BIOLOGICAL OPINION

For

Willow Master Development Plan

Consultation with the
Bureau of Land Management

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LIST OF ABBREVIATIONS USED IN THIS DOCUMENT

ABR	Alaska Biological Research, Inc.
ACP	Arctic Coastal Plain
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
AO	Authorized Official
AOGCC	Alaska Oil and Gas Conservation Commission
BA	Biological Assessment
BMP	Best Management Practice
BLM	Bureau of Land Management
BO	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CFWR	Constructed Freshwater Reservoir
CI	Confidence Interval
CPF	Central Processing Facility
CRD	Colville River Delta
CS	Chukchi Sea Subpopulation of Polar Bears
DEIS	Draft Environmental Impact Statement
DMA	Division of Management Authority
DOI	Department of Interior
DPS	Distinct Population Segment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FR	Federal Register
GIS	Geographic Information System
HSM	Horizontal Support Member
IPCC	Intergovernmental Panel on Climate Change
ITRs	Incidental Take Regulations
ITS	Incidental Take Statement
IUCN	International Union for Conservation of Nature and Natural Resources
LBCHU	Ledyard Bay Critical Habitat Unit
LOA	Letter of Authorization
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MSIP	Multi Season Ice Pad
MTR	Marine Transit Route
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPR-A	National Petroleum Reserve Alaska
NSE	North Slope Eider Survey
NSIDC	National Snow and Ice Data Center
OC	Organochlorine Compound
OSR	Oil Spill Response Plan
PBCMP	Polar Bear Conservation Management Plan

PBF	Physical or Biological Features
PBSG	Polar Bear Specialist Group
PCB	Polychlorinated Biphenyls
PCE	Primary Constituent Element
PCH	Porcupine Caribou Herd
POP	Persistent Organic Pollutant
ROD	Record of Decision
ROP	Required Operating Procedure
RPM	Reasonable and Prudent Measure
SBS	Southern Beaufort Sea Subpopulation of Polar Bears
SE	Standard Error
SD	Standard Deviation
SPCCP	Spill Prevention, Control, and Countermeasure Plans
STP	Seawater Treatment Plant
TAPS	Trans-Alaska Pipeline System
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VSM	Vertical Support Member

1. INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service's or USFWS') biological opinion (BO) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.), on the effects of the Bureau of Land Management's (BLM's) proposed authorization for Conoco Phillips Alaska Inc. (CPAI) to construct, operate, and maintain the Willow Master Development Plan (MDP) on lands managed by BLM within the National Petroleum Reserve in Alaska (NPR-A). This BO evaluates the potential effects of the Willow MDP on species under the Service's jurisdiction that are listed as threatened or endangered, and designated critical habitat pursuant to the ESA.

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitats on which they depend. Section 7(a)(2) of the ESA states that Federal agencies must ensure that their activities are not likely to:

- Jeopardize the continued existence of any listed species, or
- Result in the destruction or adverse modification of designated critical habitat.

Federal agencies fulfill this obligation by consulting with the Service or National Marine Fisheries Service (NMFS), depending on the species potentially affected (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and the consulting agency (the Service or NMFS, as appropriate) concurs, consultation concludes informally (50 C.F.R. §402.14(b)). In the event of a determination that one or more listed species or designated critical habitat are "likely to be adversely affected" by the action, formal consultation is conducted. In this case, the BLM determined (BLM 2020a) that one or more listed species would likely be adversely affected by the proposed Willow MDP, so formal consultation was initiated.

Section 7(b)(3) of the ESA requires that at the conclusion of formal consultation, the consulting agency provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If the action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat, the consulting agency provides reasonable and prudent alternatives that can be taken by the Federal agency or the applicant that allow the action to proceed in compliance with section 7(a)(2) of the ESA.

The consultation addresses potential effects of the Willow MDP on threatened spectacled eiders (*Somateria fischeri*), Alaska-breeding Steller's eiders (*Polysticta stelleri*), polar bears (*Ursus maritimus*), northern sea otters (*Enhydra lutris kenyoni*), and areas designated as critical habitat for these four species, as appropriate. We used information provided in the Biological Assessment (BA; BLM 2020a), errata to the FEIS (BLM 2020b), communications with BLM, previous BOs, other Service documents, and published and unpublished literature to develop this BO.

2. DESCRIPTION OF THE PROPOSED ACTION

Proposed Action
Based on information provided by BLM, CPAI would construct a gravel road from the existing Greater Mooses Tooth 2 (GMT-2) development in northeast NPR-A, southwest to the Willow MDP project area. Components of the Willow MDP would include: the Willow Processing Facility (WPF), Willow Operations Center (WOC), five gravel drill pads, gravel infield and access roads, an airstrip, pipelines, the Tiŋmiaqsiuġvik gravel mine site, multi-season ice pads (MSIPs), modifications to Oliktok Dock and annual screeding for barge lightering, and sealift operations during construction (Figure 2.1). All permanent gravel infrastructure would be constructed to a minimum thickness of 5 feet (1.5 m), with 2:1 side slopes, and with embankment erosion protection as necessary. Individual project components are described in more detail below.

Figure 2.1. Overview of the proposed Willow Development in northeast NPR-A, existing Kuparuk Unit infrastructure east of the Colville River, and Oliktok Dock.

Willow Processing Facility
The roughly 22.8 acre (0.092 km^2) WPF pad would house facilities for separating and processing produced multiphase fluids (e.g., oil, gas, and water), and facilities for delivering sales-quality oil to the Trans-Alaska Pipeline System (TAPS). Produced water would be processed at the

WPF and re-injected to the subsurface to maintain reservoir pressure. Produced natural gas would fuel the WPF and other equipment including electrical power generation, or be re-injected to the subsurface to maintain reservoir pressure, or be used for gas lift. At times, produced gas may also be flared. Processing equipment at the WPF would include emergency shutdown equipment, power generators, compressors, gas treatment facilities, heat exchangers, separators, a flare system, pumps, pigging and metering facilities, warm storage, fuel storage and dispensing facilities, and a tank farm. The WPF would be approximately 20.1 mi (32.3 km) from the Beaufort Sea coast.

Willow Operations Center
The roughly 31.3 acre (0.13 km^2) WOC pad would be near the WPF and adjacent to the airstrip approximately 19.2 mi (30.8 km) from the coast. The WOC would house utility and storage facilities, including camp living quarters, offices, meeting and dining facilities, a laboratory, and medical clinic. The WOC would also house water and wastewater treatment plants, water tanks, chemical storage, a Class I injection well, generators, hazardous waste storage, a mud plant, drilling, fleet maintenance, and fabrication shops, and a municipal solid waste incinerator. Additionally, the WOC would include an emergency response center with spill response shop, fire department, and ambulance bay.

Airstrip – A gravel airstrip would be constructed adjacent to the WOC to provide year-round access to the Willow Development area. The airstrip would be 6,200 × 200 feet (1,890 × 61 m) with an area of 42.1 acres or 17 km^2. The airstrip would also house an air traffic advisory center, approach lighting, and airstrip module lighting pads. Fueling and chemical de-icing would occur on the airstrip apron.

Communications Tower Pad – A 0.5 acre (0.002 km^2) communications tower would be constructed adjacent to the WOC on a separate pad to comply with Federal Aviation Administration (FAA) requirements. This pad would be approximately 19.4 mi (31.3 km) inland, and would house communications infrastructure including a self-supported 200-ft (61-m) communications tower. The tower would be lighted in compliance with FAA regulations.

Gravel Roads
In total, approximately 37 mi (59.5 km) of new permanent gravel roads would be constructed to support the Willow MDP covering an area of 257.2 acres (1.04 km^2). Gravel roads would be at least 5 ft thick with 2:1 side slopes to maintain tundra thermal regime. Road width would vary depending on the road, purpose, and location. Specifically:

- Access roads to water sources, the airstrip, BT3, BT4, and B5 would be 24 feet (7.3 m) wide at the surface with an average toe-to-toe width of 53 feet (16.2 m);
- Access roads to GMT-2, BT1, and BT2 would be 32 feet (9.8 m) wide at the surface with an average toe-to-toe width of 61 feet (18.6 m).

Roads would be constructed at least 500 feet (152.4 m) from pipelines to the extent practicable, but with no more than 1,000 feet (305 m) of separation to facilitate road-based visual pipeline monitoring.

Roadway Turnouts and Subsistence Ramps - Eight turnouts with subsistence ramps would be constructed, with one located roughly every 2.5 to 3 mi (4.0 to 4.8 km). Turnouts and subsistence ramps would impact approximately 3 acres (0.012 km^2) total.

Boat Ramps – Up to three boat ramps would be constructed to support local subsistence access. Boat ramps would be constructed to provide access at:

- Ublutuoch River – between Alpine CD5 and GMT-1;
- Iqalliqpik Creek – pending community input; and
- Uvlutuuq Creek – pending community input.

Boat ramps would include a pad with space for vehicles to turnaround and parking for approximately 10 trucks with trailers. Ramp footprints would vary by location but are estimated to be approximately 1.8 to 2.1 acres (0.007 to 0.008 km^2) per boat ramp for a total of 5.9 acres (0.024 km^2) including access roads and parking areas. Pile driving for boat ramp construction is not anticipated. Boat ramps would be designed and constructed to avoid impacts on fish and fish habitat in consultation with BLM and ADF&G.

Bridges – Seven bridges would be constructed with minimum bottom chord clearance of 4 feet (1.2 m) above the 100-year design flood elevation, or 3 feet (0.9 m) above the highest documented flood elevation, whichever is higher. The Iqalliqpik and Uvlutuuq creek bridges would be designed to maintain a 13 foot (4.0 m) bottom chord clearance above the 2-year design flood elevation to provide vessel clearance.

Shorter, single-span bridges would be designed, where practicable to avoid placement of piers in the main channel. Multi-span bridges would be constructed on steel-pile pier groups placed approximately 40 to 70 feet apart (12.2 to 21.3 m) with sheet pile abutments above ordinary high water at each end.

Bridges would range from 40 to 420 ft (12.2 to 128 m) in length, and all bridges would be 32 ft wide to accommodate drill rig movement. Specific bridge locations would include crossings at: Iqalliqpik, Kayyaaq, and Uvlutuuq creeks, and Willow Creek 2, Willow Creek 4, Willow Creek 4A, and Willow Creek 8.

Culverts – Culverts would be designed to maintain fish passage and stream flow. Culverts would be placed in the road to maintain natural surface drainage, and culverts at stream or swale crossings would be placed perpendicular to the road, where feasible. Fish-passage culverts would be placed as required by ADF&G. Final culvert design, number, and locations would be determined based on field conditions and direct observation, and installation would take place before breakup in the first construction season. Approximately 195 cross-drainage culverts are expected at 1,000 foot (304.8 m) intervals. Additional culverts may be placed as site-specific needs are assessed.

Gravel Pads

Drill Pads – The Willow MDP would involve construction of five Bear Tooth Unit drill sites: BT1, BT2, BT3, BT4, and BT5 to house 251 total wells. Collectively, drill pads would occupy approximately 79.8 acres (0.32 km^2). Each drill pad would accommodate 40 to 70 wells, drilling and operations facilities, wellhead shelters, drill rig movement, and material storage. Drill pads would also include emergency shutdown equipment, operations storage and stand-by tanks, pipe racks and/or manifold piping valves, high-mast lights, and communications infrastructure. Production and injection wells would use hydraulic fracturing and directional drilling to access targeted reservoirs. Flaring of produced gas may occur at BT1 and BT2, during well predrilling, cleanout, and testing, and at the WPF over the life of the development.

Hydraulic Fracturing Operations – At drill pads, each production well would undergo multistage hydraulic fracturing by isolating well sections and pumping gelled seawater or brine mixed with a proppant (small beads of sand or human-made ceramic material) at high pressure into the formation. Each well would be hydraulically fractured once, with approximately 12 to 20 individual fracturing locations within the well. Hydraulic fracturing operations would last approximately 6 days per well, with six wells per pad per year being fracture stimulated. Two hydraulic fracturing operations could occur concurrently, although not on the same pad; although fracturing operations and well drilling may be concurrent on the same pad. Total water use for hydraulic fracturing would be approximately 14,000 to 24,000 barrels (0.6 to 1.0 million gallons [MG]) of seawater per well. All hydraulic fracturing would comply with Alaska Oil and Gas Conservation Commission regulations (20 AAC 25.283).

Valve Pads – Pads to accommodate isolation valves would be constructed on either side of pipeline crossings at Uvlutuuq (Fish) and Iqalliqpik (Judy) creeks. In total, approximately 1.3 acres (0.005 km^2) would be impacted by construction of four valve pads. Valve pads would be set back 400 to 2,000 feet (122 to 610 m) from creeks.

Pipeline Pads – Four pads would be constructed to support pipeline construction and operations. These pads would include:

- A 0.5 acre (0.002 km^2) pipeline pad would be constructed at the proposed import/export pipeline near GMT-2 to allow ice road crossings. Pipelines at this crossing would be placed in casings through the gravel pad embankment;
- Two horizontal directional drilling (HDD) pads would be constructed on either side of the Colville River near the existing Alpine Pipeline HDD. Equipment on the west bank pad would include a rectifier (anti-corrosion system) and electrical instrumentation module, and both pads would include thermosiphons. In total, HDD pads would impact 1.5 acres (0.006 km^2); and
- A 0.7 acre (0.003 km^2) tie-in pad for the Willow export pipeline would be constructed near the Alpine pipeline and CD4N. This pad would house modules for pigging, overpressure protection, metering equipment, infrastructure to facilitate warm-up or de-inventory the Willow export and seawater pipelines.

Water Source Access Pads – Two freshwater source access pads would be constructed to facilitate access to Lake L9911 and the constructed freshwater reservoir (CFWR). Each pad would be 1.3 acres (0.005 km^2).

Gravel Sources

Tiŋmiaqsiuġvik Mine Site - The Tiŋmiaqsiuġvik Mine Site would be composed of two cells; Mine Site Area 1 and Mine Site Area 2, at 109.3 acres (0.44 km^2), and 40.4 acres (0.16 km^2), respectively. Mine Site Area 2 would be developed first, followed by Mine Site Area 1. The

Mine Site would be developed with vertical walls and horizontal benches to create an effective side slope of 3:1, and a total disturbance area of 149.7 acres (0.61 km^2). Mine site development would proceed in three separate stages:

1. Organic material would be loosened through trimming, followed by removal with an excavator, dozer, and/or front-end loader;
2. Removal of inorganic overburden through drilling and blasting; and
3. Excavation and removal of suitable gravel material through drilling and blasting, followed by removal with heavy equipment.

Mine Site Access - Access for development and excavation of either cell would be via a seasonal ice road. No permanent gravel road would be constructed for mine site access. Summer access to the mine site would be by helicopter. Additionally, a 10-acre (0.04 km^2) multi-season ice pad (MSIP), and several single-season ice pads, 188 acres total (0.76 km^2), would be constructed adjacent to the mine site for:

- Stockpiling organic and inorganic overburden;
  - Stockpiles would be up to 30 feet (9.1 m) high with 3:1 side slopes, and stockpile storage areas would be sized to accommodate roughly one third of the total overburden quantity generated from the mine site;
  - Following the second season of mining activities, overburden material would be removed from the ice pad and returned to the mined area;
  - Overburden stockpiling would only be necessary for approximately two years during mine development. In subsequent seasons, overburden would be placed within previously excavated areas of the mine site to minimize overall footprint;
  - Mine site cells would require dewatering and water within the mine site would be discharged through a diffuser onto the tundra close to the Ublutuoch River, near Bill's Creek; and
  - Some inorganic overburden would be used to construct water diversions as needed around the perimeter of each cell, and a perimeter berm would be constructed around the entire Tiŋmiaqsiuġvik *Mine Site*.
- Storing excavated material over summer;
- Housing construction equipment; and
- Providing the mine site perimeter.

Mine site rehabilitation – When material is no longer needed from the Tiŋmiaqsiuġvik Mine Site, it will be allowed to naturally fill with water. There would be no constructed hydraulic connection to the mine site from any adjacent stream. Complete mine site recharge is estimated to take a decade or longer. Overburden and some berm material would be used to finish grade the excavated area, with the objective of protecting and stabilizing adjacent permafrost and tundra. Perimeter berms would be incrementally expanded to function as thermal berms. Following completion of rehabilitation efforts, all equipment and waste materials would be removed from the site, and CPAI would monitor rehabilitation for two years post-completion and until the site fills with sufficient water to prevent erosion and thermal degradation.

Other gravel sources – Existing Kuparuk area gravel sources such as Mine Sites C, E, and F may also be utilized for the Willow MDP.

Modifications to existing infrastructure

Road from Oliktok Dock to DS2P – Some curves along the existing road from Oliktok Dock to DS2P would be widened to accommodate sealift module transport. Approximately 5.0 total acres (0.02 km^2) would be impacted by curve widening.

Oliktok Dock modifications – To accommodate 25-foot-high (7.6 m) side-shell sealift barges, the existing dock surface would be raised approximately 6 feet (1.8 m) by adding structural components and a gravel ramp. All modifications to the dock would be within the existing footprint.

An existing 12.0-acre (0.05 km^2) staging pad approximately 2 miles (3.2 km) south of Oliktok Dock would be modified with new gravel to create a minimum thickness of 5 feet (1.5 m). Rig mats would then be installed on the surface to provide further structural support for module storage. No changes would be made to the existing pad footprint.

The existing 2-mile-long (3.2 km) gravel road from Oliktok Dock to the staging pad would be modified to a minimum 5 foot (1.5 m) thickness. This modification would require 40,300 cubic yards (30,800 m^3) of gravel and increase the road footprint by less than 0.1 acre (0.0004 km^2). Additionally, an estimated 12 culverts would be extended within this segment to accommodate the thicker roadway.

Some curves would be widened to accommodate the turning radius of 200-foot-long (61 m) self-propelled module transporters (SPMTs). Approximately 5.0 acres (0.02 km^2) of additional gravel fill would be placed along the existing gravel road to widen these curves within the Kuparuk area. Culverts would be extended as needed. Gravel fill for cure widening would be placed during summer using material acquired from an existing Kuparuk mine site (e.g., Mine Sites C, E, and/or F).

