AK. 129p.

Carroll, A. B., C. Parker, T. Craig. 2003. Toolik Lake Research Natural Area/ACEC Rare Plant Inventory, 2002. U.S. Department of the Interior, Bureau of Land Management, Alaska State Office, BLM/AK/ST-03/010+6700+025. July 2003.

Celewycz, A.G. and A.C. Wertheimer. 1993. Distribution, abundance, size, and growth of juvenile pink and chum salmon in western Prince William Sound after the Exxon Valdez oil spill. Chapter 2 of Impact of the Oil Spill on Juvenile Pink and Chum Salmon and Their Prey in Critical Nearshore Habitats. Fisheries Study Number 4. Natural Resource Damage Assessment Final Report. Auke Bay Laboratory, National Marine Fisheries Service, NOAA. Juneau, Alaska. 52 p.

CIRCAC (Cook Inlet Regional Citizens Advisory Council). 2010. Integrated Cook Inlet Environmental Monitoring and Assessment Program. Draft Report, March 2010. Cook Inlet Regional Citizens Advisory Council, Kenai, Alaska.

Clough, N. K., P. C. Patton, and A. C. Christiansen, editors. 1987. Arctic National Wildlife Refuge, Alaska, coastal plain resource assessment - report and recommendation to the Congress of the United States and final legislative environmental impact statement. U.S. Fish and Wildlife Service, U.S. Geological Survey, and Bureau of Land Management, Washington D. C.

Colonell, J.M. and B.J. Gallaway. 1997. Wind-driven transport and dispersion of age-0 arctic ciscoes along the Alaskan Beaufort coast. Pages 90-103 in J. Reynolds, editor. Fish ecology in arctic North America. American Fisheries Society Symposium 19, Bethesda, MD.

Conant, B., D.J. Groves, and R.M. Platte. 2007. A comparative analysis of waterfowl breeding population surveys over tundra habitats in Alaska. U.S. Fish and Wildlife Service. Available online at http://www.fws.gov/alaska/mbsp/mbm/waterfowl/surveys/pdf/TundraAnalysisRept.pdf. Accessed October 30, 2014.

Conant, B. J. I. Hodges, D. J. Groves, J. G. King. 2007b. The 2005 Census of trumpeter swans on Alaska nesting habitats. U.S. Fish and Wildlife Service, Waterfowl Management, Juneau, Alaska.

Cooney, R., D. Urquhart, and D. Barnard. 1981. The behavior, feeding biology, and growth of hatchery released pink and chum salmon fry in Prince William Sound, Alaska Report No. 81-5. Alaska Sea Grant College Program, University of Alaska Fairbanks. Fairbanks, Alaska. 71p.

Cortes-Burns, H., M. L. Carlson, R. Lipkin, L. Flagstad, and D. Yokel. 2009. Rare vascular plants of the North Slope, a review of the taxonomy, distribution, and ecology of 31 rare plant taxa that occur in Alaska's North Slope region. U.S. Department of the Interior, Bureau of Land Management, BLM/AK/GI-10/002+6518+F030, December 2009.

Craig, P.C. 1984. Fish Use of Coastal Waters of the Alaskan Beaufort Sea: A Review, Transactions of the American Fisheries Society 113:265−282.

Craig, P.C. 1989. Subsistence Fisheries at Coastal Villages in the Alaskan Arctic, 1970−1986, Biological Papers of the University of Alaska 24:131−152, Anchorage, Alaska.

Craig, P.C. and G.J. Mann. 1974. Life History and Distribution of Arctic Cisco (*Coregonus autumnalis*) along the Beaufort Sea Coastline in Alaska and the Yukon Territory, Arctic Gas Biological Report Series 20, Canadian Arctic Gas Study Limited et al.

Craig, P.C, and P. McCart. 1974. Fall spawning and overwintering areas of fish populations along routes of proposed pipeline between Prudhoe Bay, Alaska, and the Mackenzie Delta 1972-1973. Arctic Gas Biol. Rep. Ser. 15. 36pp.

Craig, P. C. and C. Hamfler. 2003. Survey of cliff-nesting raptors, Dalton Highway Management Unit, Alaska, 1999-2002. U.S. Bureau of Land Management, Alaska State Office, Anchorage, AK. BLM/AK/ST-03/009+6501+024. September 2003. http://www.blm.gov/pgdata/etc/medialib/blm/ak/aktest/ofr.Par.39052.File.dat/OFR%2089.pdf

Craig, T. and P. Leonard. 2009. Bureau of Land Management (BLM). Dall Sheep Use of Areas of Critical Environmental Concern in the Utility Corridor Management Area, Alaska.BLM Alaska Open File Report 114. Available online at https://www.blm.gov/epl-front-office/projects/lup/35315/48429/52593/Dall_Sheep_ACEC_Utility_Corridor_Alaska.pdf. Accessed October 30, 2014.

Cronin, M.A., B.J. Pierson, S.R. Johnson, L.E. Noel, and W.B. Ballard. 1997. Caribou population density in the Prudhoe Bay region of Alaska. Journal of Wildlife Research 2:59–68.

Cronin, M.A., H.A. Whitlaw, and W.B. Ballard. 2000. Northern Alaska oilfields and caribou. Wildlife Society Bulletin 28:919–922.

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

Delarue, J., B. Martin, D. Hannay, and C.L. Berchok. 2013. Acoustic occurrence and affiliation of fin whales detected in the northeastern Chukchi Sea, July to October 2007–2010. Arctic 66:159–172.

DeMaster, D.P. and I. Stirling. 1981. *Ursus maritimus*. Polar bear. Mammalian Species 145:1–7.

Densmore, R. V., C. R. Ely, K. S. Bollinger, S. Kratzer, M. S.Udevitz, D. J. Fehringer, T. C. Rothe. 2006. Nesting habitats of the Tule Greater white-fronted goose Anser albifrons elgasi. Wildfowl 56:37-51.

Dunton, K.H and S.V. Schonberg. 2000. The Benthic Faunal Assemblage of the Boulder Patch Kelp Community. In: Truett, J. C., and Johnson S.R. (eds.) The Natural History of an Arctic Oil Field. Academic Press. pp 371-397.

Durner, G.M., S.C. Amstrup, and K.J. Ambrosius. 2001. Remote identification of polar bear maternal den habitat in northern Alaska. Arctic 54(2):115–121.

Durner, G.M., S.C. Amstrup, and A.S. Fischbach. 2003. Habitat characteristics of polar bear terrestrial maternal den sites in northern Alaska. Arctic 56(1):55–62.

Durner, G.M., S.C. Amstrup, R. Neilson, and T. McDonald. 2004. The Use of Sea Ice Habitat by Female Polar Bears in the Beaufort Sea. U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska. OCS study, MMS 2004-014.

Durner, G.M., S.C. Amstrup, and K.J. Ambrosius. 2006. Polar bear maternal den habitat in the Arctic National Wildlife Refuge, Alaska. Arctic 59(1):31-36.

Earnst, S.L. 2004. Status Assessment and Conservation Plan for the Yellow-billed loon (*Gavia adamsii*). U.S. Geological Survey, Scientific Investigations Report 2004-5258. 42 pp.

EPA (Envrionmental Protection Agency). 2010. Level III Ecoregions of Alaska. Western Ecology Division, U.S. Environmental Protection Agency. Available online at http://www.epa.gov/wed/pages/ecoregions/ak_eco.htm. Accessed December 5, 2014.

Fechhelm, R.G., and D.B. Fissel. 1988. Wind-aided recruitment of Canadian arctic cisco (*Coregonus autumnalis*) into Alaskan waters. Canadian Journal of Fisheries and Aquatic Science 45:906-910.

Fechhelm, R.G. and W.B. Griffiths. 1990. The effect of wind on the recruitment of Canadian arctic cisco (*Coregonus autumnalis*) into the central Alaskan Beaufort Seas. Canadian Journal of Fisheries and Aquatic Sciences 47(11):2164-2171.

Fechhelm, R.G., J.D. Bryan, W.B. Griffiths, W.J. Wilson and B.J. Gallaway. 1994. Effect of coastal winds on the summer dispersal of young least cisco (*Coregonus sardinella*) from the Colville River to Prudhoe Bay, Alaska: a simulation model. Can. J. Fish. Aquatic Sci. 51(4):890-899.

Fechhelm, R.G., W.J. Wilson, W.B. Griffiths, T.B. Stables, and D.A. Marino. 1999. Forage fish assessment in Cook Inlet oil and gas development areas, 1997-1998. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, and BioSonics, Inc., Seattle, WA, for USDOI, Minerals Management Service, Anchorage, AK.

Fechhelm, R.G., C.L. Ziokowski, N.D. Jahns and M.R. Link. 2011. Year 29 of the long-term monitoring of nearshore Beaufort Sea fishes in the Prudhoe Bay region: 2011 annual report. Report for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc. Anchorage, AK. 76p.

Ferguson, S.H., M.K. Taylor, and F. Messier. 2000. Influence of sea ice dynamics on habitat selection by polar bears. Ecology 81:761–772.

Fischbach, A.S., S.C. Amstrup and D.C. Douglas. 2007. Landward and eastward shift of Alaskan polar bear denning associated with recent ice changes. Polar Biology 30:1395-1405. DOI 10.1007/s00300-007-0300-4.

Fox, J., and P. Shields. 2005. Upper Cook Inlet Commercial Fisheries Annual Management Report, 2004. Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries. Juneau, Alaska.

Fredrickson, L.H. 2001. Steller's Eider (*Polysticta stelleri*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/571 doi:10.2173/bna.571. Accessed October 13, 2014.

Fritts, E.I. 2007. Wildlife and people at risk: a plan to keep rats out of Alaska. Alaska Department of Fish and Game. October, 2007.

Frost, K.J. 1985. Unpubl. rep. The ringed seal. Alaska Dep. Fish and Game, Fairbanks.

Fruge, D.J., D.W. Wiswar, L.J. Dugan, and D.E. Palmer. 1989. Fish population characteristics of Arctic National Wildlife Refuge coastal waters, summer 1988. U.S. Fish and Wildl. Serv., Fairbanks, AK. 69pp.

Gallant, A. L. E. F. Binnian, J. M. Omernik, and M. B. Shasby. 1995. Ecoregions of Alaska. U.S. Department of the Interior, U. S. Geological Survey Professional paper 1567.

Gallaway, B.J., W.B. Griffiths, P.C. Craig, W.J. Gazey, and J.W. Helmericks. 1983. An assessment of the Colville River delta stock of arctic cisco -- migrants from Canada? Biological Papers of the University of Alaska 21:4-23.

Gallaway, B.J., W.J. Gazey and L.L. Moulton. 1989. Population trends for the arctic cisco (*Coregonus autumnalis*) in the Colville River of Alaska as reflected by the commercial fishery. Biological Papers of the University of Alaska 24:153-165.

Garlich-Miller, J., J.G. MacCracken, J. Snyder, R. Meehan, M. Myers, J.M. Wilder, E. Lance, and A. Matz. 2011. Status review of the Pacific walrus (*Odobenus rosmarus divergens*). January 2011. U.S. Fish and Wildlife Service, Marine Mammals Management, Anchorage, AK. 163 p.

Glass, D., C. Whitmus, and M. Prewitt. 1990. Fish distribution and abundance. Vol. 5, Chap. 1, Part IV. In Endicott Environmental Monitoring Program., final reports, 1986. Unpublished rep. Available at U.S. Army Corps of Eng., Anchorage, AK. 154pp. + append.

Gotthardt, T.A. and A. Jansen. 2006. Lugworm (*Abarenicola pacifica*). State Conservation Status, Element Ecology and Life History. Alaska Natural heritage Program, University of Alaska Anchorage. Available online at http://www.adfg.Alaska.gov/static/species/speciesinfo/_aknhp/Lugworm.pdf. Accessed October 2, 2014.

Gotthardt, T.A., K.M. Walton, and T.L. Fields. 2012. Setting priorities for Alaska's Wildlife Action Plan. Alaska Natural Heritage Program, University of Alaska Anchorage, AK. 46 pp.

Graham, E. and T. Heutte (editors). 2014. Forest Health Conditions in Alaska 2013. Forest Health Protection Report R10-PR-035. U.S. Department of Agrigulture, Forest Service, Alaska Region. Anchorage, Alaska 81 pp. Available online at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3797075.pdf. Accessed November 12, 2014.

Griffiths, W.B. 1983. Fish, pp. 325−368 in Environmental Characterization and Biological Use of Lagoons in the Eastern Beaufort Sea, prepared by LGL Ecological Research Associates, Inc., for NOAA/OCSEAP Office of Marine Pollution Assessment, Juneau, Alaska.

Griffiths, W.B., P.C. Craig, G.L. Walder, and G.J. Mann. 1975. Fisheries investigations in the coastal region of the Beaufort Sea (Nunaluk Lagoon, N.W.T.). Arctic Gas Biol. Rep. Ser. 34. 219pp.

Griffiths, W.B., J. DenBeste, and P. Craig. 1977. Fisheries investigations in a coastal region of the Beaufort Sea (Kaktovik Lagoon, Barter Island, Alaska). Arctic Gas Biol. Rep. Ser. 40. 190pp.

Griffiths, W.B., D.R. Schmidt, R.G. Fechhelm, and B.J. Gallaway. 1983. Fish ecology, volume III in B.J. Gallaway and R. Britch, editors. Environmental Summer Studies (1982) for the Endicott Development. Report by LGL Alaska Research Associates, Inc. and Northern Technical Services for Sohio Alaska Petroleum Company, Anchorage, Alaska. 323p.

Griffiths, W.B., R.G. Fechhelm, L.R. Martin, and W.J. Wilson. 1996. The 1995 Endicott Development fish monitoring program. Vol. I: Fish and hydrography data report. Unpublished rep. Sponsored by BP Exploration (Alaska) Inc., Anchorage, AK 99519. 180pp. + append.

Gustafson, R.L., and W.R. Bechtol. 2005. Kachemak Bay small-mesh trawl survey, 2000. Alaska Department of Fish and Game, Fishery Data Series No. 05-54, Anchorage, AK.

Hannay, D.E., J. Delarue, X. Mouy, B.S. Martin, D. Leary, J.N. Oswald, and J. Vallarta. 2013. Marine mammal acoustic detections in the northeastern Chukchi Sea, September 2007–July 2011. Continental Shelf Research 67:127–146.

Hansen, D.J., and J.D. Hubbard. 1999. Distribution of Cook Inlet beluga whales (Delphinapterus leucas) in winter. Final Rep. OCS Study. MMS 99-0024. U.S. Department of the Interior, Minerals Management Service. Alaska OCS Region, Anchorage, AK.

Hart, J.C. 1973. Pacific fishes of Canada. Fish. Res. Board Can. Bull. 180.

Hasbrouck, J.J., and J.A. Edmundson. 2005. Escapement goals for salmon stocks in Upper Cook Inlet, Alaska. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries, Anchorage, AK.

Heard, W.R. 1991. Life history of pink salmon (*Oncorhynchus gorbuscha*). In: C. Groot and L Margolis (eds.). Pacific Salmon Life Histories. UBC Press. Vancouver, British Columbia. p. 119-230.

Hebert P.D.N., and J. Wearing-Wilde. editors. 2002. Canada's Polar Life [Internet]. CyberNatural Software, University of Guelph. Revised 2002. Available online at www.polarlife.ca. Accessed November 21, 2014.

Hobbs, R. C., K. L. Laidre, D. J. Vos, B. A. Mahoney, and M. Eagleton. 2005. Movements and Area Use of Belugas, *Delphinapterus leucas*, in a Subarctic Alaskan Estuary. Arctic 58(4), 331-340.

Hobbs, R. C., C. L. Sims, and K. E. W Shelden. 2012. Estimated abundance of belugas in Cook Inlet, Alaska, from aerial surveys conducted in June 2012. NMFS, NMML Unpublished Report. Available online at

http://alaskafisheries.noaa.gov/protectedresources/whales/beluga/abundance/2012estimates.pdf. Accessed October 13, 2014.

Homer, C., Huang, C., Yang, L., Wylie, B., and Coan, M. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, Vol. 70, No. 7, July 2004, pp. 829-840.

Hollis, A.L. 2010. Units 20C, 20F, and 25C moose. Pages 366-379 in P. Harper, ed. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Hollis, A.L. 2011. Units 20F, 21B, 21C, 21D, 24A, 24B, and 25D caribou. Pages 171-186 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska department of Fish and Game. Project 3.0. Juneau, Alaska.

Holsten, E., P. Hennon, L. Trummer, J. Kruse, M. Schultz, J. Lundquist. 2008. Insects and Diseases of Alaskan Forests. U.S. Department of Agriculture, Forest Service, Alaska Region, State and Private Forestry, Forest Health Protection. R10-TP-140. 248 p. illus.

Houghton, J. 2012. 2011 West Dock Marine Sampling Program – Marine Sediment, Water Quality, and Biological Sampling. Alaska Pipeline Project. May 23, 2012. USAG-UR-SRWDF-000010.

Houghton, J., J. Starkes, M. Chambers, and D. Ormerod. 2005a. Marine fish and benthos studies in Knik Arm, Anchorage, Alaska. Report prepared for the Knik Arm Bridge and Toll Authority, and HDR Alaska, Inc., Anchorage, AK, by Pentec Environmental, Edmonds, WA.

Houghton, J., Starkes, M. Chambers, and D. Ormerod. 2005b. 2004-2005 marine fish and benthos studies-Port of Anchorage, Anchorage, Alaska. Report prepared by Pentec Environmental, Edmonds, WA, for Integrated Concepts and Research Corporation.

Howe, A.L., et al. 1998. Harvest, Catch and Participation in Alaska Sport Fisheries during 1997, Fisheries Data Series 98-25, Alaska Department of Fish and Game, Division of Sport Fish, Anchorage, AK.

Huryn, A. and J. Hobbie. 2012. Land of Extremes: A Natural History of the Arctic North Slope of Alaska. University of Alaska Press, Fairbanks, Alaska. 311 pp.

Ireland, D.S., R. Rodrigues, D. Funk, W. Koski, D. Hannay. (eds.) 2009. Marine mammal monitoring and mitigation during open water seismic exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July–October 2008: 90-day report. LGL Rep. P1049-1. Rep. from LGL Alaska Research Associates Inc., LGL Ltd., and JASCO Research Ltd. for Shell Offshore Inc, Nat. Mar. Fish. Serv., and U.S. Fish and Wild. Serv. 277 pp, plus appendices.

Ivey, S. S. and D. Sweet. 2004. Recreational fisheries of Northern Cook Inlet, 2003-2004: Report to the Alaska Board of Fisheries, January 2005. Fishery Management Report No. 04-18. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries. Juneau, Alaska.

Jansen, A. and T.A. Gotthardt. 2005. Baltic Macoma (*Macoma balthica*). State Conservation Status, Element Ecology and Life History. Alaska Natural heritage Program, University of Alaska

Anchorage. Available online at http://www.adfg.Alaska.gov/static/species/speciesinfo/_aknhp/Marine_Clam.pdf. Accessed October 2, 2014.

Jay, C.V., A.S. Fischbach, and A.A. Kochnev. 2012. Walrus areas of use in the Chukchi Sea during sparse sea ice cover. Marine Ecology Progress Series 468:1–13.

Johnson, C.B., J.P. Parrett, and P.E. Seiser. 2008. Spectacled eider monitoring at the CD-3 Development, 2007. Prepared for ConocoPhillips Alaska, Inc. and Anadarko Petroleum Corporation by ABR, Inc.-Environmental Research & Services, Fairbanks, AK. 51 p.

Johnson, C. B., B.E. Lawhead, and A.M. Wildman. 2011. Draft Biological Assessment of the Polar Bear (*Ursus maritimus*), Spectacled Eider (*Somateria fischeri*), Steller's Eider (*Polysticta stelleri*), and Yellow-Billed Loon (*Gavia adamsii*). October 2011. Prepared for ExxonMobil Point Thomson Project North Slope, Alaska by ABR, Inc.—Environmental Research and Services (Fairbanks and Anchorage, AK), and URS Corporation (Anchorage, AK).

Johnson, J. A., R. B. Lanctot, B. A. Andres, J. R. Bart, S. C. Brown, S. J. Kendall, and D. C. Payer. 2007. Distribution of breeding shorebirds on the Arctic Coastal Plain of Alaska. Arctic 60:277–293.

Johnson, S.R. and D.R. Herter. 1989. The Birds of the Beaufort Sea. British Petroleum Exploration Inc. Anchorage, AK. 372 p.

Joly, K., D.R. Klein, D.L. Verbyla, T.S. Rupp, and F.S. Chapin III. 2011. Linkages between large-scale climate patterns and the dynamics of Arctic caribou populations. Ecography 34:345-352.

Kelly, B.P. 1988. Ringed seal, *Phoca hispida*. Pages 57-75 in J. W. Lentifer, editor. Selected Marine Mammal Species of Alaska: Species Accounts with Research and Management Recommendations. Marine Mammal Commission, Washington, D.C.

Kessel, B., and D.D. Gibson. 1978. Status and Distribution of Alaska Birds. Studies in Avian Biology No. 1. The Cooper Ornithological Society. Allen Press, Inc., Lawrence Kansas. 108 pp.

Laidre, K. L., K. E. W. Shelden, D. J. Rugh, and B. Mahoney. 2000. Beluga, *Delphinapterus leucas*, distribution and survey effort in the Gulf of Alaska. Mar. Fish. Rev. 62(3):27-36.

Larned, W.W. 2006. Winter distribution and abundance of Steller's eiders (*Polysticta stelleri*) in Cook Inlet, Alaska, 2004-2005. Final Report December 2006. OCS Study MMS 2009-66. Prepared for U.S. Department of Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, Environmental Studies Section. Anchorage, AK. Available online at http://www.fws.gov/alaska/mbsp/mbm/waterfowl/surveys/pdf/cistei_report.pdf. Accessed October 11, 2014.

Larned, W.W. 2012. Steller's eider spring migration surveys, Southwest Alaska 2012. U.S. Fish and Wildlife Service, Waterfowl Management, Soldotna, Alaska. Available online at http://www.fws.gov/alaska/mbsp/mbm/waterfowl/surveys/pdf/swstrpt12 .pdf. Accessed October 11, 2014.

Lees, D.C., W.B. Driskell, J.R. Payne, and M.O. Hayes. 2013. CIRCAC Intertidal Reconnaissance Survey in Middle and Upper Cook Inlet. Draft Report. December 2013. Prepared for Cook Inlet Regional Citizens Advisory Council, Kenai, Alaska. 250 pp + Appendices.

Lenart, E.A. 2003. Units 26B and 26C muskox. Pages 54-71 in C. Healy, ed. Muskox management report of survey and inventory activities 1 July 2000–30 June 2002. Alaska Department of Fish and Game. Project 16.0. Juneau, Alaska.

Lenart, E.A. 2010. Units 26B and 26C moose. Pages 666-684 in P. Harper, ed. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Lenart, E.A. 2011a. Units 26B and 26C caribou. Pages 315-345 in P. Harper, ed. Caribou management report of survey and inventory activities 1 July 2008–30 June 2010. Alaska Department of Fish and Game. Project 3.0. Juneau, Alaska.

Lenart, E.A. 2011b. Units 26B and 26C muskox. Pages 63-84 in P. Harper, ed. Muskox management report of survey and inventory activities 1 July 2008–30 June 2010. Alaska Department of Fish and Game. Project 16.0. Juneau, Alaska.

Lenart, E.A. 2014. 2013 Central Arctic Caribou Photocensus Results. August 3, 2013 Memorandum. To Doreen Parker McNeil, Management Coordinator, Region III, from E.A. Lenart, Northeast Alaska Area Wildlife Biologist, Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks, Alaska. 7 pp.

Lent, P.C. 1998. Alaska's indigenous muskoxen: a history. Rangifer 18:133-144.

LGL Alaska (LGL Alaska Research Associates, Inc.). 1992. The 1990 Endicott Development Fish Monitoring Program. Vol. II: Analysis of Fyke Net Data. Anchorage, AK. Report for BP Exploration (Alaska) Inc. and North Slope Borough. 160 p.

LGL Alaska (LGL Alaska Research Associates, Inc.). 1993. The 1991 Endicott Development Fish Monitoring Program. Vol. III: Analysis of Fyke Net Data. Anchorage, AK. Report for BP Exploration (Alaska) Inc. and North Slope Borough. 189 p. + appendices.

LGL Alaska (LGL Alaska Research Associates, Inc.). 1994a. The 1992 Endicott Development Fish Monitoring Program. Vol. I: Analysis of Fyke Net Data. Anchorage, AK. Report for BP Exploration (Alaska) Inc. and North Slope Borough. 195 p. + appendices.

LGL Alaska (LGL Alaska Research Associates, Inc.). 1994b. The 1993 Endicott Development Fish Monitoring Program: Vol. I. Fish and hydrography data report. Prepared by LGL Alaska Research Associates, Inc. to BP Exploration (Alaska) Inc., Anchorage, and North Slope Borough, Barrow, AK. 217p.

Lipkin, R. and C. Parker. 1995. Rare Vascular Plants of the BLM Dalton Highway Corridor. Alaska Natural Heritage Program, University of Alaska, Anchorage and University of Alaska Museum Fairbanks. Available online at http://aknhp.uaa.alaska.edu/big-files/Botany/Publications/1995/Rare_Vascular_Plants_of_BLM_Dalton_Highway.pdf. Accessed October 30, 2014.