Module storage, transport, Alpine Ice Road and Colville River crossing – Sealift modules stored over winter would be skirted to prevent snow from accumulating beneath them. Each January following a sealift module delivery, modules and other materials would be transported using SPMTs from the staging pad near Oliktok Dock along existing gravel roads to a temporary staging ice pad near DS2P (Figure 3.1). Modules would then be transported on a task specific heavy-haul ice road to GMT-2, crossing the Colville River on a partially-grounded ice bridge near Ocean Point (Figure 3.1). From GMT-2 to the WPF, modules would be transported over the Willow Development gravel access road.

The Colville River crossing location near Ocean Point was selected based on the following engineering factors:

- Maximum allowable ice road grades for SPMT travel;
- Assumed SPMT dimensions of 27 feet wide × 200 feet long (8.2 × 61 m); and
- A suitable Colville River crossing location (as described below).

The 60-foot-wide (18.3 m), 40.1-mile-long (64.5-km) heavy-haul ice road for module transport would be constructed from both the east and west ends at DS2P and GMT-2, respectively. The segments would meet at the Colville River crossing near Ocean Point where an engineered ice crossing would be constructed to provide sufficient load-carrying capacity to support the sealift modules and SPMTs. The partially-grounded-ice crossing would be approximately 1 river mile (1.6 km) downstream (south) of Ocean Point (as defined on U.S. Geological Survey topographic quadrangle A3 – Harrison Bay). The specific crossing location was selected based on favorable conditions for hydrology, topography, and bathymetry. The crossing location was also sited far enough upstream from the Colville River Delta (CRD) to minimize potential impacts to fish passage.

The Colville River ice crossing would be approximately 2,800 feet (853 m) long from top of bank to top of bank (approximately 700 feet long [213 m] from edge of water to edge of water), and 65 feet wide at the travel surface. Approach and departure ramps at the riverbanks may be wider depending on the amount of fill ice required to construct them. Total ice thickness of the ramp and crossing would range up to 7.1 feet (2.2 m) from the river bottom (natural ice thickness in this area varies and was 0.5 to 6.2 feet [0.15 to 1.9 m] thick in April 2019).

Kuparuk River Unit CPF2 – The Willow MDP would include a 1 acre (0.004 km^2) expansion of the existing gravel pad at Kuparuk River Unit (Kuparuk) central processing facility 2 (CPF2), to accommodate installation of new modules and equipment. New modules and equipment at Kuparuk CPF2 would include:

- Diesel transfer tanks, pumps, and pigging facilities for delivery to the Alpine processing facility (at Alpine CD1) and WPF;
- Seawater transfer pumps and pigging facilities for delivery to the WPF; and
- Infrastructure to facilitate warm-up or de-inventory of the Willow Pipeline and seawater pipeline.

Modules, equipment, and storage tanks would be installed on the Alpine CD1 pad at the Alpine processing facility for the following purposes:

- Drag reducing agent tanks and injection equipment for the Alpine sales oil pipeline system;
- Crude oil surge drum and associated equipment for pressure management of the Alpine sales oil pipeline system;
- Diesel tanks and pigging facilities to receive product from Kuparuk CPF2; and
- Infrastructure to facilitate warm-up or de-inventory of the Willow Pipeline and seawater pipeline

The Alpine CD1 pad would not require expansion to accommodate the additional facilities described above.

Pipelines

The Willow Development would include infield pipelines and import/export pipelines. Infield pipelines between the WPF and each drill site would carry produced fluids, produced water, seawater, miscible injectant, and gas. Additional infield pipelines would include a freshwater pipeline from the CFWR to the WOC, and treated water and fuel gas pipelines from the WPF to WOC. The Willow export pipeline would carry crude oil processed at the WPF to a tie-in with the existing Alpine sales pipeline near Alpine CD4N. Other import/export pipelines would include a seawater pipeline from Kuparuk CPF2 to the WPF.

All pipelines would be aboveground and supported by vertical support members (VSMs), except at road and river crossings. Pipelines would be non-reflective. VSMs would be roughly 55 feet (17 m) apart and at least 7 feet (2.1 m) above ground. Each VSM would have a typical diameter of 12 to 24 inches (30 to 61 centimeters) and a disturbance footprint (diameter) of 18 to 32 inches (46 to 76 centimeters or 5.6 $feet^2$). Approximately 13,000 new VSMs would be installed with an overall disturbance footprint of approximately 0.81 acres (0.003 km^2). Pipelines would be offset between 500 and 1,000 feet (152 to 305 m) from gravel roads where practicable. Where pipelines would parallel existing pipelines, new VSMs would be aligned with existing VSMs to the extent practicable.

At Uvlutuuq and Iqalliqpik creeks, pipelines would be placed on structural steel supports attached to bridge girders. At smaller stream crossings, pipelines would be installed on VSMs roughly perpendicular to the channel. VSM placement in streams would be avoided to the extent practicable.

VSMs would also support fiber-optic communications and power cables with a minimum clearance of 7 feet (2.1 m) above ground level. At pipeline-road crossings, fiber optic and power cables would be installed in the road bed. Cable trenches would be excavated during winter, material would be temporarily sidecast, and backfilled into the trench following cable placement. Cables may also be buried in the HDD pads.

Camps
A camp to support construction would be required at the WOC. Additionally, existing camp space at Alpine, Kuukpik Pad, and Sharktooth would be used. A temporary camp to support ice road construction for module delivery would be located on an ice pad near Kuparuk DS2P. Construction workers may also be lodged at the Kuukpik Hotel in Nuiqsut. Camps to support drilling operations would be located at each drill site. A permanent camp to support Willow MDP operations would be located on the WOC pad (Figure 3.1).

Power Generation and Distribution
Electrical power for the Willow MDP would be generated by a 98-megawatt power plant at the WPF equipped with natural gas-fired turbines. Power would be delivered to each drill site and the WOC via power cables suspended from pipeline horizontal support members (HSMs). Following WPF startup, the power plant would also power drill rigs, except during periods when power from the WPF is unreliable.

During construction and drilling, prior to completion of the permanent power supply, portable generators would provide temporary power at various locations. Portable generators would be fueled by ultra-low sulfur diesel. Once fuel gas is available for the WPF turbines, on startup of the WPF, diesel-fired emergency backup generators would be installed at the WPF and at the Willow Camp (located at the WOC). Portable diesel-fired emergency backup generators would be available to provide emergency power at drill sites. Permanent electric power generator sets would be fully enclosed or acoustically packaged to reduce noise emissions.

Communications
Communications infrastructure throughout the Willow MDP area would be provided by fiber-optic cables suspended from pipe rack HSMs. A total of six permanent communication towers would be located on the communications tower pad near the WOC and at each drill site. The communications towers would be up to 200 feet (61 m) tall, triangular, self-supporting lattice towers and will not use guy-wires. Temporary towers would be pile supported and may require guy-wire supports. Guy-wires would include bird diverters to reduce and avoid bird strikes. All communication towers would have warning lights in compliance with Federal Aviation Administration regulations. Bird nesting diversion tactics may be installed on towers consistent with ROP A-8 (BLM email 4/13/20 updating Table 9 of the Willow MDP BA [BLM 2020a]).

Water Use
Freshwater would be required for domestic use (discussed in *Potable Water* section) at Willow MDP camps and for ice road and pad construction and maintenance. Freshwater would also be used for hydrostatic pipeline testing with specific volumes required based on pipeline diameter and length.

Ice road widths would be 35 feet (11 m) to 70 feet (21 m) depending on purpose and use, and freshwater volumes required for construction would vary from approximately 1.0 to 2.5 MG, respectively. Approximately 0.25 MG of freshwater would be required to construct 1 acre of ice pad. MSIPs would require approximately 0.25 MG of water per acre, per foot of thickness; Willow MSIPs would typically be between 5 to 7 feet thick (including insulation and rig mats), depending on site-specific topography. MSIPs would be individually engineered based on geographic and seasonable variables; approximately 0.25 MG of water per acre, per foot of MSIP thickness is used as a high-level estimate for construction. Water for ice roads and pads would be withdrawn from lakes near the construction activities, as allowed by Alaska Department of Natural Resources water rights and temporary water use authorizations. Some water for construction of the Colville River crossing may be sourced from the Colville River.

Freshwater would also be required for domestic use at camps and during drilling activities. A demand of 100 gallons per person per day is estimated. Prior to WPF startup, freshwater would be used for drilling and hydraulic fracturing. Drilling water requirements would be 1.4 MG per drilling rig per month for each of the two drilling rigs; hydraulic fracturing would require approximately 1.0 MG water per well. Following WPF startup, freshwater needs to support well drilling would drop to approximately 0.4 MG per well, with the remaining drilling and hydraulic fracturing water being seawater sourced from the Kuparuk Seawater Treatment Plant. Freshwater for drilling may be withdrawn from lakes near the Willow MDP area using a temporary triplex pump and truck connection, as allowed by temporary water use authorization and fish habitat permits, where necessary.

In total, the Willow MDP is expected to use 1,919.6 MG of freshwater over the 30-year life of the development. During construction, seawater would be used for ballast to support barge delivery at Oliktok Dock. After WPF startup, seawater would be used for hydraulic fracturing of production and injection wells, for drilling, and for reservoir injection to support enhanced oil recovery. Hydraulic fracturing would require approximately 1.0 MG of seawater per rig per month for each of the two operating drilling rigs. Enhanced oil recovery would require approximately 2.1 to 3.8 MG of seawater per day beginning in 2025.

Constructed Freshwater Reservoir
The CFWR will be constructed to ensure the Willow Development has a reliable source of freshwater. The CFWR would be roughly 700 ft (213 m) wide by 800 ft (244 m) long and 50 ft (15.2 m) deep. Additionally, a 1,325 ft (404 m) long by 15 ft (5 m) wide (at the bottom) connection channel would be trenched to connect the CFWR to Lake M0015 for initial reservoir flooding and annual recharge. The connection channel would be up to 10 ft (3 m) deep with 6:1 side slopes, and flow control gate and sheet pile weir to prevent fish access to the CFWR. During low water periods, the flow control gate would be closed so that water is not diverted into the CFWR. The CFWR would not be refilled during periods of low flow. The CFWR would be recharged annually during spring breakup (i.e., high water).

The CFWR would be accessed by a 0.3 mi (0.0003 km) gravel road from BT3, and the excavation footprint of the reservoir pit would be 16.3 acres (0.07 km^2). The CFWR would also be surrounded by a 7ft berm which would impact 3.9 additional acres (0.02 km^2). The berm would be constructed primarily using material excavated from the reservoir pit combined with approximately 6,000 cubic yards of gravel cap.

Seasonal Ice Roads and Pads
Ice Roads – Temporary ice roads would facilitate gravel placement, pipeline construction, freshwater lake access, and Tiŋmiaqsiuġvik mine access. For safety, separate ice roads would be used for general traffic, pipeline construction, and gravel placement. Ice road construction would typically begin in November or December, with vehicle access depending on tundra travel opening and closing dates and distance from existing infrastructure. Ice roads would be a minimum of 6 inches (15.2 centimeters) thick, with a 35- or 70-foot-wide (10.6- or 21.3-m-wide) surface, depending on the road's purpose.

Ice road routes presented in Figure 3.1 are estimations; final alignments would be determined by optimization and impact minimization prior to initiating construction. During the Project's drilling and operations the Willow MDP will use the annual Alpine Resupply Ice Road to support equipment transport and resupply. As this ice road is constructed annually to support the Alpine development, this ice road is not considered further herein. Following the end of the ice road season, all ice road stream crossings will be breached or slotted, and ice built up artificially at crossings (e.g., ice or snow ramps) will be removed to match the static water elevation. Following spring breakup, work crews will pick up litter (known as stick picking) to remove any anthropogenic materials.

Single-season Ice Pads - Single-season ice pads would be used during all years of construction to house construction camps, stage construction equipment, and support construction activities. Single-season ice pads would also be used during construction at the Tiŋmiaqsiuġvik gravel mine site, at bridge crossings during gravel road and pipeline construction, at the Colville River HDD crossing, near Kuparuk drill site 2P (DS2P), and at other locations as needed near Willow MDP infrastructure.

Multi-Season Ice Pads
MSIPs would be used to stage construction materials between winter construction seasons. MSIP construction would use compacted snow over a base layer of ice with a vapor barrier over the ice to prevent melting from rain and evaporation, and foam insulation and white tarps to

insulate the pads. MSIPs would then be covered by rig mats. Once MSIPs are no longer needed, materials would be removed, any spills or releases would be remediated, and the ice base would be excavated to within 1 foot (0.3 m) of the tundra surface before being allowed to melt over the course of the summer.

MSIPs would be built in one winter to be used over the following summer and winter before being allowed to melt. Each MSIP would last approximately 18 months. In areas where MSIPs would be required for a longer time period, consecutive ice pads would be constructed in a slightly different location so footprints would not overlap. Accordingly, figures showing the locations of MSIPs should be viewed as portraying approximate locations rather than exact locations.

Seven MSIPs[1] totaling 114.8 acres (0.46 km^2) would be used during construction: one 10-acre MSIP near GMT-2 (winter 2021 through spring 2025), one 10-acre MSIP near the WOC (winter 2021 through spring 2022), and five MSIPs totaling 94.8 acres (0.38 km^2) near the Tiŋmiaqsiuġvik Mine Site (Winter 2021 through spring 2023; Figures 3.1 and 3.3; BLM 2020a; 2020b). These pads would allow ice road, gravel mining, and other equipment to be stored on-site over summer to support earlier construction starting dates the following winter, while minimizing gravel fill. Gravel would not be stored on the MSIP near the mine site.

Potable Water

The CFWR adjacent to Lake M0015 would be the primary source of freshwater for domestic use, and Lake L9911 would provide additional freshwater for drilling and operations. Water intake infrastructure at Lake L9911 would consist of a triplex pump, in secondary containment, on the water source access pad, with a hose hookup to allow trucks to connect to the pump system. No permanent infrastructure is proposed on the Lake L9911 water source access pad.

Water from the CFWR and Lake L9911 would be treated in accordance with State of Alaska Drinking Water Regulations (18 AAC 80) as required for any potable drinking water system. Prior to operation of the freshwater intake system, potable water for construction and drilling camp use would be withdrawn using temporary equipment and trucked to the water plant at the temporary construction camp. Additional freshwater withdrawals from other local permitted lakes may be needed during construction (e.g., ice road, ice pad, hydrostatic pipeline testing), drilling (e.g., drilling support), and operations (e.g., dust control).

Seawater

During construction, seawater would be used for ballast water by sealift barges making deliveries to Oliktok Dock. During drilling and operations, seawater to support hydraulic fracturing and injection would be sourced from the existing Kuparuk Seawater Treatment Plant at Oliktok Point. Seawater would be transported to the Willow MDP area from Kuparuk CPF2 via a new seawater pipeline.

Domestic Wastewater

Sanitary wastes generated from camps would be hauled to the WOC wastewater treatment

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[1] MSIPs would typically be maintained and reconstructed as needed within the same footprint; however, the footprint may shift based on CPAI and agency inspection and summer evaluation of tundra impacts.

facility for disposal in the Class I underground injection control (UIC) disposal well located at the WOC. Before UIC well establishment, treated wastewater would be hauled to another approved disposal site or be discharged under the Alaska Pollutant Discharge Elimination System (APDES) General Permit (AKG-332000). Prior to the WOC UIC well establishment, treated domestic wastewater would either be hauled to Alpine or Kuparuk (winter only) for injection in an existing UIC disposal well, or in instances where weather or conditions at Alpine prevent disposal, discharged to tundra per APDES permit conditions.

Solid Waste
Domestic waste (e.g., food, paper, wood, plastic) would either be incinerated on-site at the WOC or at Alpine, or if non-burnable, would be recycled or transported to a landfill facility in Deadhorse (e.g., the North Slope Borough landfill), Fairbanks, or Anchorage. Incinerator ash would be stored on-site until it could be transported to an off-site landfill for disposal. Hazardous and solid waste from the Willow MDP would be managed under Alaska Department of Environmental Conservation and U.S. Environmental Protection Agency regulations, as well as ROPs A-1 and A-2 (BLM email 4/13/20 updating Table 9 of the Willow MDP BA [BLM 2020a]). The WOC would have two UIC wells: one dedicated to wastewater disposal and a second used for drilling fluids and operations waste disposal. An existing UIC well at Alpine would provide backup as needed.

Drilling Waste
Drilling waste (e.g., drilling mud, cuttings) would be disposed of on-site through annular disposal (i.e., pumped down well through space between the two casing strings) and/or transported to an approved disposal well (e.g., Class I UIC disposal well at the WOC). Reserve pits would not be used by the Willow MDP, though a temporary storage cell (typically a lined, wooden structure) may be constructed on drill site pads for staging drilling muds and cuttings prior to UIC well disposal. Produced water would be processed at the WPF and re-injected to the subsurface through injection wells as part of reservoir pressure maintenance for secondary recovery. Well work waste materials would be managed according to the Alaska Waste Disposal and Reuse Guide. In addition to waste handling and disposal regulations, the Willow MDP would be managed under ROP A-2 (BLM email 4/13/20 updating Table 9 of the Willow MDP BA [BLM 2020a]).

Fuel and Chemical Storage
Fuel and other chemicals would primarily be stored at the WPF, with additional storage at drill sites. Diesel fuel would be stored in temporary tanks on-site during construction. During drilling and operations phases, the WPF would include a fuel supply storage tank(s) and fueling station, as well as a tank farm to store methanol, crude oil flowback, corrosion inhibitor, scale inhibitor, emulsion breaker, and various other chemicals as required. Jet fuel would be stored on the airstrip apron for helicopter use; jet fuel would be delivered to airplanes by fuel trucks supplied by storage tanks located at the WPF.

Drill sites would have temporary tanks to support drilling activity, including brine tanks, cuttings and mud tanks, and a drill rig diesel-fuel tank (built into the drill rig structure). Production storage tanks at drill sites will include chemical storage tanks that may contain corrosion inhibitor, methanol, scale inhibitor, emulsion breaker, anti-foam, and diesel fuel. Portable oil storage tanks to support well and pad activities and maintenance may be present on an as-needed basis.

Fuel and oil storage would comply with local, state, and federal oil pollution prevention requirements, according to the Oil Discharge Prevention and Contingency Plan (ODPCP) and Spill Prevention Control and Countermeasures Plan. Secondary containment for fuel and oil storage tanks will be sized as appropriate to the container type and according to governing regulatory requirements (18 AAC 75 and 40 CFR 112). Fuel and chemical storage for the Project would be managed under BLMs ROPs A-3, A-4, and A-5 (BLM email 4/13/20 updating Table 9 of the Willow MDP BA [BLM 2020a]).

Vehicle traffic
Ground traffic would include buses, light commercial trucks, short-haul trucks, passenger trucks, and other miscellaneous vehicles. Ground transportation would also include gravel hauling operations with B70/maxi dump trucks.

Aircraft Operations
Fixed wing – Fixed-wing aircraft to support Willow MDP operations would include C-130, DC-6, Twin Otter/CASA, Q400, Cessna, or similar. In total, BLM estimates 12,171 fixed-wing flights would take place over the life of the project at the WOC airstrip.

Helicopters – Helicopters would support construction, hydrology and environmental studies, ice road cleanup, agency inspections, and pre-staged boom deployment during all phases of the Willow MDP. Helicopters employed by the Willow MDP would include A-Star and 206 Long Ranger models, though other similar types of helicopters may also be used. BLM estimates 2,437 helicopter flights would take place over the life of the project throughout the Action Area. Of these, between 25 and 96 flights per year would occur during summer months (BLM email 4/13/20).

All aircraft will maintain minimum altitudes of 1,500 ft above ground level (agl) consistent with ROP F-3 (BLM email 4/13/20 updating Table 9 of the Willow MDP BA [BLM 2020a]), except during takeoffs and landings or when conditions are unsafe.

Sealift Operations
Barges would deliver large sealift modules (anticipated to weigh up to 4,000 tons [3,630 metric tons]) for the WPF and drill sites, as well as other bulk construction materials (e.g., pipe, VSMs) to the North Slope. Transit routes to Oliktok Dock would follow existing marine transportation routes (Figure 3). Bulk materials weighing less than 550 tons (500 metric tons) would be transferred to the Willow MDP area via the annual Alpine Resupply Ice Road; large sealift modules would be transported to the Willow MDP area over existing Kuparuk gravel roads and task-specific ice roads.

A total of 33 barge trips would make deliveries to Oliktok Dock over four open-water seasons during construction; no regular use of barges is planned during Willow MDP drilling and operations phases. Barges would make deliveries in the summers of 2022 through 2024 and 2026 (for a total of 4 years). After delivery by barge to Oliktok Dock, bulk materials and modules will be stored on an existing 12-acre (0.05 km^2) gravel pad approximately 2 miles (3.2 km) south of

Oliktok Dock. The following winter, these materials would be transported to the Willow MDP area.

Barges would be accompanied by tugboats between Dutch Harbor and Oliktok Dock. Approximately 53 tugboat trips are anticipated to accompany proposed sealift operations. Finally, support vessels (e.g., crew boats, a screeding barge, and other support vessels) would operate between Oliktok Dock and the barge lightering area (see below). Vessels would travel at speeds < 14 knots (16 mph). Approximately 318 support vessels trips are predicted during the same 4-year timeframe planned for sealift operations.

Barge Lightering and Screeding

To facilitate module and materials delivery, CPAI would use a 9.6-acre (0.04 km^2) offshore barge lightering area in water approximately 10 feet (3 m) deep and 2.3 nautical miles (4.3 km) from Oliktok Dock (Figure 3). During lightering, barges would be grounded on the seafloor, which would require screeding (i.e., redistributing and contouring of the existing marine sediments) of the lightering area. Screeding would be accomplished by dragging a metal plate fixed to a screed barge to move sediments in a leveling operation. The amount of material moved would generally be small and localized; no sediments would be removed from the water, and no new fill material would be added.

A backhoe may be used to assist where required; however, the bucket would not be raised above the water surface during operation. Following barge grounding and cargo transfer to the lightering barge, the lightering barge would be grounded adjacent to Oliktok Dock for offload. To prevent pressure points on the barge hull during grounding, approximately 2.5 acres (0.01 km^2) of marine area in front of Oliktok Dock would also be screeded annually prior to the first barge delivery. Bathymetry of the screeding area would be measured annually to ensure the seafloor surface is acceptable, screeding would take approximately 1 week to complete.

Willow MDP Schedule

The 30-year Willow MDP schedule is based on the current best available information. The schedule may be modified as detailed design progresses or as circumstances require, although modifications to the schedule would require Action Agency notification, and potential re-initiation of section 7 consultation. CPAI would construct the Willow MDP over approximately 9 years beginning in the first quarter (Q1) of 2021. The WPF would be anticipated to come online in the fourth quarter (Q4) of 2025 (first oil from BT1 production). Production from BT2, BT3, BT4, and BT5 would begin in second quarter (Q2) of 2026, Q4 of 2026, Q1 of 2029, and Q1 of 2030, respectively. Operations would run to the end of the Willow Development's life, which is estimated to be 2050.

Construction Phase – Gravel mining and placement would be conducted almost exclusively during winter. Prepacking snow and constructing ice roads to access the Tiŋmiaqsiuġvik gravel mine and gravel road and pad locations would occur in December and January, with ice roads expected to be available for use by February 1. Gravel infrastructure associated with initial construction of BT1, BT2, BT3, connecting roads, WPF, WOC, and the airstrip, would be mined and placed during winter (from January through April) for the first 4 years of construction. Two additional winter seasons of gravel mining and placement would occur to construct BT4, BT5, and associated roads. Gravel roads and pads would be built following ice road construction.

Gravel conditioning (turning upper layers during summer) and re-compaction would occur later that same year. Culvert locations would be identified and installed during the first construction season prior to spring breakup.

Bridges would be constructed during winter from ice roads and pads. On-pad facilities would be constructed following completion of gravel pad construction. Modules for the WPF and BT1, BT2, and BT3 would be delivered by barge to Oliktok Dock during summer 2024, and moved to the Willow MDP area the following winter. Modules for BT4 and BT5 would be delivered via a second sealift to Oliktok Dock in summer 2026, and moved to the Willow MDP area the following winter. Other bulk construction materials delivered by barge would arrive in the summers of 2022 through 2024, and the summer of 2026.

The CFWR would be constructed during Q1 and Q2 of 2023, and freshwater pipelines would also be constructed in 2023. CPAI anticipates the CFWR would flood during spring breakup seasons (end of Q2) of 2023 and 2024. The degree to which the CFWR fills in 2023 would be dependent on the volume of water available from Lake M0015 during spring breakup and adaptive management procedures implemented by CPAI to avoid impacts to Lake M0015 and Willow Creek 3.

CPAI assumes the CFWR will be available for use in the third quarter (Q3) of 2024. Pipelines would be installed during winter from ice roads. VSM locations would be surveyed and drilled, followed by installation of VSMs and HSMs with a sand slurry fill. Alternatively, engineering design may require VSMs be driven into an undersized hole using a vibratory hammer. Pipelines would be placed, welded, tested, and installed on pipe saddles atop the HSMs. The Colville River HDD pipeline crossing would be completed during the 2024 winter construction season. Pipeline installation would take between 1 and 4 years per pipeline type, depending on pipeline length and location.

Gravel haul and placement to modify Oliktok Dock would occur in summer 2022. Around mid-July during each summer open-water season, before sealift barge arrival and after the risk of ice encroachment has passed, screeding would occur at Oliktok Dock and in the barge lightering area.

Drilling Phase – Drilling is planned to begin in 2024 at BT1. The two drill rigs would be mobilized to the Willow MDP area, and drilling would begin prior to completion of the WPF and drill site facilities. Approximately 24 months of pre-drilling activities would allow the WPF to be commissioned immediately following construction. Wells would be drilled consecutively from BT1 to BT5; however, CPAI would determine the timing and order of drilling based on economics and drill rig availability.

Drilling would include hydraulic fracturing techniques described above in *Drill Pad Operations*. Hydraulic fracturing would occur only in the initial stage of well drilling to stimulate flow at production wells; it would not be needed for continued production over the life of the Willow MDP. Drilling would be anticipated to take 6 years and would be conducted year-round with approximately 15 to 30 days of drilling per well.

Operations Phase – Following initial drilling and WPF startup, typical operations would consist of well operations and production. Production would begin in Q4 of 2025. Well maintenance operations would occur intermittently throughout the life of the Willow Development. CPAI's standard operations and maintenance practices would be implemented throughout the operations phase.

Minimization Measures
The following sections describe measures BLM will require to prevent adverse effects to listed species, or to limit adverse effects.

CPAI's Minimization and Avoidance Measures
A complete list of CPAI's avoidance and minimization measures are in Appendix A of the Willow MDP BA (BLM 2020a), Design Features to Avoid and Minimize Impacts. However, the subset of CPAI's design features that directly or indirectly avoid and minimize adverse effects to polar bears, listed eiders, or northern sea otters, and minimize the destruction or adverse modification of critical habitat are listed below.

The following design features would minimize potential impacts to polar bear critical habitat, listed eider nesting, and near-shore habitat:

Design feature 2:	Construct road surfaces to the minimum width required for Project operations to minimize the placement of gravel fill (ROP E-5);
Design feature 4:	Share use of existing equipment and facilities (e.g., camps, seawater treatment plant, warehouses, maintenance shops, emergency response equipment) to reduce the overall Project gravel- and ice-pad footprint (ROP E-5);
Design feature 5:	Use an ice road to access the Tiŋmiaqsiuġvik mine site (instead of a gravel road) to reduce the Project's overall gravel footprint;
Design feature 6:	Use 2:1 side slopes (i.e., gravel road and pad embankment slopes) to reduce the Project's overall gravel footprint (ROP E-5);
Design feature 8:	Avoid permanently flooded wetlands by locating Project infrastructure on higher, and relatively drier areas, when practicable;
Design feature 10:	Use ice roads and pads, including MISPs, for Project access, pipeline construction, camps, and temporary storage of mine site overburden to reduce the Project's overall gravel footprint (ROP E-5);
Design feature 12:	Co-locate the WPF with drill site BT3 to eliminate the need for an additional gravel pad and associated gravel fill (ROP E-5);
Design feature 15:	Do not discharge reserve pit fluids to surface waters or lands;
Design feature 17:	Restrict tundra travel for Project personnel to emergency response or to permitted activities required by statute or regulation (ROP L-1);
Design feature 18:	Conduct overland (i.e., tundra) moves and similar off-road or cross-country activity to minimize impacts to streambanks, soil substrate, and vegetation (ROP C-2);
Design feature 22:	Use recent ecological mapping to assess wildlife habitat types to inform the design, placement, and development of permanent (i.e., gravel) infrastructure (ROP E-12); and

Design feature 109: Do not refuel equipment within 500 feet of the active floodplain of any waterbody unless approved by the BLM Authorized Officer (AO). Fuel-storage stations, except as approved by the BLM AO, would be located at least 500 feet from waterbodies except for small caches (up to 210 gallons) for fueling motor boats, float planes, and small equipment (ROP A-5).

The following design features would reduce human-polar bear interactions, thereby reducing potential human-polar bear conflicts:

Design feature 47: Do not construct causeways or docks in any river mouth or delta. Causeways, docks, artificial islands, or other bottom-fast structures, if employed, would be designed to ensure free passage of fish and prevent changes to water circulation patterns or water quality (ROP E-3);

Design feature 49: Develop a bear-interaction plan for Project personnel to minimize conflicts between bears and humans (ROP A-8);

Design feature 62: Implement policies, procedures, and training to prevent wildlife attraction to Project facilities, including use of predator-proof dumpsters for food waste collection; a strict policy prohibiting the feeding of wildlife; and the use of Ziploc bags or other sealed containers for meals-on-the go to conceal food odors (ROPs A-1, A- 2, A-8, and M-1);

Design feature 63: Produce a Wildlife Avoidance and Interaction Plan that would include procedures to eliminate, minimize, and mitigate bear interactions. CPAI conducts training on waste management practices and would conduct Project-specific training on waste management to guide employees and contractors on managing predators (ROPs A-1, A-2, A-8, C-1, and M-1);

Design feature 64: Protect grizzly and polar bear denning sites by prohibiting cross-country travel or use of heavy equipment within 0.5 mile of a grizzly bear den and within 1.0 mile of a polar bear den or seal birthing lairs. Where necessary, CPAI would conduct surveys near coastal areas to locate potential polar bear dens and seal-birthing lairs, in consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service, as appropriate, before initiating activities in coastal habitat between October 30 and April 15 (ROP C-1); and

Design feature 90: Audit contractor' health, safety, and environment performance to ensure safe practices are followed (ROPs A-2, A-3, A-4, and A-5).

The following design features would reduce impacts to listed eiders:

Design feature 9: Suspend communications and power cables from horizontal support members to avoid additional fill associated with utility poles and to reduce the potential for bird strikes and perches for predators (ROPs E-11 and E-21);

Design feature 37: Implement dust control measures for gravel roads, pads, and mining operations to reduce fugitive dust that can settle on vegetation or snow, which could increase thermal conductivity (i.e., reduce albedo), lead to thermokarsting, and promote earlier spring thaw in affected areas (ROP A-10);

Design feature 41: Prepare an erosion control plan to detail ways the Project would prevent or mitigate erosion that would impact terrestrial and aquatic environments. The plan would include CPAI's operations, monitoring, and maintenance procedures that detail the actions CPAI would undertake to monitor, maintain, and if needed, remediate gravel fill impacting surrounding tundra and wetlands (ROPs C-2, C-3, E-3, E-8, and stipulations K-1, and K-2,);

Design feature 42: Place cleared (i.e., plowed) snow in designated snow-storage areas and manage stormwater from all gravel pads to prevent contaminants from being released during spring breakup. Select snow push areas annually based on avoiding areas of thermokarsting, proximity to waterbodies, and evaluations of areas used the previous year;

Design feature 51: Design facilities to minimize nesting, denning, or sheltering opportunities for ravens, raptors, and foxes (ROP A-8);

Design feature 52: Implement a Project lighting plan that would include measures to minimize the amount of light visible from outside of facilities, including directing artificial exterior lighting inward and downward from August 1 to October 31, which would prevent waterfowl (including species listed under the ESA) from striking facilities during low light conditions (ROP E-10);

Design feature 53: Minimize the take of species, particularly those listed under the ESA and BLM Special Status Species, by conducting eider and yellow-billed loon surveys and working with resource agencies to ensure facilities minimize impacts to species found (e.g., ensure off-pad utility lines are either buried or suspended from pipe racks to the extent feasible, locate towers on pads near existing buildings to the extent feasible, minimize the use of tower guy wires, clearly mark guy wires that are used to prevent collisions) (ROP E-11);

Design feature 73: Conduct high-disturbance construction activities such as gravel mining and placement, and pipeline and facility construction, primarily during the winter months when subsistence activity levels are relatively low and disruptions to water flows can be managed (stipulation K-1 and ROP L-1); and

Design feature 75: Prohibit the use of airboats on rivers within BLM-managed lands and within a 50-mile radius of Nuiqsut, except for emergencies and emergency response training (ROPs, H-3, K-1, K-2, and M-1).

The following design features would reduce impacts to both listed eiders and polar bears:

Design feature 48: Maintain air-traffic altitudes consistent with NPR-A ROP F-3 except during takeoffs and landings, and unless doing so would endanger human life or violate safe flying practices, to avoid disturbing caribou, birds, and subsistence users, when feasible. (Some air traffic would be required to support the Project or for regulatory compliance [e.g., wildlife studies, hydrology studies] and to ensure cleanup following the ice-road season could require flying at lower altitudes);

Design feature 55:	Minimize the electrocution hazard by suspending electrical distribution lines from pipe racks or burying cables (versus the use of overhead power lines) off pad (ROP E-21);
Design feature 69:	Prohibit the disturbance of caribou and strictly prohibit the harassment of wildlife with vehicles (ROP M-1);
Design feature 84:	Use completely enclosed or otherwise acoustically packaged permanent electric power generator sets to abate noise;
Design feature 92:	Employ Field Environmental Coordinators to monitor compliance with permits and other Project requirements;
Design feature 95:	Develop and implement a spill prevention and response contingency plan for the Project (in accordance with 40 CFR 112) to reduce impacts to human health and safety and to minimize potential effects to subsistence resources, including fish and wildlife. The Plan would cover Project operations and describe spill prevention measures and on-site cleanup materials for permanent fueling stations, use of proper storage containers and liner materials, proper container identification, and notice of reportable spills. Identification of drip pans (i.e., "duck ponds") would be addressed through Project operating procedures (ROPs A-3, A-4, and A-5);
Design feature 96:	Use a hazardous materials contingency plan (also known as a spill prevention and response contingency plan), that would detail response actions, drills, and responder training (ROP A-3); and
Design feature 97:	Build and operate pipelines with the best available technology for detecting and preventing corrosion or mechanical defects to minimize impacts related to point source pollution from oil spills or leaks.

Applicable Stipulations and Required Operating Procedures

Stipulations and required operating procedures (ROPs) intended that directly or indirectly avoid and/or reduce impacts to ESA-listed species and designated critical habitat are summarized below.

The following ROPs apply to waste prevention, handling, disposal, spills, and public safety.

ROP A-1: Waste and Litter

Objective: Protect public health, safety, and the environment by disposing of solid waste and garbage in accordance with applicable federal, State, and local laws and regulations.

Requirement/Standard: Areas of operation shall be left clean of all debris. All solid waste and industry-derived trash originating from permitted activities is required to be properly containerized while on-site or removed from the area of operation and activity.

ROP A-2: Waste Management Plan

Objective: Minimize potential impacts on the environment from nonhazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil field workers, local communities, subsistence users, recreationists, and the general public. Avoid human-caused changes in predator populations. Minimize attraction of predators, particularly bears, to human use areas.

Requirement/Standard: Permittees shall prepare and implement a comprehensive waste management plan; the AO may waive this requirement for minimally impactful activities. The plan shall be submitted to the AO for approval, as part of a plan of operations or other similar permit application.