Logerwell, E., K. Rand, S. Parker-Stetter, J. Horne, T. Weingartner, and B. Bluhm. 2010. Beaufort Sea marine fish monitoring 2008: Pilot survey and test of hypotheses. Final Report prepared for USDOI/MMS BOEMRE 2010-08. Alaska Fisheries Science Center, NOAA/NMFS, Seattle, WA.

MacDonald, S.O., and J.A. Cook. 2009. Recent Mammals of Alaska. University of Alaska Press, Fairbanks, Alaska. 387 pp.

McClory, J.G. and T.A. Gotthardt. 2005a. Arrow Worm (*Sagitta elegans*). State Conservation Status, Element Ecology and Life History. Alaska Natural heritage Program, University of Alaska Anchorage.Available online at http://www.adfg.Alaska.gov/static/species/speciesinfo/_aknhp/Arrow_Worm.pdf. Accessed October 2, 2014.

McClory, J.G. and T.A. Gotthardt. 2005b. Sitka Periwinkle (*Littorina sitkana*). State Conservation Status, Element Ecology and Life History. Alaska Natural heritage Program, University of Alaska Anchorage. Available online at http://www.adfg.Alaska.gov/static/species/speciesinfo/_aknhp/Sitka_periwinkle.pdf. Accessed October 2, 2014.

McClory, J.G. and T.A. Gotthardt. 2006a. Eskimo Arctic (*Oeneis alpine*). State Conservation Status, Element Ecology and Life History. Alaska Natural heritage Program, University of Alaska Anchorage. Available online at http://www.adfg.Alaska.gov/static/species/speciesinfo/_aknhp/Eskimo_Arctic.pdf. Accessed October 2, 2014.

McClory, J.G. and T.A. Gotthardt. 2006b. Treeline Emerald (Somatochlora sahlbergi). State Conservation Status, Element Ecology and Life History. Alaska Natural heritage Program, University of Alaska Anchorage. Available online at http://www.adfg.Alaska.gov/static/species/speciesinfo/_aknhp/Treeline_Emerald.pdf. Accessed October 2, 2014.

McDonough, T. 2011. Units 7 and 15 caribou management report. Pages 1-10 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game Juneau, Alaska.

Mecklenburg, C.W., T.A. Mecklenburg, and L.K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, MD. 1037 p.

Mills, M.J. 1986. Alaska statewide sport fish harvest studies- 1985 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies. Annual Performance Report 1985–1986. Project F-10-1, 27 (RT-2), Juneau, AK.

Moulton, L.L. 1989. Recruitment of arctic cisco (*Coregonus autumnalis*) into the Colville Delta, Alaska, in 1985. Biological Papers of the University of Alaska 24:107-111.

Moulton, L.L. 1994. The 1993 Colville River Fishery. The 1993 Endicott Development Fish Monitoring. Vol. II. Report by MJM Research to BP Exploration (Alaska) Inc. and North Slope Borough. 60 p. + appendices.

Moulton, L.L. 1995. The 1994 Colville River Fishery. The 1994 Endicott Development Fish Monitoring Program. Volume II. Compiled by LGL Alaska Research Assoc. for BP Exploration (Alaska) Inc., Anchorage, and North Slope Borough, Barrow, AK. 53p. + appendices.

Moulton, L.L. 1997. Early marine residence, growth, and feeding by juvenile salmon in northern Cook Inlet. Alaska Fisheries Research Bulletin 4(2):154-177.

Moulton, L.L., and L.J. Field, 1988. Assessment of the Colville River Fall Fishery 1985 − 1987, prepared by Environmental Sciences and Engineering Inc. for ARCO Alaska, Inc., Anchorage, Alaska.

Moulton, L.L., and L.J. Field, 1991. The 1989 Colville River Fishery; the 1989 Endicott Development Fish Monitoring Program, Vol. III, prepared by MJM Research for BP Exploration (Alaska), Inc., Anchorage, Alaska.

Moulton, L.L., and L.J. Field, 1994. The 1992 Colville River Fishery; the 1992 Endicott Development Fish Monitoring Program, Vol. II, prepared by MJM Research for BP Exploration (Alaska), Inc., Anchorage, Alaska.

Moulton, L.L., B.J. Gallaway, M.H. Fawcett, W.B. Griffiths, K.R. Critchlow, R.G. Fechhelm, D.R. Schmidt, and J.S. Baker. 1986. 1984 Central Beaufort Sea Fish Study. Chapter 3. Prudhoe Bay Waterflood Project Environmental Monitoring Program 1984. Prepared by Woodward-Clyde Consultants, Entrix and LGL Ecological Research Associates for Dept. of the Army Alaska District, Corps of Engineers. Anchorage, AK. 322 p.

Moulton, L.L., L.C. Lestelle and L.J. Field. 1992. The 1991 Colville River Fishery. The 1991 Endicott Development Fish Monitoring. Vol. IV. Report by MJM Research to BP Exploration (Alaska) Inc. and North Slope Borough. 58 p. + appendices.

Moulton, L.L., W.A. Morris, J.C. George, J. Bacon, and M. Whitman. 2011. Surveys of fish in the Chipp River region during 1993-1995 and 2008. Prepared by MJM Research for North Slope Borough Department of Wildlife Management. Lopez Island, WA.

NatureServe. 2014. Comprehensive Report Species, *Anodonta beringiana*, Yukon Floater. http://explorer.natureserve.org/servlet/NatureServe?sourceTemplate=tabular_report.wmt&loadTe. Accessed October 27, 2014.

Nawrocki, T., H. Klein, M. Carlson, L. Flagstad, J. Conn, R. DeVelice, A. Grant, G. Graziano, B. Million, and W. Rapp. 2011. Invasiveness Ranking of 50 Non-Native Plant Species for Alaska. Available online at http://aknhp.uaa.alaska.edu/wp-content/uploads/2011/09/Invasiveness-Ranking-of-50-Non-Native-Plant-Species-for-Alaska_Online-Size_012012.pdf). Accessed November 21, 2014.

Nawrocki, T., J. Fulkerson, and M. Carlson. 2013. Alaska Rare Plant Field Guide. Alaska Natural Heritage Program, University of Alaska Anchorage. 352 pp. Available online at http://aknhp.uaa.alaska.edu/botany/alaska-rare-plant-field-guide/#content. Accessed November 19, 2014.

NMFS (National Marine Fisheries Service). 2005. Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. Alaska Region.

NMFS (National Marine Fisheries Service). 2008. Conservation Plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). National Marine Fisheries Service, Juneau, Alaska. Available online at http://www.alaskafisheries.noaa.gov/protectedresouces/whales/beluga/managment.htm. Accessed October 13, 2014.

NMFS (National Marine Fisheries Service). 2011. Biological Opinion. Cook Inlet Beluga Whale Critical Habitat and the Marine Terminal Redevelopment Project at Port of Anchorage Alaska. 87 pp. Available online at http://alaskafisheries.noaa.gov/protectedresources/whales/beluga/section7/biop.htm. Accessed October 13, 2014.

NMFS (National Marine Fisheries Service). 2014a. Endangered, Threatened, and Candidate Species under NMFS' Authority in Alaska. Updated April 2014. Available online at http://alaskafisheries.noaa.gov/protectedresources/esa/ak_nmfs_species.pdf. Accessed September 24, 2014.

NMFS (National Marine Fisheries Service). 2014b. Steller sea lion range and breeding sites (rookeries) in the North Pacific Ocean. Available online at http://alaskafisheries.noaa.gov/mapping/esa/.

NMFS (National Marine Fisheries Service). 2014c. Alaska ShoreZone Coastal Mapping and Imagery. National Marine Fisheries Service, Alaska Regional Office. Available online at http://alaskafisheries.noaa.gov/shorezone/. Accessed November 12, 2014.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 2013. Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, MD. Available online at http://www.nmfs.noaa.gov/pr/listing/5yearreview_leatherbackturtle.pdf. October 30, 2014.

NMFS and USFWS (National Marine Fisheries Service and U.S. Fish and Wildlife Service). 2014. Olive Ridley Sea Turtle (*Lepidochelys olivacea*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, MD. Available online at http://www.nmfs.noaa.gov/pr/pdfs/species/oliveridleyturtle_5yearreview2014.pdf. Accessed October 31, 2014.

NOAA (National Oceanic and Atmospheric Administration). 2010. Stefansson Sound: A User's Guide. GNOME Location Files – Arctic Region. Office of Response and Restoration. Available on-line at http://response.restoration.noaa.gov/book_shelf/753_Gnome_StefSnd_UG.pdf. [as cited in APP RR3 – no longer valid link]

NOAA (National Oceanic and Atmospheric Administration). 2013. Draft Guidance for Assessing the Effects of Anthropogenic sound on Marine mammals: Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts. Draft: December 23, 2013. Available online at http://www.nmfs.noaa.gov/pr/acoustics/draft_acoustic_guidance_2013.pdf. Accessed October 30, 2014.

Nowacki, G. J., G. P. Spencer, T. Brock M. Fleming, and T. Jorgenson. 2001. Ecoregions of Alaska and neighboring territory (map). U. S. Geological Survey, Reston, VA. http://agdc.usgs.gov/data/usgs/erosafo/ecoreg/index.html. Accessed October 30, 2014.

NPFMC (North Pacific Fisheries Management Council). 2009. Fishery Management Plan for Fish Resources of the Arctic Management Area. Anchorage, AK.

NPFMC (North Pacific Fisheries Management Council). 2014. Fishery Management Plan for Groundfish of the Gulf of Alaska. Anchorage, AK.

NPFMC (North Pacific Fisheries Management Council), NMFS (National Marine Fisheries Service), and ADFG (Alaska Department of Fish and Game). 2012. Fishery Management Plan for the Salmon Fisheries in the EEZ off the Coast of Alaska. Anchorage, AK.

NPS (National Park Service). 2013. Caribou Resource Brief. October 2013, No. 49. Alaska Region Inventory and Monitoring Program. Central Alaska Network. Available online at HTTP://SCIENCE.NATURE.NPS.GOV/IM/UNITS/CAKN. Accessed October 22, 2014.

NPS (National Park Service). 2014. Denali National Park and Preserve: Nature &Science, Animals. http://www.nps.gov/dena/naturescience/animals.htm. Accessed October 19, 2014.

NRCS (Natural Resources conservation Services). 2014. Plants Database. Common vascular plant names. Available online at http://www.plants.usda.gov. Accessed October 18, 2014.

Obritschkewitsch, T., and R.J. Ritchie. 2008. Steller's Eider survey near Barrow, Alaska, 2008. Unpublished report prepared for U.S. Bureau of Land Management, Fairbanks, AK, and ConocoPhillips Alaska, Inc., Anchorage, AK, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 15 pp.

Parrett, L.S. 2011. Unit 26 A, Teshekpuk caribou herd. Pages 283-314 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game. Project 3.0. Juneau, Alaska.

Parrett, L.S. 2014. 2013 Teshekpuk Caribou Herd Photocensus Results – for Distribution. March 17, 2014 Memorandum. To Interested Parties from Lincoln Parrett, Teshekpuk Caribou Herd Biologist through Brian Taras, Biometrician and Jim Dau, Western Arctic Herd Biologist, Alaska Department of Fish and Game, Division of Wildlife Conservation, Fairbanks, Alaska. 10 pp.

Peltier, T.C. 2010a. Unit 16A moose management report. Pages 225-234 in P. Harper. editor. Moose management report of survey and inventory activities 1 July2007-30 June 2009. Alaska Department of Fish and Game Project 1.0. Juneau, Alaska.

Peltier, T.C. 2010b. Unit 16B moose management report. Pages 235-247 in P. Harper. editor. Moose management report of survey and inventory activities 1 July2007-30 June 2009. Alaska Department of Fish and Game Project 1.0. Juneau, Alaska.

Peltier, T.C. 2010c. Unit 14A moose management report. Pages 165-180 in P. Harper. editor. Moose management report of survey and inventory activities 1 July2007-30 June 2009. Alaska Department of Fish and Game Project 1.0. Juneau, Alaska.

Person, B.T., A.K. Prichard, G.M. Carroll, D.A. Yokel, R.S. Suydam, J.C. George. 2007. Distribution and movements of the Teshekpuk Caribou herd 1990-2005: Prior to oil and gas development. Arctic 60:238-250.

Petersen, M. R., J.B. Grand, and C. P. Dau. 2000. Spectacled Eider (*Somateria fischeri*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/547 doi:10.2173/bna.547. Accessed October 11, 2014.

Pitelka, F.A. 1974. An avifaunal review for the Barrow region and North Slope of arctic Alaska. Arctic and Alpine Research 6: 161-184.

Powell, A. N. and Backensto. 2009. Common ravens (*Corvus corax*) nesting on Alaska's North Slope oil fields. Coastal Marine Institute, University of Alaska. Final Report, OCS Study MMS 2009-007. February 2009, 39 pp.