Management decisions affecting waste generation would be addressed in the following order of priority: 1) prevention and reduction, 2) recycling, 3) treatment, and 4) disposal. The plan would consider and take into account the following requirements:

a. Disposal of food or other organic waste. Permittees shall have a written procedure to ensure that the handling and disposal of food or other organic waste will be accomplished in a manner that prevents the attraction of wildlife. All food or other organic waste shall be incinerated, backhauled, or composted.
b. All solid waste, including incinerator ash, shall be disposed of in an approved waste-disposal facility, in accordance with EPA and ADEC regulations and procedures.
c. The burial of human waste is prohibited, except as authorized by the AO.
d. Use bear-resistant containers for all waste materials and classes that are bear attractants. The plan will include a list of all classes of waste material that are bear attractants and thus must be stored in bear-resistant containers.
e. Disposal of pumpable waste products. Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by injection, in accordance with EPA, ADEC, and the Alaska Oil and Gas Conservation Commission regulations and procedures. On-pad temporary muds and cuttings storage, as approved by ADEC, will be allowed as necessary to facilitate annular injection and/or backhaul operations.

ROP A-3 Hazardous Substances Contingency Plans
Objective: Minimize potential pollution through effective hazardous substances contingency planning.

Requirement/standard: For oil and gas-related activities, a hazardous substances contingency plan shall be prepared and implemented before transportation, storage, or use of hazardous substances. The plan shall include the following:

a. Identification of the hazardous substances
b. Procedures for proper storage and handling of the hazardous substances
c. Procedures for prompt response, notification, and cleanup in the event of a release

If the elements of this plan are included in documents prepared to meet other federal, State, or local requirements, the AO may approve referencing the appropriate documents instead of preparing a hazardous substances contingency plan.

ROP A-4: Spill Prevention
Objective: Minimize potential impacts of contaminants on fish, wildlife, and the environment, including wetlands, marshes, and marine waters, as a result of fuel spills. Protect subsistence resources and subsistence activities. Protect public health and safety.

Requirement/Standard: Permittees with oil storage capacity of 1,320 gallons or greater shall prepare a spill prevention, control, and countermeasure plan as required by 40 CFR 112. Additionally, all permittees shall be required to do the following:

a. Notice of any spill shall be given to the AO as soon as possible but no later than 24 hours after occurrence. Other federal, State, and NSB entities shall be notified as required by law.
b. All spills shall be cleaned up immediately and to the satisfaction of the AO and all agencies with regulatory authority over spills.
c. Sufficient oil spill cleanup materials (sorbent pads, containment devices, etc.) shall be stored at all fueling points and maintenance areas. Drip basins and/or sorbent pads would be placed under all non-dry disconnect type fuel line couplings and valves during fueling.
d. All fuel and oil or petroleum containers, including barrels, and propane tanks, shall be marked with the permittee's name.
e. Fuel containers and hazardous materials containers of any size shall be stored in secondary containment.

ROP A-5: Refueling and Fuel Storage
Objective: Minimize potential impacts of contaminants from refueling operations on fish, wildlife, and the environment.

Requirement/Standard: Fuel storage and refueling of equipment within 100 feet of any lake shoreline or top of streambank is prohibited. Small fuel caches (up to 210 gallons) are permitted within this distance. The AO may allow larger fuel caches or refueling operations within the 100 foot setback if properly designed to account for local site conditions

ROP A-8: Minimize Wildlife Interaction
Objective: Minimize conflicts between humans and wildlife and avoid human-caused increases in predator populations.

Requirement/Standard: Permittees shall minimize conflicts between wildlife and humans.

a. Permittee shall develop a site-specific wildlife interaction plan that would include, but is not limited to:
    i. Strategies to minimize attraction of wildlife to activity sites.
    ii. Organize layout of buildings and work sites to minimize human/wildlife interactions.
    iii. Warning personnel of bears near or on work sites and identifying proper procedures to be followed.
    iv. Establishing procedures, if authorized, to discourage wildlife from approaching the work site.

    v. Providing contingencies in the event bears do not leave the site or cannot be discouraged by authorized personnel.
    vi. Establishing proper storage and disposal of materials that may be toxic or attractants to wildlife.
b. Provide, annually, a systematic record of all species of bears on and near the project area.
c. Incorporate into infrastructure design measures to deter ravens, raptors, and foxes from nesting, denning, or seeking shelter. The permittee shall provide the AO with an annual report on any instances when, despite use of such measures, the use of infrastructure by ravens, raptors, and foxes did occur.
d. Feeding wildlife is prohibited.
a. Prevent the emission of odors by installing kitchen hood exhaust filtration systems such as cleaners, filters, purifiers, and scrubbers.

ROP A-10: Air Quality
Objective: Prevent unnecessary or undue degradation of the air and lands and protect health.

Requirement/Standard: This measure includes the following elements:

a. Prior to initiation of NEPA analysis for an application to develop a central processing facility, production pad/well, airstrip, road, gas compressor station, or other potential air pollutant emission source (hereafter called project), the BLM AO may require the permittee to provide up to 1 year of baseline ambient air monitoring data. Such a determination would be made in consultation with the EPA/ADEC and with the permittee, to assess the technical practicability of any new data collection. If the BLM determines that baseline monitoring is required, this pre-analysis data must meet ADEC and EPA air monitoring standards. The BLM will not require pre-project monitoring when the life of the project is less than 1 year.
b. For an application to develop a central production facility, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the permittee shall prepare and submit for BLM approval an emissions inventory that includes quantified emissions of regulated air pollutants from all direct and indirect sources related to the proposed project. This includes reasonably foreseeable air pollutant emissions of criteria air pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases estimated for each year for the life of the project. The BLM uses this estimated emissions inventory to identify pollutants of concern and to determine the appropriate form of air analysis to be conducted for the proposed project.
c. The BLM may require air quality modeling for purposes of analyzing project direct, indirect, or cumulative impacts to air quality, air quality related values, and hazardous air pollutants, should no recent modeling analysis be available as a proxy. The BLM may require air quality modeling depending on the following:
    i. The magnitude of potential air emissions from the project
    ii. Proximity to a federally mandated Class I area
    iii. Proximity to a population center
    iv. Location in or proximity to a nonattainment or maintenance area
    v. Meteorological or geographic conditions
    vi. Existing air quality conditions
    vii. Magnitude of existing development in the area

viii. Issues identified during the NEPA process

d. The BLM will determine the information required for a project-specific modeling analysis through the development of a modeling protocol for each analysis. The BLM will consult with appropriate federal (including federal land managers), State, and/or local agencies and with the permittee regarding modeling to inform its modeling decision and avoid duplication of effort.
e. The BLM may require the proponent to provide an emissions reduction plan that includes a detailed description of permittee-committed measures to reduce project-related air pollutant emissions, including, but not limited to, criteria pollutants, hazardous air pollutants, greenhouse gases, heavy metals, mercury, and fugitive dust.
f. Air monitoring or air modeling reports will be provided to the BLM.
g. The BLM may require monitoring, depending on the following:
    i. The magnitude of potential air emissions from the project
    ii. Meteorological or geographic conditions
    iii. Magnitude of existing development in the area
    iv. Issues identified during the NEPA process
    v. Proximity to a population center

Alternatively, copies of the Facility Operating Report prepared for ADEC in compliance with the State of Alaska air quality regulations, may be submitted to satisfy this requirement.

h. If ambient air monitoring or air quality modeling indicates that project-related emissions cause or contribute to unnecessary or undue degradation of the public lands, or exceedances of the NAAQS/AAAQS, air quality related values, and hazardous air pollutants threshold levels, then the BLM may require the permittee to change their proposal or propose mitigation to reduce impacts or comply with the NAAQS/AAAQS. Project changes and mitigation measures will be analyzed through appropriate NEPA analysis to determine effectiveness.

The following ROPs apply to overland moves, seismic work, and any similar cross-country vehicle use of heavy equipment on non-roaded surfaces during the winter season. These restrictions do not apply to the use of such equipment on ice roads after they are constructed.

ROP C-1: Den Buffers and Survey Requirements
Objective: Protect grizzly bear, polar bear, and marine mammal sea ice breathing holes, lairs, and birthing locations.

Requirement/Standard:

a. Grizzly bear dens—Cross-country use of all vehicles, equipment, and oil and gas activity is prohibited within 0.5 miles of occupied grizzly bear dens identified by the ADF&G or the USFWS, unless alternative protective measures are approved by the BLM AO, in consultation with the ADF&G.
b. Polar bear dens—Cross-country use of vehicles, equipment, oil and gas activity, and seismic survey activity is prohibited within 1 mile of known or observed polar bear dens, unless alternative protective measures are approved by the BLM AO and are consistent

with the Marine Mammal Protection Act and the ESA.

c. In order to limit disturbance around known polar bear dens, implement the following:
   i. Attempt to locate polar bear dens—Permittees seeking to carry out onshore activities in known or suspected polar bear denning habitat during the denning season (approximately November to April) must make efforts to locate occupied polar bear dens within and near areas of operation, utilizing den detection techniques approved in consultation with the USFWS. All observed or suspected polar bear dens must be reported to the USFWS prior to the initiation of activities.
   ii. Observe the exclusion zone around known polar bear dens—Permittees must observe a 1-mile operational exclusion zone around all known polar bear dens during the denning season (approximately November–April, or until the female and cubs leave the areas). Should previously unknown occupied dens be discovered within 1 mile of activities, work must cease and the USFWS must be contacted for guidance. The USFWS will evaluate these instances to recommend the appropriate action. Potential actions may range from cessation or modification of work to conducting additional monitoring, and the holder of the authorization must comply with any additional measures specified.
   iii. Use the den habitat map developed by the U.S. Geological Survey. This measure ensures that the location of potential polar bear dens is considered when conducting activities in the coastal areas of the Beaufort Sea.
   iv. Polar bear den restrictions—Restrict the timing of the activity to limit disturbance around dens.

d. In order to limit disturbance of activities to seal lairs in the nearshore area (< 9.8 foot water depth):
   i. Specific to seismic operations:
      a) Prior to the initiation of winter seismic surveys on marine ice, the permittee will conduct a sound source verification test approved by the BLM and NMFS. The test is to measure the attenuation distance to the 120 decibels re 1 micro Pascal of project-associated sound levels through grounded ice to areas potentially occupied by ice seals (ungrounded ice and open water). The permittee will share the results with the BLM and the NMFS. The attenuation distance will be used to buffer all marine on-ice seismic survey activity operations to areas potentially occupied by ice seals.
   ii. For all activities:
      a) Maintain airborne sound levels of equipment below 100 decibels re 20 micro Pascals at 66 feet. If equipment will be used that differs from what was originally proposed, the permittee must inform the BLM AO and share sound levels and air and water attenuation information for the new equipment.
      b) On-ice operations after May 1 will employ a full-time, trained, protected species observer on vehicles to ensure that all basking seals are avoided by vehicles by at least 500 feet and will ensure that all equipment with airborne noise levels above 100 decibels re 20 micro Pascals are operating at distances from observed seals that allow for the attenuation of noise to levels below 100 decibels. All sightings of seals will be reported to the BLM using a NMFS-approved observation form.

c) Sea ice trails must not be greater than 12 feet wide. No driving will be allowed beyond the shoulder of the ice trail or off planned routes unless necessary to avoid ungrounded ice or for other human or marine mammal safety reasons. On-ice driving routes shall minimize travel over snow/ice/topographical features that could foster the development of birthing lairs.
d) No unnecessary equipment or operations (e.g., camps) will be placed or used on sea ice.

ROP C-2: Winter Tundra Travel
Objective: Protect stream banks, minimize compaction of soils, and minimize the breakage, abrasion, compaction, or displacement of vegetation.

Requirement/Standard:

a. Off-road travel will be allowed by the BLM AO when soils are frozen to sufficient depth (defined by a soil temperature of 23 degrees Fahrenheit or lower at a depth of 12 inches), and 6 inches of snow cover exists. Snow distribution and pre-packing may be used to maintain sufficient snow cover in areas of poor snow coverage. The permittee shall submit data to the BLM to show that these conditions have been reached prior to conducting work.
b. Snow survey and soil freeze-down data collected for ice road or snow trail planning and monitoring shall be submitted to the BLM with the required weekly report of operations.
c. Off-road travel is generally to be conducted with low-ground pressure vehicles unless otherwise approved by the BLM AO. Low-ground pressure is defined as vehicles with less than 4 psi ground pressure, or vehicles which have passed the Alaska Department of Natural Resources low-pressure vehicle qualification certification.
d. All vehicles shall be selected and operated in a manner that eliminates direct impacts on the tundra by shearing, scraping, or excessive compaction. *Note: This provision does not include the use of heavy equipment required during ice road construction; however, heavy equipment would not be allowed on the tundra until conditions in a., above, are met.*
e. Bulldozing tundra mat and vegetation for the construction trails or seismic lines is prohibited. Clearing or smoothing drifted snow is allowed to the extent that the tundra mat is not disturbed. Only smooth pipe snow drags would be allowed for smoothing drifted snow.
f. Ice roads would be designed and located to avoid the most sensitive and easily damaged tundra types, as much as practicable.
g. Motorized ground vehicle use associated with overland moves, seismic work, and any similar use of heavy equipment shall be minimized within an area that extends 1 mile west or northwest of the bluffs of the Colville River and 2 miles on either side of the Kogosukruk and Kikiakrorak Rivers and tributaries of the Kogosukruk River from April 15 through August 5, with the exception that use shall be minimized in the vicinity of gyrfalcon nests beginning March 15. Such use would remain 0.5 miles from known raptor nesting sites, unless authorized by the AO.
h. Incidents of damage to the tundra shall be reported to the AO within 72 hours of occurrence. Follow-up corrective actions shall be determined in consultation with and

approved by the AO.

i. The permittee shall provide the BLM with an as-built of all ice roads, snow trails, and ice pads after the infrastructure is completed. Data must be in a GIS format (ESRI shapefiles referencing the North American Datum of 1983).

ROP C-3: Ice Bridges
Objective: Maintain natural spring runoff patterns and fish passage, avoid flooding, prevent streambed sedimentation and scour, protect water quality, and protect stream banks.

Requirement/Standard: Crossing of waterway courses shall be made using a low-angle approach. Crossings that are reinforced with additional snow or ice ("bridges") shall be removed, breached, or slotted before spring breakup. Ramps shall be removed to the extent possible without damaging stream banks. Ramps and bridges shall be substantially free of soil and debris.

The permittee shall provide to the BLM any ice thickness and water depth data collected at ice road or snow trail stream crossings during the pioneering stage of road and trail construction.

At the end of operations in the spring, the permittee shall provide the BLM with photographs of all stream crossings that have been removed, breached, or slotted.

The following ROPs apply to facility design and construction.

ROP E-2: Infrastructure Siting Near Waterbodies
Objective: Protect fish-bearing waterbodies, water quality, and aquatic habitats.

Requirement/Standard: Permanent infrastructure, except essential pipeline and road crossings, is prohibited within 500 feet of the ordinary high-water mark of fish-bearing waterbodies, (also refer to Stipulation K-1 and Stipulation K-2). Construction camps are prohibited on frozen lakes and river ice. Where leveling of trailers or modules is required and the surface has a vegetative mat, leveling shall be accomplished through blocking rather than use of a bulldozer.

ROP E-3: Shoreline Infrastructure
Objective: Maintain free passage of marine and anadromous fish, protect shorebird staging and feeding areas, and protect subsistence use and access to subsistence hunting and fishing.

Requirement/Standard: Linear infrastructure that connects to the shoreline (e.g., causeways and docks) is prohibited in river mouths or deltas. Artificial gravel islands and permanent bottom-founded structures are prohibited in river mouths or active stream channels on river deltas. In areas where it is permissible, linear infrastructure that connects to the shoreline shall be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. BLM will require submittal of a minimum of 2 years of site-relevant data on fish, circulation patterns, and water quality before approving a permit for construction. If such data does not exist, the permittee may be required to gather these data. A post-construction monitoring program, developed in consultation with appropriate federal, State, and NSB regulatory and resource agencies, shall be required to track circulation patterns, water quality, and fish movements around the structure.

ROP E-5: Minimize Development Footprint
Objective: Minimize impacts of the development footprint.

Requirement/Standard: Facilities would be designed and located to minimize the development footprint and impacts. Issues and methods that are to be considered include:

a. Using extended-reach drilling whenever practical for production drilling to minimize the number of pads and the network of roads between pads.
b. Consider sharing of facilities and infrastructure with existing developments.
c. Collocating other oil and gas facilities with drill pads when feasible. Exceptions would generally include airstrips, docks, existing base camps, and saltwater treatment plants.
d. Using gravel-reduction and gravel-recovery technologies (e.g., insulated or pile-supported pads, and use of geotextile under gravel pads).
e. When possible, locating facilities and other infrastructure outside areas identified as important for wildlife habitat, subsistence uses, and recreation. These areas would be identified during the project permitting phase through consultation with federal, State, and local agencies as well as consultation with appropriate Alaska Native organizations.
f. Optimize the size of gravel pads to balance storage space against the need to minimize aircraft traffic.

ROP E-8: Sand and Gravel Mining
Objective: Minimize the environmental impacts of mining sand and gravel.

Requirement/Standard: Mine site design and reclamation shall comply with a plan reviewed and approved by the AO. The permittee shall coordinate during the plan preparation with other federal, State, and local agencies having jurisdiction.

a. The plan shall consider locations outside the active floodplain.
b. The plan shall incorporate as much as practicable the storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope.
c. Removal of greater than 100 cubic yards of bedrock outcrops, sand, and/or gravel from cliffs is prohibited.
d. Any extraction of sand or gravel from an active river or stream channel must be preceded by a hydrological study that describes impacts on streamflow, fish, turbidity, and the integrity of the river bluffs, if present.
e. Mine pit design and methods shall be engineered to minimize permafrost regime disturbance and protect surface stability.
f. Geotechnical data collected for materials source reconnaissance (gravel exploration), shall be submitted to the BLM.

ROP E-10: Facility Visibility Requirements
Objective: Minimize bird collisions with infrastructure, especially during migration and inclement weather.

Requirement/Standard: Flagging of structures, such as elevated utility lines and guy wires, shall be required to minimize bird collision. All facility external lighting, during all months of the year, shall be designed to direct artificial exterior lighting inward and downward or be fitted with shields to reduce reflectivity in clouds and fog conditions, unless otherwise required by the Federal Aviation Administration.

ROP E-11: Protections for Certain Bird Species with Special Status
Objective: Minimize impacts on bird species, particularly those listed under the ESA and BLM special status species, resulting from direct or indirect interaction with infrastructure.

Requirement/Standard: Bird species with special status are protected under ROP E-10 and ROP E-21, and by the protections outlined below. In accordance with the guidance below, before the approval of infrastructure construction, the following studies shall be conducted, and recommended design elements shall be incorporated.

Special Conditions in Spectacled and/or Steller's Eiders Habitats:

a. BLM will require submittal of a minimum of 3 years of site-relevant survey data before authorization of construction, if such construction is within spectacled and Steller's eider habitats, as defined by the area contained within the USFWS Arctic Coastal Plain Aerial Waterbird Breeding Population Survey area or the Barrow Triangle Steller's Eider Survey area. The BLM will evaluate adequacy of survey data and ecological mapping (as required under ROP E-12) to determine if ground-based nest surveys are required. If required, spectacled and/or Steller's eider ground nest surveys shall be conducted, following accepted BLM protocol. Information gained from these surveys shall be used to make infrastructure siting decisions, as discussed in sub-paragraph "b," below. Data shall be transmitted to the BLM in a GIS format (ESRI shapefiles referencing the North American Datum of 1983).
b. If spectacled and/or Steller's eiders are determined to be present within the proposed development area, the applicant shall work with the USFWS and the BLM early in the design process to site roads and infrastructure in order to minimize impacts on nesting and brood-rearing eiders and their habitats. Such consultation shall address timing restrictions and other temporary mitigating measures, location of permanent infrastructure, placement of fill, alteration of eider habitat, aircraft operations, and management of noise levels.

Special Conditions in Yellow-billed Loon Habitats:

The permittee shall determine and submit to the BLM information on the presence of yellow-billed loon habitat within a project area, using the most current data and analysis results from research conducted within the NPR-A.

c. If yellow-billed loon habitat is determined to be present within the project area, the BLM will require submittal of a minimum of 3 years of site-relevant survey data of lakes greater than 25 acres within one mile of the proposed infrastructure. If required, surveys along shorelines of lakes shall be conducted, following accepted BLM protocol, during nesting in late June and during brood rearing in late August.

d. The design and location of infrastructure must be such that disturbance is minimized. The default standard mitigation shall be a minimum 0.5-mile buffer around all recorded nest sites and shall be up to 1 mile where feasible. Lakes with yellow-billed loon occupancy shall also include a minimum 1,625-foot buffer around the shoreline. Development would generally be prohibited within buffers. The BLM would consider waivers or modifications to this requirement if no other feasible option exists.

ROP E-12: Use of Ecological Mapping or Equivalent
Objective: Use ecological mapping (or equivalent approach) as a tool to assess fish and wildlife habitat before development of permanent infrastructure to conserve important habitat types, including BLM sensitive plant species and habitat for BLM sensitive animal species.

Requirement/Standard: The permittee shall submit an ecological land classification map (or similar instrument) of the development area as part of the permitting process for infrastructure construction. The map would integrate geomorphology, soils, surface form, and vegetation (including sensitive plant species and habitat for sensitive wildlife species) at a scale, level of resolution, and level of positional accuracy adequate for detailed analysis of development alternatives. A separate map shall be developed displaying detailed water flowlines and small-scale delineation of drainage catchments. BLM will use these maps and related information to determine the need for BLM or the permittee to conduct any additional ground-based assessments before approval of the exact infrastructure location and infrastructure construction.

ROP E-18: Protection for Nesting Steller's and Spectacled Eiders in the Barrow Triangle Area
Objective: Avoid and reduce temporary impacts on productivity from disturbance near Steller's and spectacled eider nests within the Barrow Triangle area.

Requirement/Standard: Ground-level activity (by vehicle or on foot) within 660 feet of occupied Steller's or spectacled eider nests, from June 1 through July 31, would be restricted to existing thoroughfares, such as pads and roads. Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 660 feet of occupied Steller's or spectacled eider nests would be prohibited. In instances where summer support/construction activity must occur off existing thoroughfares from June 1 through July 31, USFWS-approved nest surveys must be conducted during the approved survey window prior to the BLM approval of the activity. Collected data would be used to evaluate whether the action could occur, based on deployment of a 660-foot buffer around nests, or if the activity would be delayed until after mid-August, once ducklings are mobile and have left the nest site.

Permittees are encouraged to work outside the eider nesting window throughout the NPR-A.

ROP E-19: GIS Files for Proposed Infrastructure
Objective: Provide information to be used in monitoring and assessing wildlife movements during and after construction.

Requirement/Standard: During the planning and permitting phase for new infrastructure, the permittee shall provide in a GIS format (ESRI shapefiles referencing the North American Datum of 1983) files of proposed footprint locations, followed by shapefiles of all new infrastructure footprints within 6 months of construction completion. Infrastructure includes all gravel roads and pads, facilities built on pads, pipelines, and independently constructed power lines (as opposed to those incorporated in pipeline design). Gravel pads would be included as polygon features. Roads, pipelines, and power lines may be represented as line features but must include ancillary data to denote such data as width and number of pipes. Poles for power lines may be represented as point features. Ancillary data will include construction beginning and ending dates.

ROP E-21: Aboveground Utility Design
Objective: Minimize the impacts on bird species from direct interaction with aboveground utility infrastructure.

Requirement/Standard:

a. To reduce the possibility of birds colliding with aboveground utility lines (power and communication), such lines would either be buried in access roads or would be suspended on VSMs. Exceptions are limited to the following situations:
    i. Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad.
    ii. Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a VSM.
    iii. Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods.
b. To reduce the likelihood of birds colliding with them, communication towers would be located, to the extent practicable, on existing pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities would be avoided to the extent practicable. If support wires are necessary, they would be clearly marked along their entire length to improve visibility to low-flying birds. Such markings would be developed through consultation with the USFWS.
c. Design of other utility infrastructure, such as wind turbines, would be evaluated under a specific development proposal.
d. The Permittee shall comply with current industry-accepted practices for raptor protection on power lines, such as the most recent Avian Power Line Interaction Committee suggested practices.

The following ROPs apply to use of aircraft for permitted activities.

ROP F-2: Aircraft Use Plan
Objective: Provide aviation data required for BLM management, for ESA consultation with USFWS and NMFS, and to minimize impacts on subsistence activities and wildlife.

Requirement/Standard: Permittees shall submit an aircraft use plan at least 60 days prior to permitted activities. The plan shall include the following elements:

a. The estimated number of anticipated flights, as defined by a single takeoff and landing, including the estimated number of which will occur north of 70 degrees North latitude (to allow for programmatic ESA consultation). The number of takeoffs and landings should be limited to the maximum extent practicable. During the design of proposed infrastructure projects, larger landing strips and storage areas should be considered to allow the use of larger aircraft.
b. Types of aircraft, including tail numbers of aircraft (as early as possible and prior to use), and description of any unmanned aircraft use.
c. Strategies to coordinate daily aircraft use with the aviation community and local subsistence users.
d. Methods of monitoring and reporting flights. The AO may require adjustments to the aircraft use plan, based on the results of the monitoring.
e. Strategies to comply with ROPs F-3 and F-4, and Stipulations K-6, K-8, K-9 and K-14, as applicable.

ROP F-3: Minimum Flight Altitudes
Objective: Minimize the effects of low-flying aircraft on wildlife, subsistence activities, and local communities.

Requirement/Standard: Except for takeoffs and landings, manned aircraft flights for permitted activities (fixed-wing and helicopters, unless specified) shall maintain a 1,500 foot minimum altitude above ground level (agl) unless doing so would endanger human health and safety or violate safe flying practices, or if the purpose of the flight requires constant sight of the ground, such as sighting of wildlife or for archaeological or engineering survey flights or ice road planning and cleanup. Exception to the 1,500-foot agl minimum altitude are listed below:

a. Single engine manned aircraft and unmanned aircraft systems devices should not knowingly fly within 0.5 miles of walrus haul-outs; or if required then maintain 2,000 feet agl when within 0.5 miles of walrus haul-outs.
b. Helicopters and multi-engine aircraft should not knowingly fly within 1 mile of walrus haul-outs; or if required then maintain 3,000 feet agl and a 1-mile buffer from walrus haul-outs.
c. Aircraft — 3,000 feet agl when within 1 mile of aggregation of seals.

The BLM will provide maps and data of the areas listed above.

ROP F-4: Reduce Impacts of Air Traffic on Subsistence Resources
Objective: To reduce the impacts of aircraft traffic on North Slope subsistence hunters.
Requirement/Standard:

a. Hazing of wildlife by aircraft is prohibited. Pursuit of running wildlife is hazing. If wildlife begins to run as an aircraft approaches, the aircraft is too close and must break away.
b. Minimize (consistent with operational efficiency and safety) helicopter flights during

peak caribou hunting within 2 miles of important subsistence rivers[2]. Pay particular attention to limiting helicopter traffic during this time to flight corridors that minimize impact (e.g., perpendicular crossings upstream of cabins). The current peak dates are July 15 through August 15, but these dates may be revised from time to time in consultation with affected communities and the NSB Department of Planning and Department of Wildlife Management.

c. Minimize aircraft use near known subsistence camps and cabins and during sensitive subsistence hunting periods (spring goose hunting, summer and fall caribou and moose hunting) by adhering to the following guidelines:
    i. Arrange site visits and flight schedules to conduct required activity near subsistence areas early in the season, on weekdays, and as early in the morning as possible; avoid holidays.
    ii. Note whether activities overlap important subsistence rivers and determine if a potentially affected community's tribal or city office should be notified.
    iii. Compare the proposed landing sites with the NSB camps and cabins map files available from the BLM Arctic District Office. If activities near camps or allotments cannot be avoided, contact the camp or allotment owner to discuss the timing of the visit.

The following ROP applies to subsistence consultation for permitted activities.

ROP H-3: Hunting, Fishing, and Trapping by Permittees
Objective: Minimize potential impacts on hunting, trapping, and fishing species and on subsistence harvest of those animals consistent with requirements of the Alaska National Interest Lands Conservation Act.

Requirement/Standard: Hunting, trapping, and fishing by the permittee's employees, agents, and contractors is prohibited when persons are on "work status." Work status is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when the individual's shift ends and he/she returns to a public airport or community (e.g., Fairbanks, Utqiaġvik, Nuiqsut, or Deadhorse). Use of permittee facilities, equipment, or transport for personal access or aid in hunting, trapping, and fishing is prohibited.

The following additional protections apply to select biologically sensitive areas.

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[2] Important subsistence rivers are as follows. This list may be adjusted by BLM in consultation with the affected community:

- Colville, Ublutuoch, Fish and Judy creeks (Nuiqsut)
- Utukok, Kokolik, and Kukpowruk (Point Lay)
- Kuk and tributaries (Kaolak, Ketik, Avalik, Ivisaruk, Kungok), Kugrua (Wainwright)
- Meade, Niġisaktugvik, Isiqtuq (Atqasuk)
- Inaru, Topagaruk, Chipp, Ikpikpuk, Miguakiak, Piasuk (Utqiaġvik)

Stipulation K-1: River Setbacks

- No surface occupancy
- No new infrastructure, except essential road and pipeline crossings
- Sand and gravel mining authorized through the normal review process except for a designated portion of Fish Creek, which is closed

Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing, or overwintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; the disruption of subsistence activities; and impacts on scenic and other resource values.

Requirement/Standard: Permanent oil and gas facilities (e.g., gravel pads, roads, airstrips, and pipelines) are prohibited in the streambed and adjacent to the rivers listed below[3] at the distances identified. Through the normal review process, essential pipeline and road crossings to the main channel would be permitted through setback areas. In addition, sand and gravel mining may be permitted through the normal review process, except in the area specified below around Fish Creek, where sand and gravel mining are prohibited. Sand and gravel mining activity along the important subsistence rivers, listed in ROP F-4, would be permitted through the normal review process and restricted to winter activity only. Gravel mines may be located within the active floodplain, consistent with ROP E-8.

The below setbacks may not be practical within river deltas; in such deltas, permanent facilities shall be designed to withstand a 200-year flood event in consultation with the BLM AO. In the below list, if no upper limit for the setback is indicated, the setback extends to the head of the stream, as identified in the National Hydrography Dataset.

a. Fish Creek: A 3-mile setback from the highest high water mark of the creek downstream from the eastern edge of section 31, T11N, R1E., U.M. and a 1-mile setback from the bank's highest high water mark farther upstream. Sand and gravel mining are prohibited in the 3-mile portion of the Fish Creek setback.
b. Colville River: A 5-mile setback from the boundary of NPR-A, where the river determines the boundary along the Colville River, as determined by cadastral survey to be the highest high water mark on the left (western or northern) bank south to the juncture of the Colville River and Chandalar River. South of that point to its source at the juncture of Thunder and Storm creeks, the setback would be 1 mile from the NPR-A boundary and from both banks' ordinary high water mark, where the BLM manages both sides of the river up through T1S, R1W, U.M. Note: The planning area excludes conveyed Native lands along the lower reaches of the Colville River. Development of road crossings intended to support oil and gas activities shall be consolidated with other similar projects and uses to the maximum extent practicable.
c. Ikpikpuk River: A 2-mile setback from the ordinary high water mark of the Ikpikpuk River extending from the mouth upstream through T7-N, R11W, U.M.; above that the

[3] Maps of these rivers are available in BLM 2020a. National Petroleum Reserve in Alaska – Final IAP/EIS. Appendix A, Maps 2-9 and 2-10.

setback would be for 1 mile to the confluence of the Kigalik River and Maybe Creek.

d. Kikiakrorak and Kogosukruk Rivers: A 2-mile setback from the top of the bluff or ordinary high water mark, if there is no bluff, on the Kikiakrorak River downstream from T2N, R4W, U.M. and on the Kogosukruk River downstream from T2N, R3W, U.M. The setback from these streams in the named townships and farther upstream, as applicable would be 0.5 miles from the top of the bluff or bank if there is no bluff. Tributaries to the Kogosukruk River, including Henry Creek and one unnamed tributary off the southern bank, will have a 1-mile setback from the top of the bluff or ordinary high water mark, if there is no bluff upstream from the confluence with the Kogosukruk River to T1N, R1W (Henry Creek) and T1N, R1E (unnamed tributary).
e. Titaluk River: A 2-mile setback from the ordinary high water mark from its confluence with the Ikpikpuk River upstream through T7N, R12W, U.M.; above that point the setback would be 0.5 miles from the ordinary high water mark.
f. 1-mile setback from the ordinary high water mark of the following rivers:
    - Alaktak River
    - Chipp River
    - Topagoruk River
    - Meade River
    - Usuktuk River
    - Nigisaktuvik River
    - Inaru River
    - Avalik River
    - Kungok River
    - Kuk River (upstream from T12N, R23W, U.M.)
    - Ketik River
    - Kaolak River
    - Ivisaruk River (upstream from T12N, R32W, U.M.)
    - Utukok River
    - Kokolik River
    - Kalikpik River
    - Judy Creek
    - Ublutuoch (Tiŋmiaqsiugvik) River
    - Kuna River
g. 0.5-mile setback from the ordinary high water mark of the following rivers:
    - Miguakiak River
    - Oumalik River: From the Oumalik River ordinary high water mark from the mouth upstream to section 5, T8N, R14W, U.M., and a 0.5-mile setback in and above section 5, T8N, R14W, U.M.
    - Kigalik River
    - Maybe Creek.
    - Ishuktak Creek
    - Pikroka Creek
    - Kucheak Creek
    - Niklavik Creek
    - Kugrua River
    - Kolipsun Creek: From upstream through T13N, R28W, U.M.
    - Maguriak Creek: From upstream through T12N, R29W, U.M.
    - Mikigealiak River: From upstream through T12N, R30W, U.M.
    - Nokotlek River
    - Ongorakvik River
    - Tunalik River
    - Avak River
    - Nigu River: From the confluence with the Etivluk River upstream to the boundary of NPR-A
    - Etivluk River
    - Ipnavik River
    - Kiligwa River
    - Driftwood Creek
    - Nuka River
    - Awuna River
    - Carbon Creek
    - Keolok Creek

Stipulation K-2 Deep Water Lakes

- No surface occupancy
- ROP for new infrastructure
- Sand and gravel mining authorized through the normal review process.

Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of deep water lakes; the loss of spawning, rearing, or overwintering habitat for fish; the loss of cultural and paleontological resources; impacts on subsistence cabin and campsites; and the disruption of subsistence activities.

Requirement/Standard: Generally, permanent oil and gas facilities (e.g., gravel pads, roads, airstrips, and pipelines) and new infrastructure are prohibited on the lake or lakebed and within 0.25 miles of the ordinary high water mark of any deep lake, as determined to be in lake zone III (i.e., depth greater than 13 feet; Mellor 1985[4]). The BLM would permit (through the normal review process) essential pipeline(s), road crossings, and other permanent facilities may be considered through the permitting process in these areas.

Additional restrictions as described in ROP E-11 may also apply in those habitats.

The following ROP applies to summer vehicle tundra access.

ROP L-1: Tundra Travel

Objective: Protect stream banks and water quality; minimize compaction and displacement of soils; minimize the breakage, abrasion, compaction, or displacement of vegetation; protect cultural and paleontological resources; maintain populations of and adequate habitat for birds, fish, and caribou and other terrestrial mammals; and minimize impacts on subsistence activities.

Requirement/Standard: Low-ground-pressure vehicles (see definition in ROP C-2) may be permitted to travel off of gravel pads and roads during times other than those identified in part "a" of ROP C-2. Permission for such use would be granted only after an applicant has completed the following:

a. Described procedures for route walking ahead of tundra vehicles, including what information will be collected.
b. Designed and/or modified the use proposal to minimize impacts based on timing to protect ground-nesting birds, and considered shifting work to winter, route selection, and minimizing interactions with wildlife or subsistence activities.
c. Submitted off-road travel as part of a vehicle use plan for AO approval, except for shorter notice and unforeseen trips; see ROP M-1.

See ROP E-13 for additional requirements to protect cultural and paleontological resources.

[4] These maps are available in BLM 2020a. See Appendix A, Maps 2-9 and 2-10.

The following BMP/ROP applies to general wildlife and habitat protection.

ROP M-1: Vehicle Use Plans
Objective: Minimize disturbance and hindrance of wildlife, or alteration of wildlife movement.