Quakenbush, L. and R.S. Suydam. 1999. Periodic non-breeding of Steller's Eiders near Barrow, Alaska with speculations on possible causes. Pp. 34-40, in R.I. Goudie, M.R. Petersen, and G.R. Robertson, eds. Behavior and ecology of sea ducks. Canadian Wildlife Service Occasional Paper No. 100.

Quakenbush, L.T., R.H. Day, B.A. Anderson, F.A. Pitelka, and B.J. McCaffery. 2002. Historical and present breeding season distribution of Steller's eiders in Alaska. Western Birds 33:99-120.

Quakenbush, L., R. Suydam, T. Obritschkewitsch, and M. Deering. 2004. Breeding biology of Steller's eiders (*Polysticta stelleri*) near Barrow, Alaska, 1991-99. Arctic 57(2):166-182.

R2 Resource Consultants. 2013. Synthesis of existing fish population data. Susitna-Watana Hydroelectric Project (FERC No. 14241). Report prepared by R2 Resource Consultants for Alaska Energy Authority. Anchorage, AK.

Reub, G.S., J.D Durst, and D.R. Glass. 1991. Fish distribution and abundance. Pages 1-60 in 1987 Endicott Environmental Monitoring Program, volume 6, chapter 1. Report by the Envirosphere Company to U.S. Army Corps of Engineers, Anchorage, Alaska.

Reynolds, P.E., K.J. Wilson, and D.R. Klein. 2002. Muskoxen. Pages 54-64 in D.C. Douglas, P.E. Reynolds, and E.B. Rhode, eds. Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries, U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR-2002-0001.

Rice, D. W. 1978. The humpback whale in the North Pacific: distribution, exploitation and numbers. Appendix 4. Pp. 29-44 In K. S. Norris and R. R. Reeves (eds.), Report on a workshop on problems related to humpback whales (*Megaptera novaeangliae*) in Hawaii. U.S. Department of Commerce, Nat. Tech. Info. Serv. PB-280 794. Springfield, VA.

Ritchie, R.J. and A.G. Palmer. 2002. Aerial and Ground Surveys for Spectacled and Steller's Eiders Along the Proposed AGPPT Alaska Highway Gas Pipeline Route and at Proposed Sites for the Gas Treatment Plant, 2001. Field Report. Alaska Biological Resources. Fairbanks, AK. 15 pp.

Robards, M.D., J.F. Piatt, A.B. Kettle, and A.A. Abookire. 1999. Temporal and geographic variation in fish communities of Lower Cook Inlet, Alaska. Fishery Bulletin 97(4):962-977.

Rodrigues, R. 2002a. Nest density, nest survival, and habitat use of tundra-nesting birds, Point Thomson, Alaska 2002. Prepared for BP Exploration (Alaska) Inc. by LGL Alaska Research Associates, Inc. Anchorage, AK.

Rodrigues, R. 2002b. Preliminary assessment of tundra-nesting birds in the Point Thomson area, Alaska, 2001. Report prepared by LGL Alaska Research Associates, Inc., Anchorage, AK, for BP Exploration (Alaska) Inc., Anchorage, AK. 26 pp. + appendices.

Roth, K.J., and M.E. Stratton. 1985. The Migration and Growth of Juvenile Salmon in the Susitna River. Pages 207 In: Schmidt, D.C., S.S. Hale, and D.L. Crawford. (eds.) Resident and Juvenile Anadromous Fish Investigations (May - October 1984). Prepared by Alaska Department of Fish and Game. Prepared for Alaska Power Authority, Anchorage, AK.

Roth, K.J., D.C. Gray, J.W. Anderson, A.C. Blaney, and J.P. McDonell. 1986. The migration and growth of juvenile salmon in the Susitna River, 1985. Alaska Department of Fish and Game, Susitna River Aquatic Studies Program, Report 14, Anchorage.

Rugh, D., D. DeMaster, A. Rooney, J. Breiwick, K. Shelden, and S. Moore. 2003. A review of bowhead whale (*Balaena mysticetus*) stock identity. J. Cetacean Res. Manage. 5(3): 267-279.

Rugh, D. J., B. A. Mahoney, and B. K. Smith. 2004. Aerial surveys of beluga whales in Cook Inlet, Alaska, between June 2001 and June 2002. U.S. Department of Commerce. NOAA Tech. Memo. NMFS-AFSC-145.

Rugh D. J., K. E. W. Shelden, R. C. Hobbs. 2010. Range contraction in a beluga whale population. Endangered Species Research 12:69-75.

Rutz, D. 1999. Movements, food availability and stomach contents of northern pike in selected Susitna River drain- ages, 1996–1997. Alaska Department of Fish and Game, Fishery Data Series. Anchorage, 1–68.

Saalfeld, S. T., R. B. Lanctot, S. C. Brown, D. T. Saalfeld, J. A. Johnson, B. A. Andres, and J. R. Bart. 2013. Predicting breeding shorebird distributions on the Arctic Coastal Plain of Alaska. Ecosphere (1):16. http://dx.doi.org/10.1890/ES12-00292.1

Salo, E.O. 1991. Life history of chum salmon (*Oncorhynchus keta*). In: C. Groot and L Margolis (eds.). Pacific Salmon Life Histories. UBC Press. Vancouver, British Columbia p. 23 1-309.

Schliebe, S., T.J. Evans, K. Johnson, M. Roy, S. Miller, C. Hamilton, R. Meehan, and S. Jahrsdoerfer. 2006. Status assessment in response to a petition to list polar bears as a threatened species under the US Endangered Species Act. U.S. Fish and Wildlife Service, Marine Mammals Management, Anchorage, AK.

Schliebe, S., K. D. Rode, J. S. Gleason, J. Wilder, K. Proffitt, T. J. Evans, and S. Miller. 2008. Effects of sea ice extent and food availability on spatial and temporal distribution of polar bears during the fall open-water period in the southern Beaufort Sea. Polar Biology 31:999–1010.

Schmidt, D.R., W.B. Griffiths, D.K. Beaubien and C.J. Herlugson. 1991. Movement of young-of-the-year arctic ciscoes across the Beaufort Sea coast, 1985-1988. American Fisheries Society Symposium 11:132-144.

Schmidt, J. H., M. S. Lindberg, D. S. Johnson, B. Conant, and J. King. 2009. Evidence of Alaskan Trumpeter Swan Population Growth Using Bayesian Hierarchical Models. The Journal of Wildlife Management 73, no. 5 (2009): 720–727.

Schumacher, J.D., N.A. Bond, R.D. Brodeur, P.A. Livingston, J.M. Napp, and P.J. Stabeno. 2003: Climate change in the southeastern Bering Sea and some consequences for its biota, pp. 17 - 40. In: Large Marine Ecosystems of the World: Trends in Exploitation, Protection, and Research, Hempel, G. and K. Sherman (Eds.) Elsevier, Amsterdam.

Schwanke, R.A. 2011. Units 13 and 14B caribou. Pages 90-108 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game. Project 3.0. Juneau, Alaska.

Seaton, C.T. 2010. Unit 20B moose. Pages 345-365 in P. Harper, ed. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Seaton, C.T. 2011a. Units 25C, 20B, and 20F caribou. Pages 271-282 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game. Project 3.0. Juneau, Alaska.

Seaton, C.T. 2011b. Units 20A caribou. Pages 128-142 in P. Harper, editor. Caribou management report of survey and inventory activities 1 July 2008-30 June 2010. Alaska Department of Fish and Game. Project 3.0. Juneau, Alaska.

Selinger, J. 2010. Unit 15 moose management report. Pages 208-224 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2007-30 June 2009. Alaska Department of fish and Game. Project 1.0. Juneau, Alaska.

Sepulveda, A.J, D.S. Rutz, S.S. Ivey, K.J. Dunker and J.A Gross. 2013. Introduced northern pike predation on salmonids in southcentral Alaska. Ecology of Freshwater Fish 2013:1-12.

Sexson, M., M.R. Petersen, and A.N. Powell. 2011. Distribution and migratory timing of threatened Spectacled Eiders in the Beaufort and eastern Chukchi seas. Poster presented at the Alaska Marine Science Symposium, January 2011, Anchorage, Alaska. 1 p. Available online at www.arcus.org/files/meetings/279/281/presentations/sexson.pdf. Accessed October 11, 2014.

Shields, P. and M. Willette. 2005. An estimate of the migratory timing and abundance of sockeye salmon into Upper cook Inlet, Alaska, 2004. Alaska Department of Fish and Game, Fishery Data series No. 05-64, Anchorage. Available online at http://www.sf.adfg.state.ak.us/FedAidPDFs/fds05-64.pdf. Accessed October 30, 2014.

Skoog, R.O. 1968. Ecology of the Caribou (*Rangifer tarandus granti*) in Alaska. Ph.D. Thesis. University of California, Berkley. 699 pp.

Smith, K.G., and P.G. Connors. 1993. Postbreeding habitat selection by shorebirds, water birds, and land birds at Barrow, Alaska: A multivariate analysis. Canadian Journal of Zoology 71: 1629-1638.

Stehn, R. A., W. W. Larned, and R. M. Platte. 2012. Analysis of aerial survey indices monitoring waterbird populations of the Arctic Coastal Plain, Alaska, 1986-2012. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage and Soldotna, Alaska.

Stout, G.W. 2010. Unit 24 moose. Pages 572-164 in P. Harper, ed. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Stirling, I., N. J. Lunn, and J. Iacozza. 1999. Long-term trends in the population ecology of polar bears in Western Hudson Bay in relation to climatic change. Arctic 52:294–306.

Sturdevant, M.V., A.C. Wertheimer and J.L. Lum. 1993. Diet of juvenile pink and chum salmon in oiled and non-oiled nearshore habitats in Prince William Sound, 1989 and 1990. Chapter 4 of Impact of the Oil Spill on Juvenile Pink and Chum Salmon and Their Prey in Critical Nearshore Habitats. Fisheries Study Number 4. Natural Resource Damage Assessment Final Report. Auke Bay Laboratory, National Marine Fisheries Service, NOAA. Juneau, Alaska. 48 p.

Tarbox, K. and R. Thorne. 1979. Measurements of fish densities under the ice in the Beaufort Sea near Prudhoe Bay, Alaska. In: Environmental studies of the Beaufort Sea - winter 1979. Report prepared for Prudhoe Bay Unit by Woodward-Clyde Consultants.

Timm, H.K. and W.N. Johnson. 2006. Raptor monitoring in the Upper Tanana Valley, Game Management Unit 12, Alaska, 2004-2005. Progress report 01-06. Tetlin National Wildlife Refuge. Tok, AK.

Tobey, R.W. and R.A. Schwanke. 2010. Unit 13 moose. Pages 150-164 in P. Harper, ed. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Truett, J.C., and S.R. Johnson (eds.). 2000. The Natural History of an Arctic Oil Field: Development and the Biota, Academic Press, San Diego, Calif.

Underwood, T.J., J.A. Gorden, M.J. Millard, L.A. Thorpe, and B.M. Osborne. 1995. Characteristics of selected fish populations of Arctic National Wildlife Refuge coastal waters, final report, 1988-1991. U.S. Fish and Wildl. Serv., Fairbanks, Alas., Alaska Fish. Tech. Rep. No. 28. 590pp.

URS. 1999. Physical Oceanography of the Point Thomson Unit Area: 1997 and 1998 regional studies, meteorology, hydrodynamics, hydrographic, bathymetry, and water chemistry in Lions Lagoon.

USACE (U.S. Army Corps of Engineers). 1980. Prudhoe Bay Oil Field Waterflood Project, Final Environmental Impact Statement, Alaska District, Anchorage, Alaska.

USACE (U.S. Army Corps of Engineers). 1984. Prudhoe Bay Oil Field, Endicott Development Project, Final Environmental Impact Statement, Alaska District, Anchorage, Alaska.

USFWS (U.S. Fish and Wildlife Service). 1996. Spectacled Eider Recovery Plan. Anchorage, Alaska. 157pp.

USFWS (U.S. Fish and Wildlife Service). 2008. Birds of Conservation Concern. Division of Migratory Bird Management, Arlington, VA. December 2008. 87 pp.

USFWS (U.S. Fish and Wildlife Service). 2009b. Steller's Eider Spotlight Species Action Plan. November 23, 2009. Available online at http://ecos.fws.gov/docs/action_plans/doc3196.pdf. Accessed October 12, 2014.

USFWS (U.S. Fish and Wildlife Service). 2010a. Kenai National Wildlife Refuge Comprehensive Conservation Plan. U.S. Fish and Wildlife Service, Region 7.

USFWS (U.S. Fish and Wildlife Service). 2010b. Range Map: Steller's Eider (*Polysticta stelleri*). Last updated: March 24, 2010. Available online at http://www.fws.gov/alaska/fisheries/endangered/StellEider_RangeMap.htm. Accessed October 11, 2014.