Requirement/Standard: Permittees will submit a vehicle use plan with their permit application for approval by the AO. The AO may waive this requirement for minimally impactful activities. Vehicle use plans will have the following elements:

a. Following wildlife with ground vehicles is prohibited. Particular attention would be given to avoid disturbing caribou.
b. The management plan would follow industry practices to minimize or mitigate delays to caribou movement, vehicle collisions, or displacement during calving, spring migration, fall migration, and post-insect aggregation movement.
c. Summary of all planned off road travel, including the number of vehicles, type and general routes.
d. Strategies for complying with Stipulations K-6, K-8, K-9, K-14, and L-1 if applicable.
e. Monitoring will be required as part of the vehicle use plan for up to 5 years after road construction. A monitoring plan could include collection of data on vehicle counts and vehicle interactions with wildlife. The AO may require adjustments to the vehicle use plan, based on the results of the monitoring.
f. Permittees shall provide an annual report to the AO, reporting roadkill of birds and mammals to help the BLM to determine whether preventative measures on vehicle collisions are effective.

Deviations from ROPs
Due to technical constraints, some Willow MDP components would require deviations from the stipulations and ROPs listed above. These include deviations from stipulations and ROPs E-2, E-11, K-1, K-2, K-6. The Willow MDP would include road and pipeline crossings within 500 feet (152 m) of fish-bearing waterbodies (including one or more of the waterbodies protected by setbacks in stipulations E-2 and K-1). Lastly, the Willow MDP would deviate from the 1-mile disturbance setback from recorded yellow-billed loon nest sites and 500-meter (1,625-feet) setback of the shoreline of documented nest lakes (deviation to ROP E-11). The CFWR would be connected to a deepwater lake and would require a deviation to stipulation K-2. Sealift barge delivery would require the exchange of ballast water within 3 miles of the coast requiring a deviation to stipulation K-6.

BLM will also apply project design criteria (PDC) developed for the NPR-A Integrated Activity Plan to the Willow Project. These include PDC 4 which states "The lease area and/or potential project areas may now or hereafter contain marine mammals. The BLM may require modifications to exploration and development proposals to ensure compliance with Federal laws, including the Marine Mammal Protection Act (MMPA). The BLM would not approve any exploration or development activity absent documentation of compliance under the MMPA. Such documentation shall consist of a Letter of Authorization, Incidental Harassment Authorization, and/or written communication from USFWS and/or NMFS confirming that a take authorization is not warranted".

Marine Mammal Protection Act Authorizations
Existing Beaufort Sea ITRs have strived to minimize disturbance and take of polar bears through mitigation, monitoring, and reporting measures that have been implemented for more than 20 years. Current mitigation measures typically required for activities in the central Beaufort Sea are described in Appendix B of the Willow MDP BA (BLM 2020a), Mitigation, Monitoring, and Reporting Requirements for the Beaufort Sea Incidental Take Regulations. The Willow MDP would be eligible to operate under Letters of Authorization from the existing or future ITRs.

The current Beaufort Sea ITRs (81 FR 52318; §18.128) describe mitigation, monitoring, and reporting requirements for oil and gas operators that are applied to active oil field operations in the central Beaufort Sea. The Beaufort Sea ITRs encompass the range of the Southern Beaufort Sea (SBS) polar bear stock, and have been important in mitigating impacts to polar bears from oil and gas activities. The general mitigation, monitoring, and reporting requirements of oil and gas operators are presented in the *Applicable Lease Stipulations and Best Management Practices* above. BLM would apply these mitigation measures to the Willow MDP as well as any additional mitigation measures included in future ITRs, if future ITRs were to be promulgated in the Action Area.

Denning Habitat Mitigation Strategy
Mitigating and minimizing human impacts to denning polar bears is an important aspect of working in polar bear denning habitat. Under the authority of the MMPA, USFWS uses a proactive and reactive approach to decrease the potential for conflicts with denned polar bears from the oil and gas industry in active oil fields (Perham 2012). This system is designed to build on historical, real-time, and localized information to develop a flexible, comprehensive approach to limit conflicts between industrial activities and denning bears. The strategy is designed to address potential den and human conflicts by locating and avoiding maternal polar bear dens. Both proactive and reactive measures can incorporate additional new and innovative measures that would be applied on a case-by-case basis. BLM is committed to working under this mitigation strategy and minimizing impacts to denning polar bears (BLM 2020a).

Proactive Tools – Proactive measures are used to find maternal dens prior to the initiation of industry activities. The USFWS works with industry to highlight potential localized denning areas during the initial planning stages of industrial activities, such as the construction of exploration pads and ice roads. No single mitigation measure is completely effective at detecting bear dens; however, a combination of tools can be used to maximize detection of dens. If a polar bear den is identified through proactive measures, CPAI and USFWS will maintain regular and open communication regarding the den site during the denning period. Additionally, USFWS and CPAI will provide training to field personnel to report any sightings or signs of polar bears. Examples of proactive tools includes, but is not limited to:

1. Regulatory and industry information-sharing meetings prior to the winter season to effectively plan den detection surveys
2. Radio-telemetry surveys for radio-collared bears and satellite-collared bear locations in the action area from the United State Geological Survey (USGS)

3. Polar bear denning habitat maps developed by USGS; habitat maps help define high-quality habitat in action area
4. Den detection surveys, which can be infrared imagery surveys (either aerial or handheld) or scent-trained dog surveys

Reactive Tools – In some cases, polar bears dens were not detected through proactive measures or polar bears select den sites in areas where initially there was no development. As the site is developed and industry activity increases, the bear may become more susceptible to disturbance. When a bear emerges from a known den near industry facilities, or if a polar bear emerges from an unknown den during ongoing industrial activities, reactive measures are implemented. These mitigation measures are maintained until the female abandons the den site. The reactive measures below have been applied to den sites in the past. Examples of reactive tools includes, but are not limited to:

1. Restricted activities within 1 mile of the den
2. 24-hour den monitoring using a camera and/or bear monitors
3. Altered or modified airport traffic patterns to avoid flying over a known den site
4. Altered flight altitudes for aircraft; at least 1,500 feet above the surface for all aircraft within 1 mile of an occupied den
5. Ice road or snow trail restrictions; for restrictions, various measures can be implemented, such as reducing traffic to essential traffic only, maintaining checkpoints on both sides of the den site to control traffic in the area, and reducing traffic speed limits on the ice roads to 15 miles per hour near the den site

Other Mitigation Required by BLM – BLM is also committing to apply the following measures, which have typically been included in other recent ESA consultations for oil and gas activities on the North Slope, to permitted activities associated with the Willow MDP:

1. General mitigation measures:
    a. Implement food handling and waste management procedures to avoid creating attractants.
    b. Schedule work to avoid the nesting period when possible, especially in areas known to support high densities of listed eiders.
    c. Avoid areas with high use by listed species where possible.
    d. Facilitate coordination of work to reduce duplication of trips and efforts in the same areas.
    e. Conduct pre-construction polar bear den surveys using FLIR. Avoid construction within 1 mile of active dens.
2. Marine activities (i.e., barge transit route, support vessel route):
    a. Conduct a visual scan of the area prior to deploying any vessels or equipment. If marine mammals are in the area, then the deployment will be delayed until the marine mammals leave.
    b. If marine mammals enter the activity area during the vessel or equipment deployment, all activity near the protected species will stop and not resume until marine mammals have departed the area.

Further, BLM will continue to support actions presented in the Polar Bear Conservation Management Plan (USFWS 2016a) and follow its guidelines when conducting Project activities.

3.2.2.6 Erosion Control

The Willow MDP will follow a Facilities Erosion Control Plan, which will outline procedures for operation, monitoring, and maintenance of various erosion control methods. The Facilities Erosion Control Plan will contain Project snow removal and dust control measures. Snow removal plans will include the use of snow-blowing equipment to minimize gravel carryover to the tundra and the placement of cleared snow in designated areas. Snow push areas will be determined annually, based on avoiding areas of thermokarst, proximity to waterbodies, and evaluating how the area looks based on the previous years' activities. A Dust Control Plan will include gravel road watering guidelines to minimize dust impacts to tundra. A Stormwater Pollution Prevention Plan will describe management of surface water drainage for the Willow MDP pads.

Spill Prevention and Response

Facilities will be designed to mitigate spills with spill prevention measures and spill response capabilities. Spill prevention and response measures to be used during construction, drilling, and operations will be outlined in a Project ODPCP and Spill Prevention Control and Countermeasures Plan, consistent with ROP A-4. CPAI will implement a pipeline maintenance and inspection program and an employee spill-prevention training program to further reduce the likelihood of spills. Production facility design will include provisions for secondary containment for hydrocarbon-based and hazardous materials. If a spill occurs on a pad, the fluid will remain on the pad, unless the spill is near the pad edge or exceeds the retention capacity of the pad. Fuel transfers near pad edges will be limited to the extent practicable to mitigate this risk.

Spill Prevention – CPAI will design and construct pipelines to comply with state, federal, and local regulations. Pipelines will be constructed of high-strength steel and will have wall thicknesses in compliance with or exceeding regulatory requirements. Pipeline welds will be validated using nondestructive testing (e.g., radiography, ultrasonic) during pipeline construction to ensure their integrity, and the pipelines will be hydrostatically tested prior to operation. Pipelines for production fluids, water injection, seawater, and export will fully accommodate pigs for cleaning and corrosion inspection.

CPAI will use two methods of leak detection for the seawater and diesel pipeline crossings under the Colville River:

1. Leak detect mass balance (primary)
2. Optical leak detection (secondary within the pipeline carrier casing)

To further minimize risk of a pipeline leak under the Colville River, the diesel and seawater pipelines will be installed inside high-strength casing pipes. The simultaneous failure of both a pipeline and the casing is highly unlikely. If fluids leak from the pipelines, they will be captured within the space between the outer wall of the pipelines and the inner walls of the casing rather than reaching the subsurface river environment. To prevent external corrosion, the casing pipes and pipeline will be protected by an abrasion-resistant coating, in accordance with industry standards.

CPAI will maintain a corrosion control and inspection program that includes ultrasonic inspection, radiographic inspection, coupon monitoring, metal loss detection and geometry pigs, and infrared technology. The inspection programs are American Petroleum Institute Standard 570-based programs that focus inspection efforts on areas with the greatest spill potential.

Spill Response – The Willow MDP ODPCP will demonstrate readily accessible inventories of fit-for-purpose oil spill response equipment, and personnel will be available at Willow Development facilities. In addition, a state-registered primary response action contractor will provide trained personnel to manage spill response(s). Threats to rivers and streams from a possible pipeline spill will be minimized by quickly intercepting, containing, and recovering spilled oil near the waterway crossing point, once detected. Valves will be installed on each side of pipeline crossings at Fish (Uvlutuuq) and Judy (Iqalliqpik) creeks, which will isolate produced fluids pipelines on either side of the creeks to minimize potential spill impact in the event of a pipeline leak or break. Spill response equipment will be pre-staged at strategic locations across the Project area for rapid deployment, as outlined in the Project's ODPCP. During summer, pre-staged containment booms will be placed at strategic locations near selected river channels. Pre-deployed booms may also be placed within select stream channels to mitigate a spill, should one occur. During summer, spill containment equipment will likely be staged or deployed using helicopters. If a spill occurs, response measures could include the use of watercraft (e.g., jetboats, and/or airboats) to access affected areas.

Spill Training and Inspections – CPAI provides regular training for its employees and contractors on preventing oil or hazardous material spills, in addition to other environmental and certification classes. The CPAI Incident Management Team participates in regularly scheduled training programs and conducts spill response drills in coordination with federal, state, and local agencies. Employees are encouraged to participate in the North Slope Spill Response Team, and as part of the team, members receive regularly scheduled spill response training to ensure continuous availability of skilled spill responders on the North Slope.

CPAI is required to conduct visual examinations of pipelines and facility piping with a frequency defined under 49 CFR 165.412 and 18 AAC 75.055 during operations at a minimum interval not exceeding 3 weeks. CPAI will conduct aerial overflights as necessary to allow both visual and infrared inspection using aircraft or from the ground using handheld systems. Infrared technology can detect warm spots (i.e., oil) in low-light conditions or when other circumstances (e.g., light fog, drifted snow) limit visibility. CPAI will also conduct regular visual inspections of facilities and pipelines from gravel roads and aircraft (for sections of pipelines not paralleled by gravel roads [i.e., more than 1,000 feet of separation]).

Willow Project Abandonment and Reclamation

Abandonment and reclamation of Willow MDP facilities would be determined at or before the time of abandonment. The Abandonment and Reclamation Plan will be subject to input from federal, state, and local authorities, as well as private landowners. Abandonment and reclamation may involve removal of gravel roads and pads or leaving these in place for use by a different entity. Revegetation of abandoned facilities could be accomplished by seeding with native vegetation or through natural colonization. Reclaimed gravel could be used for other development projects. Reclamation standards will be determined by the BLM AO prior to reclamation. Depending on abandonment and reclamation activities, summer road and air traffic levels would be similar to those experienced during construction, but at potentially lower intensity and for shorter duration.

3. ACTION AREA

Under regulations implementing Section 7 of the ESA, the Action Area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. In determining the effects of the action, and hence the Action Area, we consider the consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that result from the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

Here, the Action Area includes terrestrial and offshore areas. The terrestrial Action Area is the area within 1 mile (1.6 km) of Willow MDP activities, or the buffer used by the USFWS to avoid polar bear den disturbance from noise, vibration, physical presence, and human activity (Figure 3.1). With respect to ESA-listed eiders in the terrestrial Action Area, the estimated disturbance zone (i.e., zone of influence) around Willow MDP infrastructure is 656 feet (200 m). BLM NPR-A ROP E-18 restricts on-tundra activity (i.e., not on pads or roads) within 656 feet (200 m) of occupied listed eider nests from June 1 through July 31 (BLM 2020a).

The offshore Action Area is the area within 1.5 miles (2.4 km) of offshore Willow MDP components: the marine transit route (MTR) for barge transit from Dutch Harbor in the southern Bering Sea to the offshore barge lightering area, the screeding area for barge lightering, the barge and support vessel route from the lightering area to Oliktok Dock, and the area encompassing construction, screeding, and offloading activities at Oliktok Dock (Figure 3.1 Inset A). The offshore action area for screeding and Oliktok Dock work was determined by using the estimated distance to the National Marine Fisheries Service (NMFS) acoustic harassment disturbance threshold for non-impulsive noise sources (120 decibels [dB] referenced to one microPascal root mean square [dB re 1 μPa rms]). To estimate the distance to the 120 dB re 1 μPa threshold for the MTR, a source level of 170 dB re 1 μPa rms at 3.28 feet (1 m) (Blackwell and Greene 2003) and a transmission loss of 15 log(R) were used, resulting in an estimated distance of 7,067 feet (2,154 m), or 1.3 miles (2.1 km). This distance was then rounded up to 1.5 miles (2.4 km).

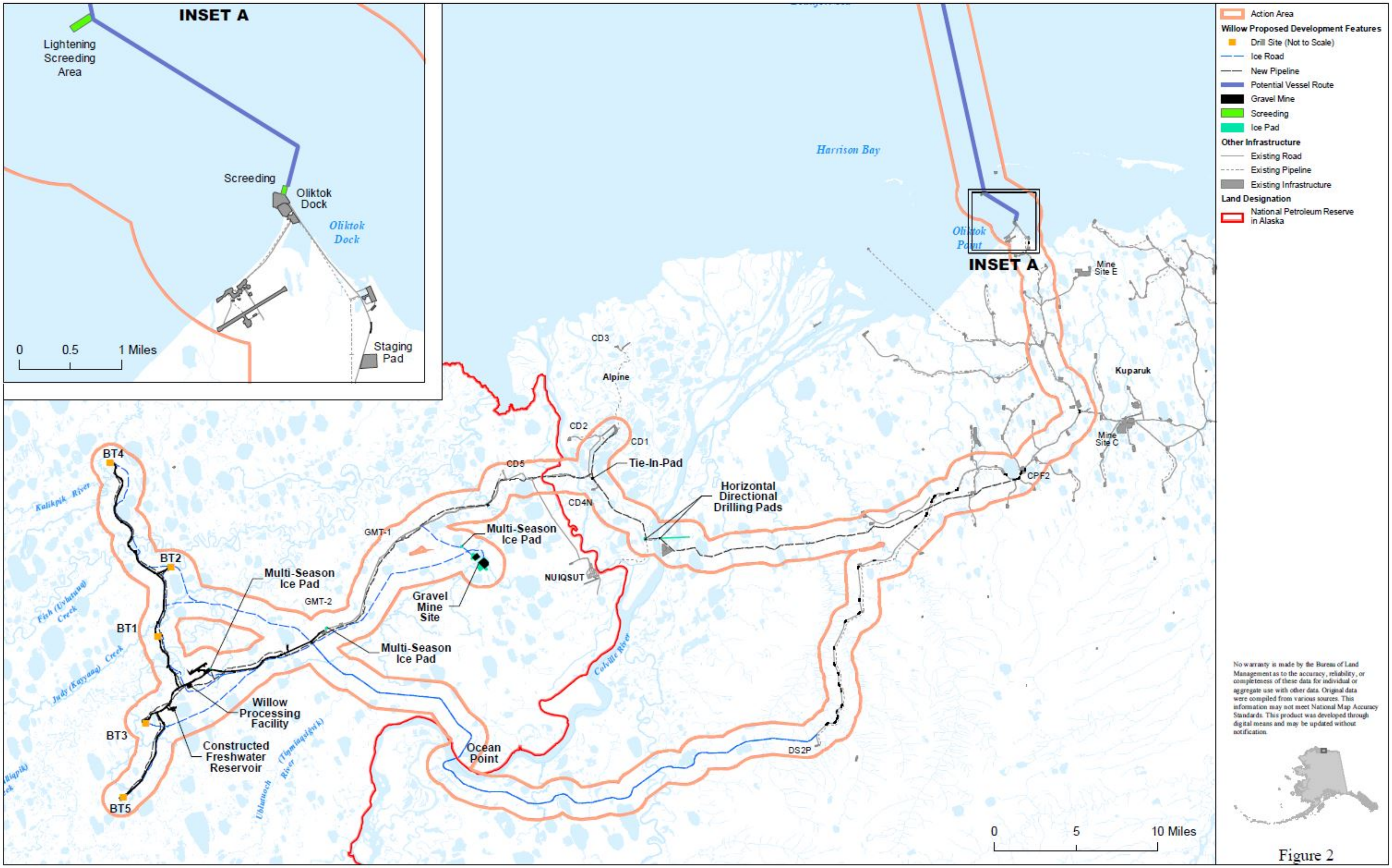

Figure 3.1. The proposed terrestrial portion of the Action Area including existing and proposed, permanent and seasonal infrastructure associated with the Willow MDP (BLM 2020a).