USFWS (U.S. Fish and Wildlife Service). 2010c. Spectacled Eider (*Somateria fischeri*) 5-year review: summary and evaluation. August 23, 2010. Fairbanks Fish and Wildlife Field Office, Fairbanks, AK. Available online at http://ecos.fws.gov/docs/five_year_review/doc3281.pdf. Accessed October 10, 2014.

USFWS (U.S. Fish and Wildlife Service). 2012a. Threatened and Endangered species: Northern Sea Otter (Southwest Alaska Distinct Population Segment) (*Enhydra lutris kenyoni*). Fact Sheet. May 2012. Available online at http://www.fws.gov/alaska/fisheries/endangered/pdf/Nseaotter_factsheet_v2.pdf. Accessed October 14, 2014.

USFWS (U.S. Fish and Wildlife Service).2012b. Range Map: Spectacled Eider (*Somateria fischeri*). Last updated: March 24, 2010. Available online at http://www.fws.gov/alaska/fisheries/endangered/SpecEider_RangeMap.htm. Accessed October 23, 2014.

USFWS (U.S. Fish and Wildlife Service). 2013. Southwest Alaska Distinct Population Segment of the Northern Sea Otter (*Enhydra lutris kenyoni*) - Recovery Plan. U.S. Fish and Wildlife Service, Region 7, Alaska. Available online at http://ecos.fws.gov/docs/recovery_plan/Recovery%20Plan%20SW%20AK%20DPS%20Sea%20Otter%20Aug13.pdf. Accessed October 10, 2014.

USFWS (U.S. Fish and Wildlife Service). 2014a. Endangered, threatened, Proposed, Candidate, and Delisted Species in Alaska. Updated May 13, 2014. Available online at http://www.fws.gov/alaska/fisheries/endangered/pdf/consultation_guide/4_Species_List.pdf. Accessed September 23, 2014.

USFWS (U.S. Fish and Wildlife Service). 2014b. Spectacled eider breeding pair density based on 2009-2012 aerial surveys. Provided by Bob Platte, USFWS, Migratory Bird Management, Anchorage, Alaska.

USGS (U.S. Geological Survey). 2013. Nonindigenous Aquatic Species – Alaska. Last modified June 6, 2013. Available online at http://nas.er.usgs.gov. Accessed January 2, 2014.

Ver Hoef, J.M., M.F. Cameron, P.L. Boveng, J.M. London, E.E. Moreland. 2014. A spatial hierarchical model for abundance of three ice-associated seal species in the eastern Bering Sea. Statistical Methodology 17:46-66.

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

Waltemyer, D.L. 1991. Abundance, age, sex, and size of chinook, coho, and chum salmon returning to Upper Cook Inlet, Alaska in 1989. Technical Fishery Report 91-17. Alaska Dept. Fish and Game, Division of Commercial Fisheries, Juneau. 209 p.

West, R.L., and D.W. Wiswar, 1985, Fisheries Investigations on the Arctic National Wildlife Refuge, Alaska, 1984, Report No. FY85-1, Fairbanks Fishery Resource Station, U.S. Fish and Wildlife Service, Fairbanks, Alaska, Dec. 15, 1984.

Woodward-Clyde Consultants and Alaska Biological Research (ABR). 1983. Terrestrial environmental study for Point Thomson development project. Report for Exxon Company, Thousand Oaks, CA. by Woodward Clyde Consultants, Anchorage, AK, and Alaska Biological Research, Fairbanks, AK.

Wiken, E., F.J. Nava, and G. Griffith. 2011. North American Terrestrial Ecoregions—Level III. Commission for Environmental Cooperation, Montreal, Canada. Available online at ftp://ftp.epa.gov/wed/ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf. Accessed October 30, 2014.

Wiswar, D.W., and R.L. West, 1987, Fisheries Investigations on the Arctic National Wildlife Refuge, Alaska, 1984, pp. 778−800 in Arctic National Wildlife Refuge Coastal Plain Resource Assessment: 1985 Update Report, G.W. Garner and P.E. Reynolds (editors), U.S. Fish and Wildlife Service, Anchorage, Alaska.

Williams, B.C., and S.E. Burril. 2011. 2010 Point Thomson Nearshore Fish Study. Prepared for ExxonMobil Development Company, Inc., Anchorage, AK, by LGL Alaska Research Associates, Inc., Anchorage, AK.

Young, D.D. 2010. Unit 20A moose. Pages 320-344 in P. Harper, ed. Moose management report of survey and inventory activities 1 July 2007–30 June 2009. Alaska Department of Fish and Game. Project 1.0. Juneau, Alaska.

Zerbini, A.N., J.M. Waite, J.L. Laake, and P.R. Wade. 2006. Abundance, trends and distribution of baleen whales off western Alaska and the central Aleutian Islands. Deep-Sea Res. Part I:1772-1790.

APPENDIX A ALASKA LNG PROJECT FISHERIES MAPPING

PROVIDED UNDER SEPARATE COVER

APPENDIX B ALASKA LNG PROJECT LAND COVER MAPPING

PROVIDED UNDER SEPARATE COVER

APPENDIX C ALASKA LNG PROJECT DRAFT BIOLOGICAL ASSESSMENT (BA) REPORT

TO BE PROVIDED IN A SUBSEQUENT DRAFT OF THIS RESOURCE REPORT

APPENDIX D ALASKA LNG PROJECT DRAFT ESSENTIAL FISH HABITAT (EFH) ASSESSMENT REPORT

TO BE PROVIDED IN A SUBSEQUENT DRAFT OF THIS RESOURCE REPORT

Alaska LNG

DOCKET NO. PF14-21-000

DRAFT APPENDIX D

OUTLINE OF ESSENTIAL FISH HABITAT (EFH) ASSESSMENT REPORT

PUBLIC VERSION

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ACRONYMS AND ABBREVIATIONS

ABBREVIATION	DEFINITION
Abbreviations for Units of Measurement	
°C	degrees Celsius
°F	degrees Fahrenheit
BSCF/D	billion standard cubic feet per day
cfs	cubic feet per second
cm	centimeters
dB	decibels
dBA	A-weighted decibels
ft	feet
g	grams
gpm	gallons per minute
ha	hectare
hp	horsepower
Hz	hertz
in	inches
kg	kilogram
kHz	kilohertz
kW	kilowatts
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
L_{max}	maximum sound level
m^3	cubic meters
Ma	mega-annum (millions of years)
mg	milligrams
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MGD	million gallons per day
mm	millimeters
MMBtu/hr	million British thermal units per hour
MMSCF/D	million standard cubic feet per day
MPH	miles per hour
MMTA	million metric tons per annum
ng	nanograms
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
ppmv	parts per million by volume
Psig	pounds per square inch gauge
rms	root mean square
SPL	sound pressure level
tpy	tons per year
µg	microgram
µg/kg	micrograms per kilogram

ABBREVIATION	DEFINITION
µPa	micropascals
Other Abbreviations	
§	section or paragraph
AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
ACC	Alaska Conservation Corps
ACEC	Areas of Critical Environmental Concern
ACP	Arctic Coastal Plain
ACRC	Alaska Climate Research Center
ACS	U.S. Census, American Community Survey
AD	aggregate dock
ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADGGS	Alaska Division of Geological and Geophysical Surveys
ADM	average daily membership
ADNR	Alaska Department of Natural Resources
ADOLWD	Alaska Department of Labor and Workforce Development
ADOT&PF	Alaska Department of Transportation and Public Facilities
AEIC	Alaska Earthquake Information Center
AGDC	Alaska Gasline Development Corporation
AGPPT	Alaska Gas Producers Pipeline Team
AHPA	Alaska Historic Preservation Act
AHRS	Alaska Heritage Resources Survey
AIDEA	Alaska Industrial Development and Export Authority
AKNHP	Alaska Natural Heritage Program
AMP	approximate mile post
ANCSA	Alaska Native Claims Settlement Act
ANGPA	Alaska Natural Gas Pipeline Act
ANGTS	Alaska Natural Gas Transportation System
ANILCA	Alaska National Interest Lands Conservation Act
ANIMIDA	Arctic Nearshore Impact Monitoring in the Development Area
ANS Task Force	Aquatic Nuisance Species Task Force
ANVSA	Alaska Native Village Statistical Area
AOGCC	Alaska Oil and Gas Conservation Commission
AOI	Area of Interest
APCI	Air Products and Chemicals Inc.
APDES	Alaska Pollutant Discharge Elimination System
APE	Area of Potential Effect
API	American Petroleum Institute
APP	Alaska Pipeline Project
Applicants	ExxonMobil Alaska LNG LLC, ConocoPhillips Alaska LNG Company, BP Alaska LNG LLC, TransCanada Alaska Midstream LP, and Alaska Gasline Development Corporation
APSC	Alyeska Pipeline Service Company
AQRV	Air Quality Related Value
Arctic NWR	Arctic National Wildlife Refuge
ARD	acid rock drainage
ARDF	Alaska Resource Data File
ARPA	Archaeological Resources Protection Act of 1979

ABBREVIATION	DEFINITION
ARRC	Alaska Railroad Corporation
AS	Alaska Statute
ASAP	Alaska Stand Alone Pipeline
ASME	American Society of Mechanical Engineers
ASOS	Automated Surface Observation System
ASRC	Arctic Slope Regional Corporation Energy Services
ATC	Allakaket Tribal Council
ATWS	additional temporary workspace
AWOS	Automated Weather Observing System
B.C.	British Columbia
BACT	Best Available Control Technology
BGEPA	Bald and Golden Eagle Protection Act
BIA	U.S. Department of the Interior, Bureau of Indian Affairs
BLM	U.S. Department of the Interior, Bureau of Land Management
BMP	best management practices
BOD_5	biochemical oxygen demand
BOEM	U.S. Department of the Interior, Bureau of Ocean Energy Management
BOG	boil-off gas
BP	Before Present
C.F.R.	Code of Federal Regulations
CAA	Clean Air Act
CAMA	Central Arctic Management Area
CCP	Comprehensive Conservation Plans
CDP	Census Designated Place
CEA	Chugach Electric Association
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGF	Central Gas Facility
CGP	Construction General Permit
CH_4	methane
CHA	Critical Habitat Area
CIRCAC	Cook Inlet Regional Citizens Advisory Council
CIRI	Cook Inlet Region Inc.
CLG	Certified Local Government
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	total greenhouse gas emissions, in CO_2-equivalent global warming potential
COC	Certificate of Compliance
CONUS	Continental U.S.
COOP	National Weather Service, Cooperative Observer Program
CPCN	Certificate of Public Convenience and Necessity
CRA	Certificate of Reasonable Assurance
CSD	Contaminated Sites Database
CSP	Contaminated Sites Program
CSU	conservation system units
CV	coefficient of variation

ABBREVIATION	DEFINITION
CWA	Clean Water Act
DB	Denali Borough
DEM	Digital Elevation Model
DGGS	ADNR Division of Geological and Geophysical Surveys
DH	dock head
DHSS	Alaska Department of Health and Social Services
DMLW	Alaska Department of Natural Resources, Division of Mining, Land, and Water
DPS	Distinct Population Segment
DWPP	Drinking Water Protection Program
EDA	U.S. Department of Commerce, Economic Development Administration
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPRP	Emergency Preparedness and Response Plan
ERL	Environmental, Regulatory and Lands
ERMA	Extended Recreation Management Areas
ESA	Endangered Species Act
ESD	Emergency Shut Down
ESU	Evolutionary Significant Unit
FAA	U.S. Department of Transportation, Federal Aviation Administration
FCC	Federal Communications Commission
FE	U.S. Department of Energy, Office of Fossil Energy
FEED	front-end engineering design
FEIS	Final Environmental Impact Statement
FEMA	U.S. Department of Homeland Security, Federal Emergency Management Agency
FERC	U.S. Department of Energy, Federal Energy Regulatory Commission
FERC Plan	FERC Erosion Control, Revegetation, and Maintenance Plan
FERC Procedures	FERC Wetland and Waterbody Construction and Mitigation Procedures
FLPMA	Federal Land Policy and Management Act (of 1976) BLM
FMP	Fisheries Management Plan
FNSB	Fairbanks North Star Borough
FR	Federal Regulation
GDP	Gross Domestic Product
GHG	greenhouse gases
GIS	geographic information system
GMU	Game Management Units
GP	General Permit
GRI	Gas Research Institute
GTP	gas treatment plant
GWP	Global Warming Potential
H_2S	hydrogen sulfide
HABS	Historic American Building Survey
HAER	Historic American Engineering Record

ABBREVIATION	DEFINITION
HAP	Hazardous Air Pollutant
HAPC	Habitat Areas of Particular Concern
HCA	High Consequence Area
HDD	horizontal directional drill
HDMS	Hazard Detection and Mitigation System
HGM	hydrogeomorphic
HLV	heavy lift vessel
HMR	Hazardous Materials Regulations
HRS	Hazard Ranking System
IBA	Important Bird Areas
ICS	Incident Command System
IHA	Incidental Harassment Authorization
IHLC	Inupiat History, Language, and Culture
ILI	In-line Inspection
IMP	Integrity Management Plan
IP	Individual Permit
ISO	International Organization for Standardization
JPO	State and Federal Joint Pipeline Office
kbpd	thousand barrels per day
KCC	Kuparuk Construction Camp
KOP	key observation points
KPB	Kenai Peninsula Borough
KTC	Kuparuk Transportation Company
LiDAR	light detection and ranging
Liquefaction Facility	natural gas liquefaction
LLC	Limited Liability Company
LNG	liquefied natural gas
LNGC	liquefied natural gas carrier
LOA	Letter of Authorization
LOD	Limits of Distribution
LP	Limited Partnership
LPG	liquefied petroleum gas
LUP	Land Use Permit
LUST	Leaking Underground Storage Tanks
MACT	maximum achievable control technology
Mainline	An approximately 800-mile-long, large-diameter gas pipeline
MAOP	maximum allowable operating pressure
MARPOL	Marine Pollution Protocol
MBTA	Migratory Bird Treaty Act
MCD	marine construction dock
MHHW	mean higher high water
MHW	mean high water
ML&P	Anchorage Municipal Light and Power
MLA	Mineral Leasing Act
MLBV	Mainline block valve
MLLW	mean lower low water

ABBREVIATION	DEFINITION
MLW	mean low water
MMPA	Marine Mammal Protection Act
MMS	Mainline Meter Station
MOF	material offloading facility
MP	Mainline milepost
MPRSA	Marine Protection Research and Sanctuaries Act of 1972
MSB	Matanuska-Susitna Borough
MSCFD	Thousand standard cubic feet per day
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAS	nonindigenous aquatic species
NCC	national certification corporation
NCDC	National Climatic Data Center
NDE	non-destructive examination
NEP	non-essential experimental population
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NGA	Natural Gas Act
NHPA	National Historic Preservation Act of 1996, as amended
NID	Negligible Impact Determination
NLURA	Northern Land Use Research Alaska, LLC
NMFS	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
North Slope	Alaska North Slope
NPDES	National Pollutant Discharge Elimination Systems
NPL	National Priority List
NPP	National Park and Preserve
NPR-A	National Petroleum Reserve – Alaska
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	Noise-Sensitive Areas
NSB	North Slope Borough
NSPS	New Source Performance Standards
NTC	national training center
NTP	Notice to Proceed
NVIC	Navigation and Vessel Inspection Circular
NWA	Northwest Alaska Pipeline
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O_3	Ozone
OC	open-cut
OCS	Outer Continental Shelf

ABBREVIATION	DEFINITION
OD	outside diameter
OEP	FERC, Office of Energy Projects
OHA	Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, Office of History and Archaeology
ONA	Outstanding Natural Area
OPMP	ADNR, Office of Project Management and Permitting
OU	Operating unit
PAC	potentially affected community
Pb	the element lead
PBTL	Prudhoe Bay Gas Transmission Line
PBU	Prudhoe Bay Unit
PCB	polychlorinated biphenyl
PHMSA	Pipeline and Hazardous Materials Safety Administration
$PM_{2.5}$	particulate matter having an aerodynamic diameter of 2.5 microns or less
PM_{10}	particulate matter having an aerodynamic diameter of 10 microns or less
PMP	Point Thomson Gas Transmission Line milepost
POC	Plan of Cooperation
POD	Plan of Development
Project	Alaska LNG Project
PRPA	Paleontological Resources Preservation Act
PSD	Prevention of Significant Deterioration
PTTL	Point Thomson Gas Transmission Line
PTU	Point Thomson Unit
PWS	public water supply
Q&A	question and answer
RCA	Regulatory Commission of Alaska
RCRA	Resource Conservation and Recovery Act
RNA	Research Natural Area
ROD	Record of Decision
ROE	right-of-entry
ROW	right-of-way
RR	Resource Report
SCC	Deadhorse Airport
SCS	Soil Conservation Corps
SDWA	Safe Drinking Water Act
SEIS	Supplemental Environmental Impact Statement
SGR	State Game Refuge
SHPO	State Historic Preservation Office(r)
SIP	State Implementation Plan
SMA	Special Management Areas
SRMA	Special Recreation Management Areas
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasure Plan
SPCO	State Pipeline Coordinator's Office
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks

ABBREVIATION	DEFINITION
SPMT	self-propelled module transporters
SRA	State Recreation Area
SRR	State Recreation River
STATSGO	State Soil Geographic
STATSGO2	State Soil Geographic2 – General Soils Map of Alaska & Soils Data (2011)
SWAPA	Southwest Alaska Pilots Association
SWPPP	Stormwater Pollution Prevention Plan
TAHC	total aliphatic hydrocarbons
TAPS	Trans-Alaska Pipeline System
TBD	To be determined
TCC	Tanana Chiefs Conference
The Applicants' Plan	Applicants' Upland Erosion Control, Revegetation, and Maintenance Plan
The Applicants' Procedures	Applicants' Wetland and Waterbody Construction, and Mitigation Procedures
TPAH	total polycyclic aromatic hydrocarbon
TSA	Transportation Security Administration
TSCA	Toxic Substances Control Act
TSD	tug support dock
TSS	total suspended solids
UCIDA	United Cook Inlet Drift Association
UIC	Underground Injection Control
U.S.	United States
U.S.C.	U.S. Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDHHS	U.S. Department of Health and Human Services
USDOE	U.S. Department of Energy
USDOI	U.S. Department of the Interior
USDOT	U.S. Department of Transportation
USDW	underground sources of drinking water
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VPSO	Village Public Safety Officer
VRM	Visual Resource Management Methodology
VSM	Vertical Support Members
WELTS	Well Log Tracking System
WRCC	Western Regional Climate Center
WSA	Waterway Suitability Assessment
WSR	Wild and Scenic Rivers

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Information in this draft Appendix D is preliminary and subject to change during scope development. Updated information will be provided in a subsequent draft of this document.

1. OUTLINE OF ESSENTIAL FISH HABITAT (EFH) ASSESSMENT REPORT

The Alaska Gasline Development Corporation, BP Alaska LNG LLC, ConocoPhillips Alaska LNG Company, ExxonMobil Alaska LNG LLC, and TransCanada Alaska Midstream LP (Applicants) plan to construct an integrated Project (the Alaska LNG Project) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce. Proposed Project facilities include: a 42-in diameter, 800-mi natural gas pipeline from the North Slope to a Liquefaction Facility near Nikiski. The Liquefaction Facility is comprised of an LNG Plant and marine terminal. The natural gas pipeline would include an offshore section crossing the Cook Inlet. Two pipeline study corridors across the Cook Inlet are being considered, an east pipeline corridor and a west pipeline corridor.

The actual footprint of the Liquefaction Facility and Interdependent Facilities, including ancillary facilities, will be identified during the pre-front-end engineering and design (Pre-FEED) process. The following sections provide an outline of how information pertaining to Essential Fish Habitat (EFH) within the Project area will be presented once further details are known on the siting of the Project. A subsequent draft of this this EFH Assessment will identify site-specific potential impacts to EFH crossed, or in the vicinity of, the (1) Liquefaction Facility, and (2) the Interdependent Facilities.

1.1. ESSENTIAL FISH HABITAT

The 1996 Sustainable Fisheries Act reauthorized the MSA (16 USC.1801, et seq.), introducing new requirements for:

- the description and identification of EFH in fishery management plans (FMPs);
- minimizing adverse impacts on EFH; and
- proposing actions to conserve and enhance EFH.

EFH guidelines were set forth by the NMFS (aka NOAA Fisheries) to help Fisheries Management Councils (FMCs) fulfill requirements of the MSA. Consultation between federal permitting or action agencies and NMFS Habitat Conservation Division is required by the MSA when an action may adversely affect designated EFH. The Magnuson-Stevens Act also requires that the federal permitting or action agency respond to comments made by NMFS.

EFH is defined as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (50 C.F.R. Part 600). For the purposes of this definition:

- "waters" means aquatic areas and their associated physical, chemical, and biological properties;

- "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities;

- "necessary" means the habitat required to support a sustainable fishery and healthy ecosystem; and

- "spawning, feeding, and breeding" is meant to encompass the complete life cycle of a species (50 C.F.R. Part 600).

EFH is designated based on the best available scientific information and the levels defined by the MSA include (NMFS, 2005):

- Level 1 information corresponds to distribution;
- Level 2 information to density or relative abundance;
- Level 3 information to growth, reproduction, or survival rates; and
- Level 4 information to production rates.

In Alaska, Arctic cod adult and late juvenile EFH is designated based on Level 1 information; however, insufficient information is available to designate EFH for the rest of the life cycle (*i.e.*, eggs, larvae, and early juveniles) (NPFMC, 2009). Pacific salmon EFH is designated for all species and all life stages based on Level 1information (NMFS, 2005).

1.1.1. Liquefaction Facility

EFH consultation for the Cook Inlet region is expected to focus on species managed under the:

- FMP for the Salmon Fisheries in the EEZ off the Coast of Alaska (Salmon FMP); and
- FMP for Groundfish of the Gulf of Alaska.

No Habitat Areas of Particular Concern (HAPC's) are identified in the Project area.

Salmon FMP

Salmon populations within the Project area are all in the West Management Area, which is the area of the U.S. Exclusive Economic Zone west of Cape Suckling in the Gulf of Alaska to Demarcation Point in the Beaufort Sea, with the exception of three excluded areas in northern Gulf of Alaska. The Salmon FMP identifies EFH for each species' life stage and in most cases is based on either the general distribution of the life stage, or the general distribution of the life stage in waters identified by the ADF&G Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (ADF&G, 2014a, b, c). Pacific salmon are anticipated to be the species of interest near the Liquefaction Facility and any fishery based on these species could potentially be affected by Project activities. Mitigation aimed at avoiding or reducing impacts to salmon will likely be beneficial to other marine species in the area.

Groundfish FMP

Marine species expected to occur in the Project area include forage fish species, such as walleye pollock, saffron cod, Pacific herring, eulachon, longfin smelt, capelin, Pacific sandfish, Pacific sandlance, snake prickleback, Pacific staghorn sculpin, and starry flounder (Moulton, 1997; Houghton et al., 2005). Of these species, pollock and flounders are considered target species of the FMP for Groundfish of the Gulf of Alaska. Freshwater and Marine EFH potentially occurring in the Project area is provided in Appendix Table D-1 and Appendix Table D-2, respectively.

1.1.2. Interdependent Facilities

EFH consultation for the Interdependent Facilities located in the Prudhoe Bay and Beaufort Sea region is expected to focus on species of the:

- FMP for the Fish Resources of the Arctic Management Area; and
- salmon FMP.

No HAPC's are identified in the Project area.

The FMP for the Fish Resources of the Arctic Management Area (NPFMC, 2009; 74 C.F.R. 56734) manages three target species: (1) arctic cod (*Boreogadus saida*), (2) saffron cod (*Eleginus gracilis*), and (3) snow crab (*Chionoecetes opilio*). Of these three target species, snow crab are more associated with deep water (Logerwell et al. 2008), and are not expected to be found within the Project area.

The general summer distributions of saffron cod, arctic cod, and all five species of Pacific salmon extend across Prudhoe Bay into the Point Thomson portion of the Project area, with pink and chum salmon, saffron cod, and arctic cod being documented in summer study programs within the area (NMFS, 2005; Williams and Burril, 2011). During winter, arctic cod are the primary species in the Prudhoe Bay region, although in low densities (Tarbox and Thorne, 1979).

Within the Project corridor, freshwater EFH consultation is anticipated to be primarily focused on the five species of Pacific salmon, which are covered under the Salmon FMP (NPFMC et al., 2012).

1.2. PROPOSED ACTION

The proposed actions which will be evaluated in a subsequent draft of this EFH Assessment include construction and operation of:

- the Liquefaction Facility and Interpendent Facilities located in the Cook Inlet region; and
- the Interdependent Facilities located in the Prudhoe Bay and Beaufort Sea region.

The actions to be analyzed include, but are not limited to, activities such as dredging, water intake/discharge (e.g., hydrostatic testing), and vessel operations.

1.2.1. Facilities and Activities within Cook Inlet Region

Information to be included concerning the:

- LNG Plant;
- marine terminal;
- marine discharges; and
- pipeline crossing.

1.2.2. Facilities and Activities within Pipeline Corridor

Information to be included concerning the:

- pipeline stream crossings.

1.2.3. Facilities and Activities within the Arctic Region

Information to be included concerning the:

- GTP ; and
- west dock and approach modifications

1.2.4. Transportation Routes

Information to be included concerning:

- transportation of construction materials and supplies; and
- LNG transport to markets.