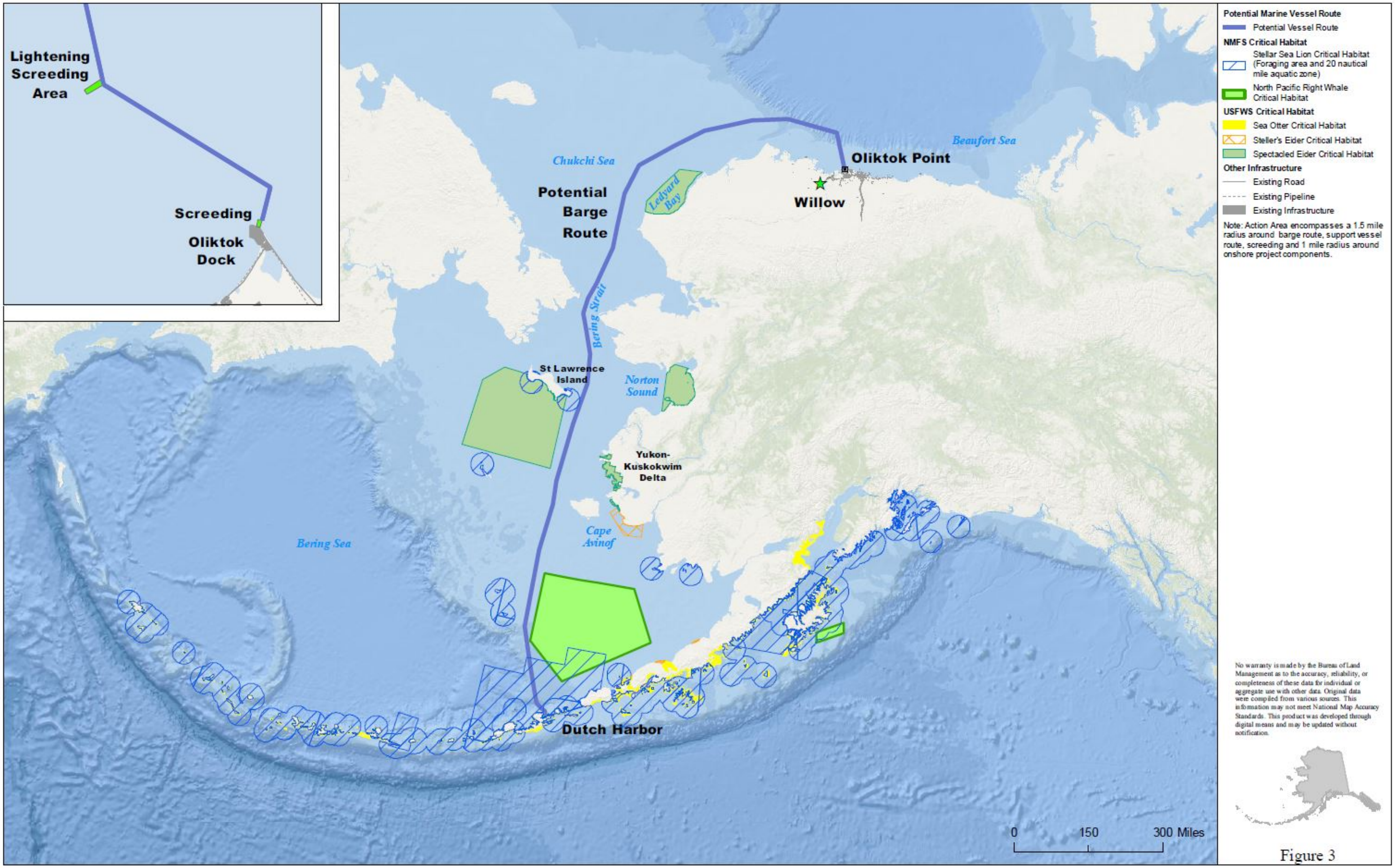

Figure 3.2. The proposed Marine Transit Route (MTR), from Dutch Harbor to Oliktok Dock, where barges and tug boats would operate during construction of the proposed Willow MDP (BLM 2020a).

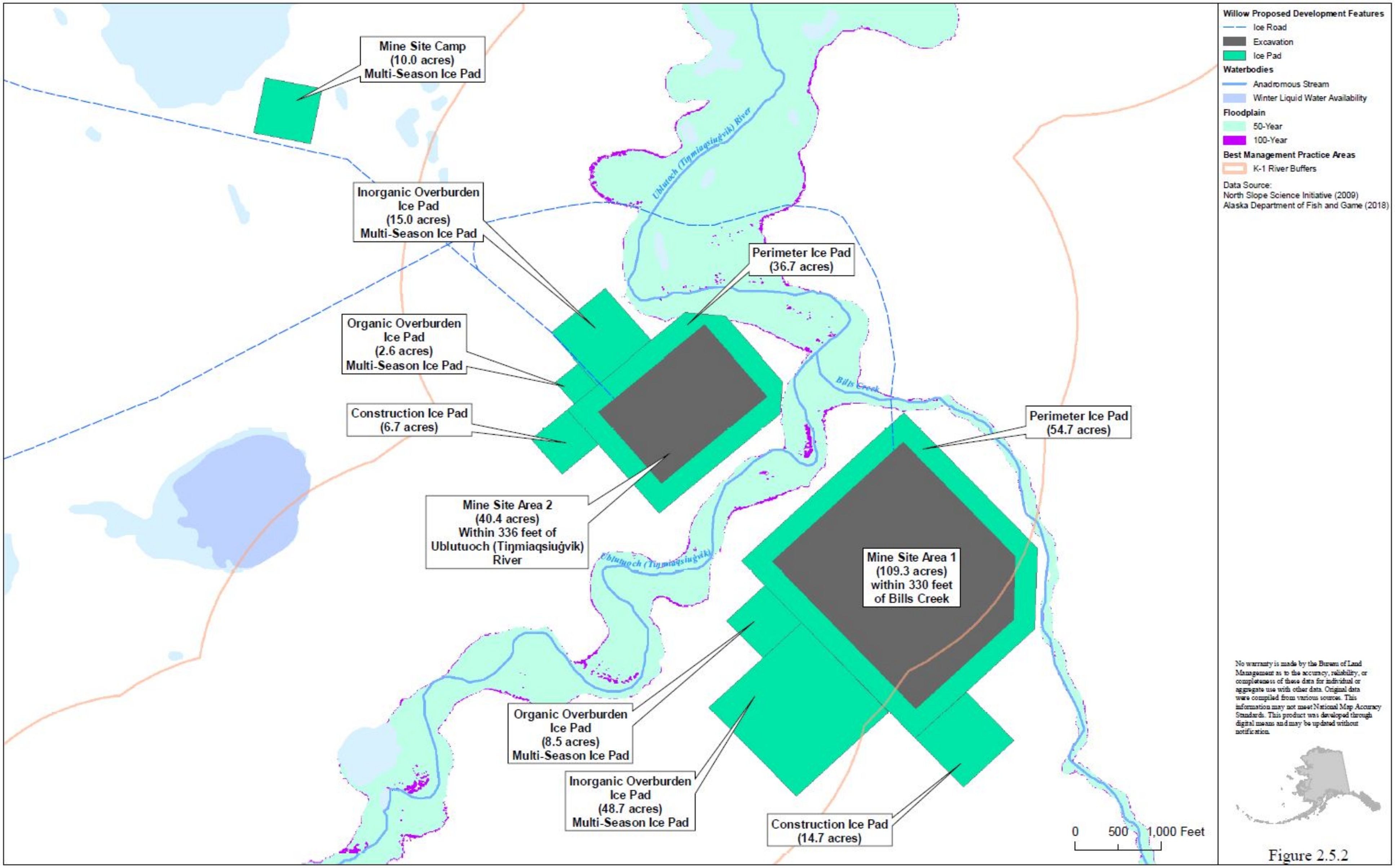

Figure 3.3. Multi-season ice pads associated with the Tiŋmiaqsiuġvik mine site (BLM 2020b).

4. EFFECT DETERMINATIONS FOR STELLER'S EIDERS, NORTHERN SEA OTTERS, AND DESIGNATED CRITICAL HABITAT FOR THESE SPECIES

Alaska-breeding Steller's Eider

The Service listed the Alaska-breeding population of the Steller's eider as threatened on June 11, 1997 (62 FR 31748). In Alaska, Steller's eiders breed almost exclusively on the Arctic Coastal Plain (ACP), migrating to the breeding grounds in late spring with brood-rearing females and remaining in the region as late as mid-October. Nesting is concentrated in tundra wetlands near Utqiaġvik, and Steller's eiders occur at extremely low densities elsewhere on the ACP (Figure 4.1; USFWS 2015).

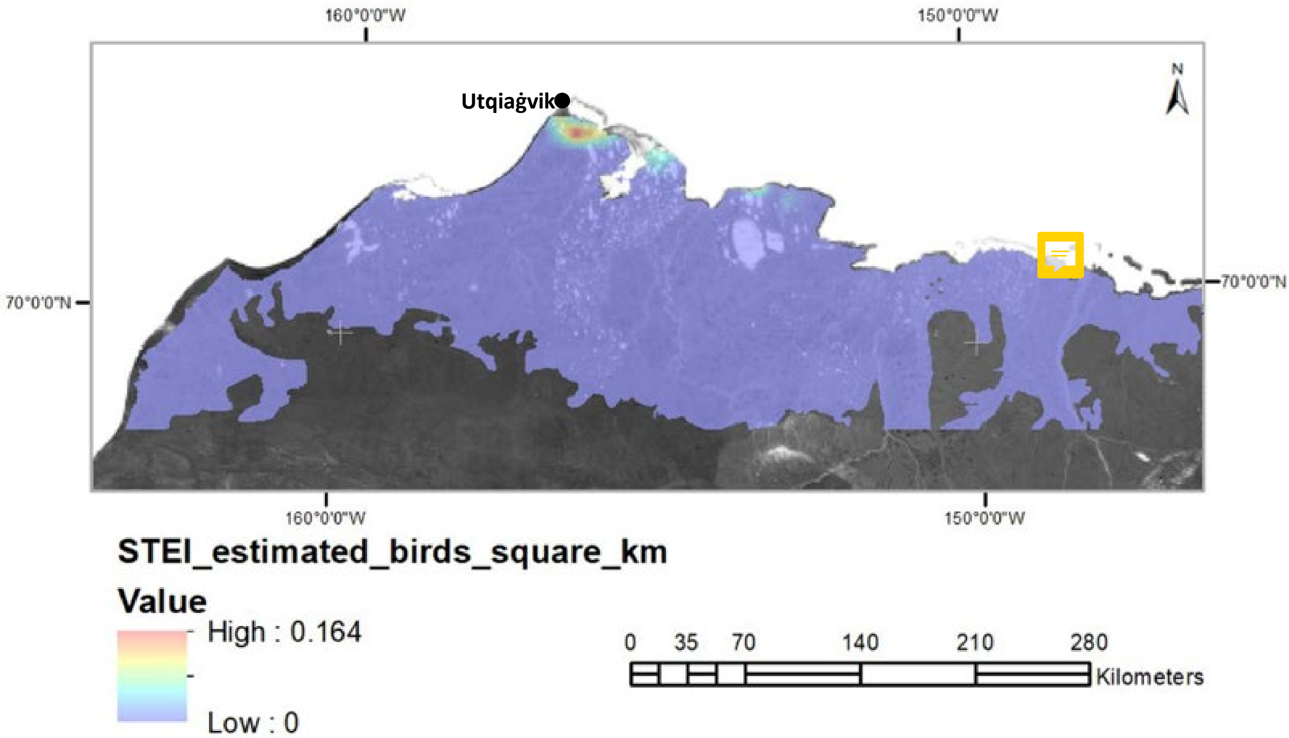

Figure 4.1. Estimated density of Steller's eiders on the Arctic Coastal Plain of Alaska.

Steller's eiders could be impacted by the Proposed Action through loss of nesting habitat and disturbance or displacement. However, because available data indicate Steller's eiders are extremely unlikely to nest in the Action Area, impacts to nesting Steller's eiders are not expected. Nonetheless, small numbers of non-breeding or migrating Steller's eiders could pass through the terrestrial portion of the Action Area, and if so, could potentially be subject to disturbance. However, we expect disturbance to non-breeding or migrating eiders would be minor because non-nesting individuals can respond to human presence or disturbance by moving away to a safe distance. Because disturbance to non-breeding or migrating Steller's eiders would be so minor that injury or death is not expected, effects of disturbance to this species would be insignificant.

Steller's eiders could also be at risk of colliding with vessels in the MTR. Using the best available information, we estimated collision risk for Steller's eiders from barge and tug boat traffic associated with the Willow MDP. We used king and common eiders as surrogates for Steller's eiders due to their greater abundance, using observations of vessel collisions collected by biological observers in a structured monitoring and reporting effort. To do that, we used observed collisions of king and common eiders with vessels in the Chukchi Sea. We first calculated a *per capita* risk of collision per vessel operating during a single season in the Chukchi Sea, based on collisions during Royal Dutch Shell's (Shell) 2012 Exploratory Program, and the estimated number of eiders migrating through the region. We then multiplied the estimated per capita collision rate (collisions per eider per vessel per season) by the estimated abundance of Alaska-breeding Steller's eiders, based on estimates from aerial surveys on the Arctic Coastal Plain. We then approximated the number of collisions expected for Steller's eiders during 86 vessel trips through the MTR, over the life of the project. Finally, because barges and tugs could theoretically operate over a longer period each season than the duration of Shell's 2012 open-water campaign, we adjusted the calculations to estimate collisions over an extended operations period. A typical open-water season in Arctic waters is approximately 150 days. We expect the proposed sealift operations would be of shorter duration (likely much shorter) than the length of a typical open-water season, but the timing of operations would be difficult to estimate precisely due to several factors including seasonal variation in sea ice conditions and marine forecasts. Therefore, lacking greater certainty in project timing, we conservatively extrapolated our estimate to cover a full open-water season. We believe this significantly overestimates the number of days that vessels would be underway and present in waters where Steller's eiders occur, and therefore represents a substantial overestimation of collision risk to listed Steller's eiders. Our calculations are presented in Appendix A.

Using the approach described above and detailed in Appendix A, we roughly estimate the number of Steller's eiders that would be injured or killed through collisions with vessels during the predicted 30-year project, as 0.07, suggesting that collisions are possible, but unlikely. While acknowledging the limitations of applying observations from vessels operating in one area to vessels that differ in size and structure operating in different areas, our estimates are based on the best information available and we believe are likely to substantially overestimate collision risk.

Due to their low density, impacts to Alaska-breeding Steller's eiders from spills in the terrestrial portion of the Action Area, or marine waters near Oliktok Dock, are not anticipated. BLM (2020a) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel), and be localized and of short duration (< 4 hours). Given spill prevention and response measures in place, the likelihood of small spills in the MTR would be very low to low and these spills would be limited to the vicinity of Dutch Harbor (e.g., during fuel transfers).

A medium to very large spill would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached. The duration and spatial extent of this type of spill could range from one to several days depending on the location, sea state, and proximity to shore-based response. However, given that all vessels associated with the Willow MDP would follow established shipping routes, the likelihood of such an accident would be very low (BLM 2020a). Furthermore, given that the duration and frequency of vessel traffic in the MTR would be limited (i.e., sealift operations would take place during a 4 year subset of the construction phase), the likelihood of a spill of this nature would be very low.

Steller's eiders in the MTR could conceivably be impacted by small spills during vessel re-fueling at Dutch Harbor. However, the BLM has indicated spills during these operations would be uncommon, localized and of short duration (BLM 2020a). Therefore we anticipate impacts to Steller's eiders from small spills would be minor. Furthermore, because larger spills (>100 gallons) resulting from the limited vessel operations would be extremely unlikely, impacts from large spills on Steller's eiders in the MTR are not reasonably certain to occur.

In summary, 1) adverse impacts to breeding Steller's eiders on the North Slope are not expected, 2) impacts from small spills would be insignificant and large spills would be discountable, and 3) although vessel traffic associated with sealift operations has the potential to pose risk of collisions between Steller's eiders and vessels, our estimate, based on the best available information, is that collisions are not likely to occur. Therefore, collectively the proposed action is *not likely to adversely affect* Alaska-breeding Steller's eiders.

Steller's Eider Critical Habitat

Critical habitat was designated for Steller's eiders on the Yukon-Kuskokwim Delta and in four marine areas, including three along the Alaska Peninsula and one just south of the Yukon-Kuskokwim Delta at the Kuskokwim Shoals (66 FR 8850). The MTR from Dutch Harbor through the Bering, Chukchi, and Beaufort seas, (Figure 3.2), is well outside of all designated units.

Accidental spills during sealift operations would likely be limited to small spills originating from fuel transfers in the vicinity of Dutch Harbor. Wintering habitat in Izembek Lagoon, the nearest critical habitat unit to Dutch Harbor, is 270 km away. Furthermore, sealift operations would not take place from October through April when wintering areas are used by Steller's eiders (BLM 2020a). Therefore, it is extremely unlikely that any oil from re-fueling spills would be carried into designated critical habitat, and we do not anticipate adverse impacts to Steller's eider critical habitat from small spills. Although conceivable, larger spills from vessels operating in the MTR would be very unlikely, and are therefore not considered reasonably certain to occur.

Because 1) impacts to terrestrial critical habitat from the Proposed Action are not expected, 2) disturbance to eiders within designated marine critical habitat, is expected to be infrequent and limited to minor short-term disturbance, and 3) due to geographic and temporal separation, impacts from spills during refueling of vessels are not anticipated; collective impacts to Steller's eider critical habitat from the Proposed Action are expected to be insignificant. Therefore, we conclude the proposed Willow MDP is *not likely to adversely affect* designated Steller's eider critical habitat.