1.3. ESSENTIAL FISH HABITAT WITHIN THE PROJECT AREA

This section will identify species with designated EFH within the Project area in a subsequent draft of this EFH Assessment, once further details are known on the siting of the Project. The analysis will include Project facilities within Cook Inlet, along the pipeline corridor, within the Arctic Region, and along the proposed transportation routes.

1.3.1. EFH Species Within Cook Inlet

Information to be included concerning:

- Pacific salmon within Proposed Project Area – identified in Table D-2;and
- Marine Fish Species within Proposed Project Area - identified in Table D-2.

1.3.2. EFH Species Associated with the Pipeline Corridor

Information to be included concerning:

- Pacific salmon within Proposed Project Area – identified in Table D-1.

1.3.3. EFH Species within the Arctic Region

Information to be included concerning:

- Pacific salmon within Proposed Project Area – identified in Table D-2; and
- Marine Fish Species within Proposed Project Area – identified in Table D-2.

1.3.4. EFH Species within the Transportation Routes

Information to be included concerning:

- Pacific salmon within Proposed Project Area – identified in Table D-2; and
- Marine Fish Species within Proposed Project Area – identified in Table D-2.

1.4. POTENTIAL EFFECTS TO EFH SPECIES AND ASSOCIATED MITIGATION OPTIONS

This section will identify potential construction and operations impacts to species with designated EFH (e.g., habitat loss, entrainment/impingement) within the Project area in a subsequent draft of this EFH Assessment, once further details are known on the siting of the Project. This section will also include a summary of the proposed mitigative measures developed to address potential impacts.

1.4.1. Potential Effects within Cook Inlet

Information to be included concerning potential impacts to EFH Species from:

- Liquefaction Facility Construction
  - dredging;
  - trestle construction; and
  - water use and water discharge during construction and operations.
- Pipeline Crossing of Cook Inlet

Information to be included concerning mitigation options for potential impacts

1.4.2. Potential Effects within the Pipeline Corridor

Information to be included concerning potential impacts to EFH Species from:

- construction of pipeline stream crossings; and
- potential fuel spills.

Information to be included concerning mitigation options for potential impacts.

1.4.3. Potential Effects within the Arctic Region

Information to be included concerning potential impacts to EFH Species from:

- GTP West Dock Modifications and channel dredging;
- pipeline crossings of rivers and streams with EFH species; and
- water use by GTP and pipeline from EFH bearing water bodies.

Information to be included concerning mitigation options for potential impacts.

1.4.4. Potential Effects within the Transportation Corridors

Information to be included concerning potential impacts to EFH Species from:

- transportation of construction materials and supplies – potential fuel spills;
- water use during construction from water bodies bearing EFH species;
- potential discharge from construction sites to water bodies bearing EFH species;
- LNG transport to markets; and
- potential for introducing invasive species introduction through ballast water.

Information to be included concerning mitigation options for potential impacts.

APPENDIX TABLE D-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
LIQUEFACTION FACILITY				
LNG Plant	None	NA	NA	
Marine Terminal	None	NA	NA	
PIPELINES				
Mainline	Bettles River	334-40-11000-2125-3912-4260	CHUMp	
	Middle Fork Koyukuk River	334-40-11000-2125-3912	CHUMp, CHINp	
	Middle Fork Koyukuk River	334-40-11000-2125-3912	CHUMp, CHINp	
	Minnie Creek	334-40-11000-2125-3912-4128	CHINr	
	Marion Creek	334-40-11000-2125-3912-4112	CHUMs; CHINr	

APPENDIX TABLE D-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
Mainline	Slate Creek	334-40-11000-2125-3912-4100	CHUMp; CHINp	
	No Name	334-40-11000-2125-3912-4076	CHINr	
	South Fork Koyukuk River	334-40-11000-2125-3740	CHUMp; CHINp; COHOp	
	Jim River	334-40-11000-2125-3740-4080	CHUMs; CHINs; COHOp	
	Douglas Creek	334-40-11000-2125-3740-4080-5062	CHINr	
	Prospect Creek	334-40-11000-2125-3740-4080-5030	CHINs,r	
	Yukon River	334-40-11000	CHUMp, CHINp; COHOp; PINKp; SOCKp	
	Hess Creek		CHUM	
	Chatanika River	334-40-11000-2490-3151-4020	CHUMp; CHINp; COHOp	
	Tanana River	334-40-11000-2490	CHINp; CHUMp;COHOp	
	Nenana River	334-40-11000-2490-3200	CHINp; CHUMp; COHOp	
	Nenana River	334-40-11000-2490-3200	CHINp; CHUMp; COHOp	
	Trib to June Creek	334-40-11000-2490-3200-4220-5005-6016	CHUMs, COHOs	
	June Creek	334-40-11000-2490-3200-4220-5005	CHUMs, COHOs	
	Panguingue Creek	334-40-11000-2490-3200-4075	COHOs, r	
	Chulitna River	247-41-10200-2381	CHINp; SOCKp; CHUMs; COHOp; PINKp	
	East Fork Chulitna River	247-41-10200-2381-3260	CHINs; COHOp; SOCKp	
	Honolulu Creek	247-41-10200-2381-3240	CHINs; COHOp, r	
	Pass Creek	247-41-10200-2381-3236	CHINp; SOCKp; CHUMp; COHOp; PINKp	
	Horseshoe Creek	247-41-10200-2381-3220	CHINp; SOCKp; CHUMp; COHOp; PINKp	
	Byers Creek	247-41-10200-2381-3180	CHINs; SOCKp; CHUMs; COHOs	
	Troublesome Creek	247-41-10200-2381-3130	CHINs; PINKs; CHUMs; COHOs	
	Chulitna River	247-41-10200-2381	CHINp; SOCKp; CHUMs; COHOp; PINKp	
	Trib Chulitna River	247-41-10200-2381-3060	COHOp	
	Trib Chulitna River	247-41-10200-2381-3051	COHOp	
	Trib Chulitna River	247-41-10200-2381-3007	COHOp	
	Trib Chulitna River	247-41-10200-2381-3007-4029	COHOp	

APPENDIX TABLE D-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
Mainline	Trib Chulitna River	247-41-10200-2381-3007-4017	COHOp	
	Trapper Creek	247-41-10200-2341	CHINr; COHOs, r	
	Trib to Rabideux Creek	247-41-10200-2291-3049	COHOs, r	
	Sawmill Creek	247-41-10200-2291-3041	COHOs, r	
	Trib to Sawmill Creek	247-41-10200-2291-3041-4002	COHOp	
	Queer Creek	247-41-10200-2291-3011	COHOr	
	Trib to Kroto Creek	247-41-10200-2081-3030	COHOp	
	Deshka River/Kroto Creek	247-41-10200-2081	CHINp,r; SOCKp,r; CHUMs; COHOs,r; PINKp	
	Fish Creek	247-41-10200-2053-3020-4015	CHINp,r; COHOr; SOCKp	
	Yentna River	247-41-10200-2053	CHINp,r; SOCKp,r; CHUMs; COHOs,r; PINKp	
	Anderson Creek	247-41-10200-2043	COHOp; PINKp	
	Alexander Creek	247-41-10200-2015	CHINp; SOCKp; CHUMp; COHOr; PINKp	
	Granite Creek	247-41-10200-2015-3017	COHOs,r; SOCKr	
	Lewis River	247-30-10070	CHINs,r; COHOr; PINKp	
	Theodore River	247-30-10080	CHINs,r; CHUMp; COHOr; PINKp	
	Pretty Creek	247-30-10090-2010	CHINr; COHOr; PINKs; SOCKr	
	Trib to Pretty Creek	247-30-10090-2010-3015	CHINs,r; COHOp; PINKs; SOCKp	
	Trib to Pretty Creek	247-30-10090-2010-3015-4015	CHINp; COHOp; PINKs; SOCKp	
	Olson Creek	247-30-10090-2020	CHINs,r; COHOs,r; PINKp	
	Beluga River	247-30-10090	CHINp,r; COHOp,r; PINKp; SOCKp,r	
	Threemile Creek	247-20-10002	CHINp,r; CHUMp; COHOs,r; PINKs; SOCKp	
PTTL	Shaviovik River	330-00-10310	PINKs	
	Sagavanirktok River	330-00-10360	CHUMp; PINKs	
	West Channel Sagavanirktok River	330-00-10361	CHUMp; PINKp	
PBTL	TBD			
PIPELINE ABOVEGROUND FACILITIES				
Compressor Stations	Not expected to impact			
Heater Station	Not expected to impact			
PTU Meter Station	Not expected to impact			
Prudhoe Bay Meter Station	Not expected to impact			

APPENDIX TABLE D-1

Freshwater Essential Fish Habitat Potentially Occurring in the Project Area

Facility	Waterbody Name	Anadromous Catalog and Atlas Number	Species	Preliminary Crossing Season/Method
Mainline Meter Station	Not expected to impact			
LNG Terminal Meter Station	Not expected to impact			
MLBVs (not on Compressor sites)	Not expected to impact			
PIPELINE ASSOCIATED INFRASTRUCTURE				
Access roads	TBD			
ATWS	TBD			
Contractor yards	TBD			
Pipe yards	TBD			
Construction camps	TBD			
Disposal sites	TBD			
Material sites	TBD			
GTP				
GTP	None	NA	NA	
ASSOCTIATED GTP INFRASTRUCTURE				
Module Staging Area	None	NA	NA	
Offshore West Dock	None	NA	NA	
Access Roads	None	NA	NA	
Construction Camp	None	NA	NA	
Material Sites	None	NA	NA	
Water Reservoir, Pump Facilities, Transfer Line	None	NA	NA	

_____

Notes: Several waterbodies are identified by a proper name and others that share a proper name with a different waterbody; therefore, the Alaska anadromous Catalog and Atlas number have been included in the table. NA = Not Applicable

Species Codes:

CHIN – Chinook salmon	PINK – Pink salmon		
CHUM – Chum salmon	SOCK – Sockeye salmon		
COHO – Coho salmon			
Life-stage Codes:	m-migration	p-present	r-rearing
	s-spawning		
Source Codes:			
1 – Alaska LNG Project survey data	2 – ADF&G Anadromous Waters Catalog (ADF&G, 2014a-c)		

OC - Open-cut conventional method; HDD - Horizontal directional drill; ISOLATED - Isolated open-cut method; AERIAL - Aerial crossing method

Several waterbodies in Appendix Table D-1 above are identified by a proper name and others that share a proper name with a different waterbody; therefore, the Alaska Anadromous Catalog and Atlas number have been included in the table.

APPENDIX TABLE D-2

Marine Essential Fish Habitat Occurring in the Project Area

Facility/Milepost	Waterbody Name	Fisheries Management Plan	Fishes	Potential Source / Season
LIQUEFACTION FACILITY				
LNG Plant	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[1] – marine stages Groundfish[2]; Forage fish[3]	Marine Discharge Potential for Spills/year-round
Marine Terminal	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[1] – marine stages; Groundfish[2]; Forage fish[3]	Habitat modification Potential for Spills Ballast Water/year-round
PIPELINES				
Mainline	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[1] – marine stages; Groundfish[2]; Forage fish[3] – egg larvae	HDD, In-water construction / TBD
PBTL	NA	NA	NA	NA
PTTL	NA	NA	NA	NA
PIPELINE ABOVEGROUND FACILITIES				
Compressor Stations	NA	NA	NA	NA
Heater Station	NA	NA	NA	NA
PTU Meter Station	NA	NA	NA	NA
Prudhoe Bay Meter Station	NA	NA	NA	NA
Mainline Meter Station	NA	NA	NA	NA
LNG Terminal Meter Station	NA	NA	NA	NA
MLBVs (not on Compressor sites)	NA	NA	NA	NA
PIPELINE ASSOCIATED INFRASTRUCTURE				
Access roads	NA	NA	NA	NA
ATWS	NA	NA	NA	NA
Contractor yards	NA	NA	NA	NA
Pipe yards	NA	NA	NA	NA
Construction camps	NA	NA	NA	NA
Disposal sites	NA	NA	NA	NA
Material sites	NA	NA	NA	NA
GTP				
GTP	NA	NA	NA	NA
ASSOCIATED GTP INFRASTRUCTURE				
Module Staging Area	NA	NA	NA	NA
Offshore West Dock	Beaufort Sea	Arctic FMP Alaska EEZ Salmon FMP	Arctic cod, saffron cod Salmon[1] – marine stages	West Dock Modifications / TBD
Dock Modifications	Beaufort Sea	Arctic FMP; Alaska EEZ Salmon FMP	Arctic cod, saffron cod, snow crab; Salmon[1] – marine stages	In-water Construction / TBD
Construction Camp	NA	NA	NA	NA
Material Sites	NA	NA	NA	NA

APPENDIX TABLE D-2

Marine Essential Fish Habitat Occurring in the Project Area

Facility/Milepost	Waterbody Name	Fisheries Management Plan	Fishes	Potential Source / Season
Water Reservoir, Pump Facilities, Transfer Line	NA	NA	NA	NA

[1] Alaska EEZ Salmon FMP	[2] GOA Groundfish FMP		[3] Forage Fish Complex
Chinook Salmon	Walleye Pollock	Dusky Rockfish	Osmeridae (smelt)
Chum Salmon	Pacific Cod	Thornyhead Rockfish	Myctophidae (lanterfish)
Coho Salmon	Sablefish	Atka Mackerel	Bathylagidae (deep-sea smelt)
Pink Salmon	Yellowfin Sole	Squids	Ammodytidae (sand lance)
Sockeye Salmon	Arrowtooth Flounder	Sculpins	Trichodontidae (sand fish)
	Northern Rock Sole	Skates	Pholidae (gunnels)
	Alaska Plaice	Sharks	Stichaeidae (pricklebacks)
	Rex Sole	Octopuses	Gonostomatidae (bristlemouths)
	Dover Sole	Southern Rock Sole	Euphausiacea (krill)
	Flathead Sole	Yelloweye Rockfish	
	Pacific Ocean Perch		
	Northern Rockfish		
	Shortraker Rockfish		
	Blackspotted / Rougheye Rockfish		

Sources: RR1; NPFMC, 2009, 2014; NPFMC et al., 2012

1.5. REFERENCES

Houghton, J., J. Starkes, M. Chambers, and D. Ormerod. 2005. Marine fish and benthos studies in Knik Arm, Anchorage, Alaska. Report prepared for the Knik Arm Bridge and Toll Authority, and HDR Alaska, Inc., Anchorage, AK, by Pentec Environmental, Edmonds, WA.

Logerwell, E., K. Rand, S. Parker-Stetter, J. Horne, T. Weingartner, and B. Bluhm. 2010. Beaufort Sea marine fish monitoring 2008: Pilot survey and test of hypotheses. Final Report prepared for USDOI/MMS BOEMRE 2010-08. Alaska Fisheries Science Center, NOAA/NMFS, Seattle, WA.

NMFS (National Marine Fisheries Service). 2005. Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. Alaska Region. Available at: http://alaskafisheries.noaa.gov/habitat/seis/efheis.htm. Accessed November 21, 2014.

NPFMC (North Pacific Fishery Management Council). 2009. Fisheries Management Plan for Fish Resources of the Arctic Management Area. August 2009. Anchorage, Alaska. 158 pp. Available online at http://alaskafisheries.noaa.gov/habitat/efh/descriptions.htm. Accessed October 29, 2014.

NPFMC (North Pacific Fishery Management Council). 2011. Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs. October 2011. Anchorage, Alaska. 229 pp. Available online at http://alaskafisheries.noaa.gov/habitat/efh/descriptions.htm. Accessed October 29, 2014.

NPFMC (North Pacific Fishery Management Council). 2014a. Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area. April 2014. Anchorage, Alaska. 164 pp. Available online at http://alaskafisheries.noaa.gov/habitat/efh/descriptions.htm. Accessed October 29, 2014.

NPFMC (North Pacific Fishery Management Council). 2014b. Fishery Management Plan for Goundfish of the Gulf of Alaska. January 2014. Anchorage, Alaska. 147 pp. Available online at http://alaskafisheries.noaa.gov/habitat/efh/descriptions.htm. Accessed October 29, 2014.

NPFMC (North Pacific Fishery Management Council). 2014c. Fishery Management Plan for the Scallop Fishery off Alaska. February 2014. Anchorage, Alaska. 175 pp. Available online at http://alaskafisheries.noaa.gov/habitat/efh/descriptions.htm. Accessed October 29, 2014.

NPFMC (North Pacific Fishery Management Council), National Marine Fisheries Service, Alaska Region, and State of Alaska Department of Fish and Game. 2012. Fishery Management Plan for the Salmon Fisheries in the EEZ off Alaska. June 2012. Anchorage, Alaska. 186 pp. Available online at http://alaskafisheries.noaa.gov/habitat/efh/descriptions.htm. Accessed October 29, 2014.

Tarbox, K. and R. Thorne. 1979. Measurements of fish densities under the ice in the Beaufort Sea near Prudhoe Bay, Alaska. In: Environmental studies of the Beaufort Sea - winter 1979. Report prepared for Prudhoe Bay Unit by Woodward-Clyde Consultants.

Williams, B.C., and S.E. Burril. 2011. 2010 Point Thomson Nearshore Fish Study. Prepared for ExxonMobil Development Company, Inc., Anchorage, AK, by LGL Alaska Research Associates, Inc., Anchorage, AK.

APPENDIX E ALASKA LNG PROJECT DRAFT AVIAN PROCTECTION PLAN

TO BE PROVIDED IN A SUBSEQUENT DRAFT OF THIS RESOURCE REPORT

Alaska LNG

DOCKET NO. PF14-21-000

DRAFT RESOURCE REPORT NO. 3

DRAFT AVIAN PROTECTION PLAN

PUBLIC VERSION

Document Number: USAKE-PT-SRREG-00-0003 – APPENDIX E

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APPENDIX F GENERAL IMPACTS AND MITIGATION MEASURES FROM SIMILAR PROJECTS IN ALASKA

Potential Impact	Project Activity												*Potential Plans to Address Impacts
	Grading, Clearing, Excavating (incl. Blasting), Trench, Pipelay, Backfill, Reclamation	Water Crossings (Pipelines & Bridges)	Ice Roads & Pads	Erosion Control & Drainage Control	Water Withdrawal & Usage	Water Discharge	Solid Waste Storage & Disposal	General Infrastructure Activities	Facility Construction	Facility Operations	Offshore Construction	Resource Report No.	
Air Emissions (including dust) from Construction	X	X	X	X	X	X	X	X	X		X	1, 9	C, J, O, T, W
Air Emissions from Operations										X		9	J, W, LL
Surface Water Quality Impacts (Increased Turbidity [TSS] / Sedimentation in Surface Water)	X	X	X	X	X	X	X	X	X	X	X	2, 3, 7	G, H, J, T, V, Y, II, KK
Contamination Migration	X	X				X	X	X		X		1, 2, 3, 7	G, I, GG
Disruption / Loss of Wildlife, Fish or Marine Mammal Habitat	X	X	X	X	X	X		X	X	X	X	2, 3	A, B, C, G, H, K, N, R, V, DD, EE, JJ
Disturbance & Vessel Strikes from Vessel Traffic								X		X	X	3	B, N
Disturbance of Known Historic Archaeological or Architectural) and Paleontological Resources	X	X	X					X	X		X	1, 4, 6, 7	C, D, E, Z, AA
Erosion	X	X		X		X			X		X	1, 2, 6, 7, 8	G, H, II, KK
Groundwater Impacts (Withdrawal, Drawdown, Vertical & Horizontal Hydraulic connectivity, Wells)	X	X	X		X				X	X		1, 2	Y, MM
Hazards to Aviation								X	X	X		1, 11	M
Hazards to Marine Navigation		X						X			X	1, 11	B, M
Inadvertent HDD Mud Release		X										1, 2, 3, 7	I
Incidental Take of Wildlife, Birds, & Marine Mammals	X	X	X		X	X	X	X	X		X	3	A, B, C. F, G, H, N, R
Increased Surface Water Runoff	X			X		X			X	X		2, 3, 7	Y, II
Introduction of Non-native Species	X	X	X			X		X	X	X	X	2, 3	G, K, KK
Impact to Public Use or Public Land	X	X						X	X	X	X	1, 2, 3, 8	B, F, H, L, BB, CC, FF
Impacts to existing infrastructure	X							X	X	X	X	1, 2, 3, 7, 8	M, S, U
Construction Noise Impacts	X	X						X	X			3, 9	C, F, P, N, FF, JJ
Operational Noise Impacts										X		9	F, P, FF
Potential Impacts to Vegetation, Wildlife, Fish, Birds, & Threatened Species	X	X	X	X	X	X	X	X	X	X	X	1, 2, 3, 6, 7, 8, 9	A, C. G, H, K, Q, R, T, DD,EE, JJ
Fish passage impacts		X										3	H, DD, JJ
Reduced Surface Water Recharge Rates	X		X		X	X						2, 3, 6	V, Y, MM
Watercourse Realignment and Scouring		X		X		X		X	X			2	G, H, V
Seismic Hazards / Mass Wasting, Soil Liquefaction	X	X						X	X	X	X	1, 6, 11	X
Tundra Degradation, Thermokarst	X	X	X	X	X				X	X		2, 3, 6, 7	G, X, KK
Unanticipated Discovery of Cultural Resources	X	X	X					X	X		X	1, 4	D, E
Unanticipated Discovery of Paleontological Resources	X	X						X	X		`	1, 4, 6	C, Z, AA
Unplanned spills/releases		X							X	X	X	2	G, I, HH, II
Vegetation & Topsoil Degradation or Loss	X		X	X				X				3, 7	G, II, KK

Potential Impact	Project Activity												*Potential Plans to Address Impacts
	Grading, Clearing, Excavating (incl. Blasting), Trench, Pipelay, Backfill, Reclamation	**Water Crossings (Pipelines & Bridges)**	**Ice Roads & Pads**	**Erosion Control & Drainage Control**	**Water Withdrawal & Usage**	**Water Discharge**	**Solid Waste Storage & Disposal**	**General Infrastructure Activities**	**Facility Construction**	**Facility Operations**	**Offshore Construction**	**Resource Report No.**	
Vertical and Horizontal Hydraulic Connectivity of Ground Water and Surface Water (Groundwater Discharge to Surface Water)	X	X	X		X	X			X		X	2, 3	C, G, X, Y, MM
Visual Impacts	X	X					X	X	X	X	X	1, 8	L, V, CC
Waste from Construction and Operations - Liquid and Solid, Hazardous and Non-Hazardous									X	X		2, 8	T
Impacts to Wetlands – footprint and functionality									X			2	DD, EE
***Potential Plans to Address Activity**	**A, C, D, E, G, K, L, O, P, R, Z, GG, II, KK**	**D, E, G, H, I, K, L, O, V, Y, DD, EE, II, JJ**	**G, L, O, R**	**G, L, O, V, II, KK**	**G, L, O, MM**	**G, K, L, O Y, MM**	**G_T O, T, Y, GG, HH**	**D, G, M, O, R, S, HH, II**	**D, E, F, G, K, M, P, R, S, T, W, X, Z, FF, GG, HH, JJ, II, MM**	**F, HH, J, K, O, P, R, T, W, FF, MM**	**D, E, G, M, N, O, P, Q, R, W**	**All**	

List of Potential Plans*

A.	Avian Protection Plan
B.	Marine Logistics Shipping Plan
C.	Blasting Plan
D.	Unanticipated Cultural Resource Discovery Plan
E.	Cultural Resources Data Recovery Plans and/or Treatment Plans
F.	Ambient Noise Level Studies
G.	FERC 2013 Wetland and Waterbody Construction and Mitigation Procedures with Requested Project-Specific Variances (the Applicants' Procedures) AKLNG Procedures
H.	Site-specific Waterbody Crossing Plans
I.	HDD Inadvertent Release Plan (Project Specific HDD Contingency Plan)
J.	Health Impact Assessment
K.	Invasive Species Mitigation Plan
L.	Public Land Construction Plan
M.	Project Logistics Plans
N.	Marine Mammal Mitigation and Monitoring Plan
O.	Mobile Emissions Control Plan
P.	Noise Control and Mitigation Plan
Q.	Plan of Cooperation (POC)
R.	Polar Bear and Wildlife Interaction Plan
S.	Project Transportation Plan
T.	Project Waste Management Plan
U.	Project-specific Railroad crossing Plans
V.	Riparian Buffer Planting Plan
W.	Modeling Site-specific Impacts to Air Quality Emissions
X.	Site-specific Geohazards Plan
Y.	Water Monitoring Plan
Z.	Unanticipated Paleontological Discovery Plan
AA.	Paleontological Resources Management Plans
BB.	Site-specific Public Land Use and Recreational Use Coordination Plans
CC.	Visual Aesthetics Study
DD.	Site-specific Wetland Resources Crossing Plans (as required)
EE.	Wetland Mitigation Plans
FF.	Site-specific Noise Mitigation Plans (as required)
GG.	Unanticipated Contamination Discovery Plan
HH.	Spill Prevention, Control, and Countermeasure Plan (SPCC)
II.	Storm Water Pollution Prevention Plan (SWPPP) – general and spread specific
JJ.	Species-specific Wildlife Protection Plan
KK.	FERC 2013 Upland Erosion Control, Revegetation, and Maintenance Plan with Requested Project-Specific Variances (the Applicants' Procedures) AKLNG Plan
LL	Design/Operations Emissions Management Plan
MM	Groundwater Management Plan

* In addition to the potential plans listed above, FERC requires implementation plans that outline how the Project will meet all required environmental permits and stipulations. The applicants will also prepare overarching Construction Environmental Management Plans and Operations Environmental Management Plans for the Project.