Northern sea otter

The Service listed the southwest Alaska distinct population segment (DPS) of the northern sea otter as threatened on August 9, 2005 (70 FR 46366). Vessels associated with sealift operations during Willow MDP construction may encounter and disturb listed sea otters when transiting in and out of Dutch Harbor in the vicinity of Unalaska Island *en route* to Oliktok Dock.

However, sea otter density is relatively low in the vicinity of Dutch Harbor, and we expect sea lift barges and tugs would encounter very few individuals. We would also expect disturbance from barge traffic to be minor and temporary because 1) barges would move slowly (< 14 knots) through the vicinity of Dutch Harbor as they arrive and depart from the port, and 2) sea otters can respond to vessel presence or disturbance by moving away to a safe distance. Because disturbance to listed sea otters would be so minor that injury or death is not expected, we expect the effects of disturbance would be insignificant.

Listed sea otters could also be impacted by unintentional spills during vessel transit through the MTR. However, overlap between the range of listed sea otters and the MTR is minor and limited to the vicinity of Dutch Harbor. Furthermore, BLM has indicated the likelihood of spills in the marine environment would be very low to low, and any spills would likely be very small to small in size (<10 to 99.9 gallons), and localized and of short duration (< 4 hours; BLM 2020a, Appendix D). Therefore, we anticipate impacts to listed sea otters from small spills in the MTR would be insignificant. Hence, because 1) vessel operations in the MTR would be limited to 4 open water seasons reducing the potential for spills, and 2) BLM anticipates larger spills (> 100 gallons) in MTR would be very unlikely, impacts from large spills on listed sea otters would be discountable.

In summary, because effects of disturbance would be minor and temporary, and impacts from spills would be insignificant and/or discountable, we expect collective effects of the proposed action on listed sea otters would be insignificant. Therefore, the Service concludes that the proposed Willow MDP is *not likely to adversely affect* the southwest Alaska DPS of the northern sea otter.

Northern sea otter critical habitat

The Service designated critical habitat for the southwest Alaska DPS of the northern sea otter on October 8, 2009 (74 FR 51988). The Eastern Aleutian Critical Habitat (Unit 2) occurs in nearshore marine waters around Unalaska Island ranging from the mean high tide line seaward for a distance of 100 meters, or to a water depth of 20 meters. Barge and tug traffic during the Willow MDP construction phase may enter designated critical habitat near Dutch Harbor and Unalaska Island.

Designated critical habitat for sea otters could be impacted by unintentional spills during vessel re-fueling in Dutch Harbor. However, BLM has indicated the likelihood of spills in the marine environment would be very low to low, and any spills would likely be very small to small in size (<10 to 99.9 gallons), and localized and of short duration (< 4 hours; BLM 2020a, Appendix D). Therefore we anticipate impacts to sea otter critical habitat from very small or small refueling spills would be insignificant. Furthermore, due to the very low likelihood of a larger spill (> 100 gallons) during sealift operations, impacts from large spills on sea otter critical habitat would be very unlikely and are therefore, discountable.

Because 1) overlap between barge traffic and designated sea otter critical habitat would be limited to the vicinity of Dutch Harbor and Unalaska Island, which represents a very small proportion of designated sea otter critical habitat, 2) vessel presence in critical habitat would be temporary as barges and tugs pass through the area, and 3) spills from re-fueling would be expected to be small, localized, and remediated quickly; action-specific impacts from proposed vessel traffic in the MTR are expected to be insignificant. Therefore, the Willow MDP is *not likely to adversely affect* designated sea otter critical habitat.

5. STATUS OF THE SPECIES

This section presents biological and ecological information relevant to the BO. Information on species' life history, habitat and distribution, and other factors necessary for their survival is included to inform our analysis in later sections.

Spectacled eider

Status and Distribution

The spectacled eider, a large, benthivorous sea duck (Figure 5.1A), was listed as threatened throughout its range on May 10, 1993 (USFWS 1993) based on indications of steep declines in the two Alaska-breeding populations. There are three primary spectacled eider populations, corresponding to breeding grounds: Alaska's North Slope or Arctic Coastal Plain (ACP), the Yukon–Kuskokwim Delta (Y-K Delta), and northern Russia. The Y-K Delta population of spectacled eiders declined 96% between the early 1970s and 1992 (Stehn et al. 1993). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, Alaska (R. Suydam, pers. comm. in USFWS 1996) suggested concurrent localized declines on the North Slope, although data for the entire North Slope breeding population were not available.

Spectacled eiders molt in several discrete areas (Figure 5.1B) during late summer and fall, with birds from different populations and genders apparently favoring different molting areas (Petersen et al. 1999). All three spectacled eider populations overwinter in openings in pack ice of the central Bering Sea, south of St. Lawrence Island (Petersen et al. 1999; Figure 4.1B), where they remain until March–April (Lovvorn et al. 2003).

(A)

(B)

Figure 5.1. Distribution of spectacled eiders. Molting areas (green) are used July through October. Wintering area (yellow) is used October through April. Nesting areas (red) are used May-July. The full extent of molting and wintering areas is not yet known and may extend beyond the boundaries shown.

Abundance and trends

The most recent range-wide estimate of abundance of spectacled eiders is 369,122 individuals

(90% CI ± 4,932) obtained by aerial surveys of the known wintering area in the Bering Sea in late winter 2010 (Larned et al. 2012). Comparison of point estimates between 1997 and 2010 indicate an average of 353,051 spectacled eiders in the global population over that 14-year period (Larned et al. 2012).

Yukon-Kuskokwim Delta
The Y-K Delta spectacled eider population declined by about 96% from the 1970s to 1992 (Stehn et al. 1993). Evidence of the dramatic decline in spectacled eider nesting on the Y-K Delta was corroborated by Ely et al. (1994), who found a 79% decline in eider nesting at a study area near the Kashunuk River between 1969 and 1992. The causes of this steep decline remain unknown. From the early 1970s to the early 1990s, the number of pairs on the Y-K Delta declined from approximately 48,000 to 2,000 (Dau and Kistchinski 1977; Stehn et al. 1993).

A combination of aerial and ground-based surveys conducted by the Service indicate that the spectacled eider population has grown on the Y-K Delta since listing in 1993. Fischer et al. (2017) used combined annual ground-based and aerial survey data to estimate the number of nests and eggs of spectacled eiders on the central coast of the Y-K Delta and evaluate long-term trends from 1985 to 2018. In a given year, the estimated number of nests reflects the minimum number of breeding pairs in the population and does not include non-nesting individuals or nests that were destroyed or abandoned. The estimated total number of spectacled eider nests on the Y-K Delta in 2016 is 9,464 (SE = 1,318; Final estimates are not yet available for 2017 and 2018). The average growth rate of estimated numbers of nests from 1985 – 2016 is 1.010 (90% CI = 0.999 – 1.021; Fischer et al. 2017).

Based on data from an aerial breeding pair survey flown annually from 1988 – 2016, the 2016 population index on the Y-K Delta is 6,339 indicated total spectacled eiders (90% CI = 5,341–7,337). From 1988 to 2016, the mean annual population index of spectacled eiders is 3,608 indicated total birds (90% CI = 3,058–4,158), with a mean annual growth rate of 1.055 (90% CI = 1.044–1.066). These population indices do not account for incomplete detection or other sources of bias (Swaim 2017a).

Lewis and Schmutz (2017) calculated density-adjusted visibility correction factors using data from both aerial surveys and ground-based surveys on the Y-K Delta to account for incomplete detection. The detection-adjusted population estimate for spectacled eiders on the Y-K Delta in 2017 is 17,176 breeding birds ± 1,605 (SE), 97% higher than the 1988–2016 average (8,732; Swaim and Fischer 2017).

Arctic Coastal Plain - Warnock and Troy (1992) documented an 80% decline in spectacled eider abundance from 1981 to 1991 in a study area near Prudhoe Bay, but evidence of a significant decline elsewhere on the North Slope since 1991 is lacking. The Service has conducted annual aerial surveys on the ACP since 1993, when approximately 3,000 pairs of spectacled eiders were estimated to be present (USFWS 2010a); survey methods were modified in 2007 and have been consistent through 2018 (Wilson et al. 2018). The 2017 population index for spectacled eiders calculated from this survey is 5,122 individuals (unadjusted for detection; 95% CI = 3,633 – 6,612) and the average annual growth rate of the index from 2008- 2017 is 0.976 (95% CI = 0.935 – 1.019; Wilson et al. 2018). Wilson et al. (2017) recently estimated aerial survey detection rates for the ACP using a double-observer approach, allowing the conversion of indices from the surveys to estimates of abundance. Based on these estimates, the 10 year average annual growth rate is 0.997 (95% CI = 0.954 – 1.043; 2007 – 2016; Wilson et al. 2017). Using data from surveys with consistent methods (2007-2019) and estimates of detection from Wilson et al. (2017), the most recent estimate of the number of spectacled eiders breeding on the ACP, in 2019, is 5,108 (SE = 725; E. Osnas, USFWS, pers. comm.). Similar to the Y-K Delta estimates, this number represents the breeding population, and does not include non-breeding or juvenile spectacled eiders.

Russia

Much larger numbers of spectacled eiders have been estimated for Russia. Aerial surveys on the eastern Arctic coast of Russia from 1993 to 1995 produced an index of 146,245 spectacled eiders (unadjusted for detection rate; Hodges and Eldridge 2001). Approximately 20% of the spectacled eiders observed were in flocks, which suggested a large number of non-breeding birds compared to Y-K Delta and ACP surveys, in which flocks are rare (Stehn et al. 2006). No surveys in Arctic Russia have occurred since 1995, and range-wide population numbers and trends are unknown, other than what can be inferred from winter population estimates, which encompass the combined world population of spectacled eiders.

Life history, seasonal habitats, and food

Breeding - The breeding habitat of spectacled eiders is in wet tundra regions. In Alaska, spectacled eiders breed primarily on the ACP of the North Slope and the Y-K Delta. On the ACP, most spectacled eiders breed closer to the coast (Figure 5.2) near large, shallow, productive thaw lakes. Nest sites are often located within three feet of a lakeshore (Johnson et al. 1996). Although spectacled eiders historically occurred throughout the coastal zone of the Y-K Delta, they currently breed primarily in the central coast zone within about 15 km (9 mi) of the coast from Kigigak Island north to Kokechik Bay (USFWS 1996). However, sightings on the Y-K Delta have also occurred both north and south of this area during the breeding season (R. Platte, USFWS, pers. comm. 1997).

Spectacled eiders arrive on the ACP breeding grounds in late May to early June. Numbers of breeding pairs peak in mid-June and decline 4–5 days later when males begin to depart from the breeding grounds (Anderson and Cooper 1994; Smith et al. 1994; Anderson et al. 1995; Bart and Earnst 2005). Lake (2008) documented some female spectacled eiders begin to breed in their third year, although most wait until their fourth year. Age at first breeding has not been determined for males, but probably occurs the third or fourth year, coinciding with the acquisition of adult plumage (Petersen et al. 2000). Mean clutch size ranges from approximately 3-4 eggs, with clutches of up to eight eggs reported (Quakenbush et al. 1995; Bart and Earnst 2005; Safine 2011). Incubation lasts 20–25 days (Kondratev and Zadorina 1992; Harwood and Moran 1993; Moran and Harwood 1994; Moran 1995), and hatching occurs from mid- to late July (Warnock and Troy 1992).

Following hatch, broods move from nests to freshwater ponds, brackish ponds, or flooded tundra usually traveling < 3 km, but occasionally up to 13 km (Petersen et al. 2000). On these breeding grounds, spectacled eiders dabble in ponds and wetlands feeding on mollusks, insect larvae (craneflies, caddisflies, and midges), small freshwater crustaceans, and plants and seeds

(Kondratev and Zadorina 1992). Ducklings fledge approximately 50 days after hatch, when females with broods move from freshwater to marine habitat prior to fall migration (USFWS 2010a).

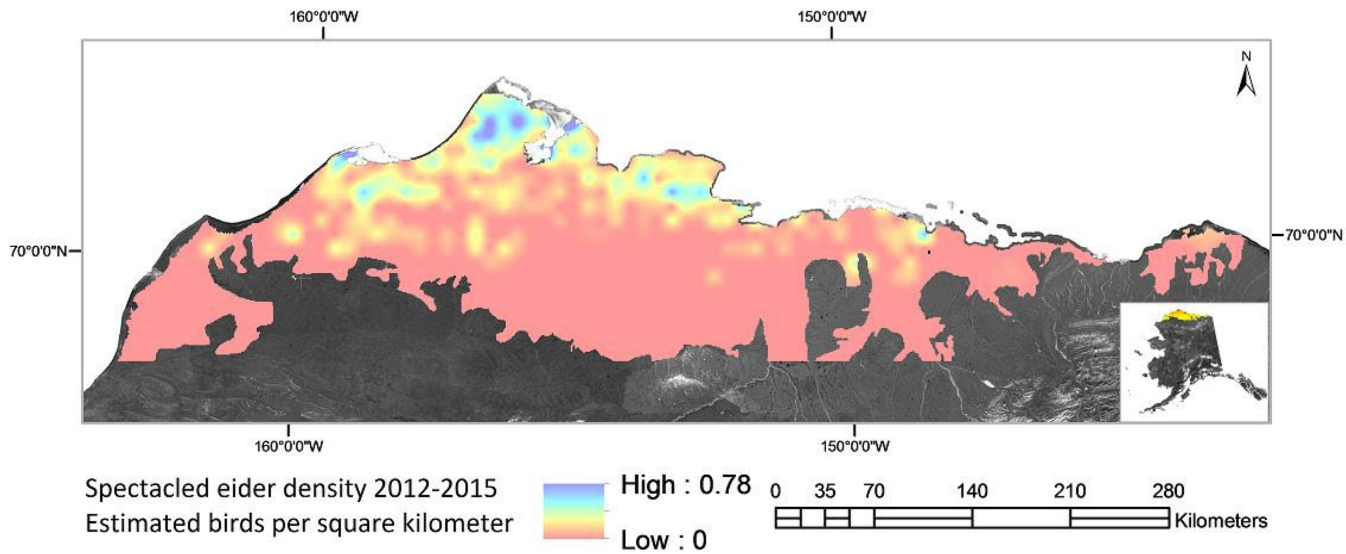

Figure 5.2. Density distribution of spectacled eiders observed on aerial transects of wetland tundra on the North Slope of Alaska during breeding pair surveys in June, 2012–2015 (USFWS 2015).

Survivorship - Nest success, the probability that a nest survives with at least one duckling hatching, is highly variable and thought to be primarily influenced by predators, including gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), red (*Vulpes vulpes*) and arctic foxes (*Alopex lagopus*). Nest success varies from as low as 2% (Pearce et al. 1998) to as high as 93% (Fischer et al. 2009). Mean apparent nest success from 1993 to 2007 in the Kuparuk oil fields on the ACP was 41.7% (Anderson et al. 2007). Nest success for all spectacled eider nests with known fate found on the Colville Delta before construction of CD-3 satellite oil well pad (1993-2004) was 37%; nest success after development was 33% in 2005, 40% in 2006 and 40-43% in 2007 (Johnson et al. 2008). Of 10 nests monitored by camera on the Colville River Delta in 2007, five failed, all due to depredation by arctic foxes (Johnson et al. 2008). In summary, spectacled eider nest success varies substantially by year and location and is negatively affected by predation.

Studies from the Y-K Delta and ACP have shown that from one third to two thirds of spectacled eider ducklings survive to 30 days, with most mortality occurring in the first 10 days (Flint, Paul L, J A Morse, J B Grand 2006; USFWS 2010a). Recruitment rate (the percentage of young eiders that hatch, fledge, and survive to sexual maturity) of spectacled eiders is poorly known (USFWS 1999) because there is limited data on juvenile survival. Annual survival rates of adult females breeding on the Y-K Delta varied depending on lead exposure on the breeding grounds, with females exposed to lead surviving at a lower rate than females not exposed to lead (Grand et al. 1998).

Fall migration and molting - Avian molt is energetically demanding, especially for species such as spectacled eiders that complete molt in a few weeks. Spectacled eiders use four molting areas from July to late October (Figure 4.1B; Larned et al. 1995; Petersen et al. 1999; Sexson et al. 2014; Sexson et al. 2016). Females generally use molting areas nearest their breeding grounds. Males do not show strong molting site fidelity with males from all three breeding areas molt in Ledyard Bay, Mechigmenskiy Bay, and the Indigirka/Kolyma River Delta. Males reach molting areas first, beginning in late June, and remain through mid-October. Failed/non-breeding females arrive at molting areas in late July, while successfully-breeding females and young of the year reach molting areas in late August or September and remain through October. In Ledyard Bay, one of the molting areas, large concentrations of spectacled eiders have been seen during aerial surveys; on 4 days in different years between 200 to 33,192 molting spectacled eiders have been counted (Larned et al. 1995; Petersen et al. 1999).

When not at inland breeding sites, spectacled eiders feed in marine waters where they feed on benthic invertebrates, primarily clams (USFWS 2010a). Although the feeding habitat and diet composition of molting spectacled eiders have not been specifically studied, they share areas with other sea duck species (Oppel et al. 2009) and benthivorous marine mammals (Jay et al. 2012), and are likely feeding on invertebrates found on the sea floor as they do at their wintering area.

Winter - Spectacled eiders generally depart molting areas in late October/early November (Sexson et al. 2014; Sexson 2015), migrating offshore in the Chukchi and Bering seas to a single wintering area in pack-ice lead complexes south/southwest of St. Lawrence Island (Figure 5.1B). In this relatively shallow area, the entire global population–over 300,000 spectacled eiders (Petersen et al. 1999)–rest and feed in gaps in the sea ice, diving up to 230 ft (70 m) to eat bivalves, other mollusks, and crustaceans (Cottam 1939; Petersen et al. 1998; Lovvorn et al. 2003; Petersen and Douglas 2004).

Spring migration - Recent information indicates spectacled eiders likely make extensive use of the eastern Chukchi Sea spring lead system between departure from the wintering area in March and April and arrival on the North Slope in mid-May or early June. Limited spring observations in the eastern Chukchi Sea have documented tens to several hundred common eiders (*Somateria mollissima*) and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea ice (W. Larned, USFWS; J. Lovvorn, Southern Illinois University, pers. comm.). Satellite telemetry data collected by the USGS Alaska Science Center (Figure 5.3; Sexson et al. 2014) also suggests that spectacled eiders use the spring lead system during spring migration.

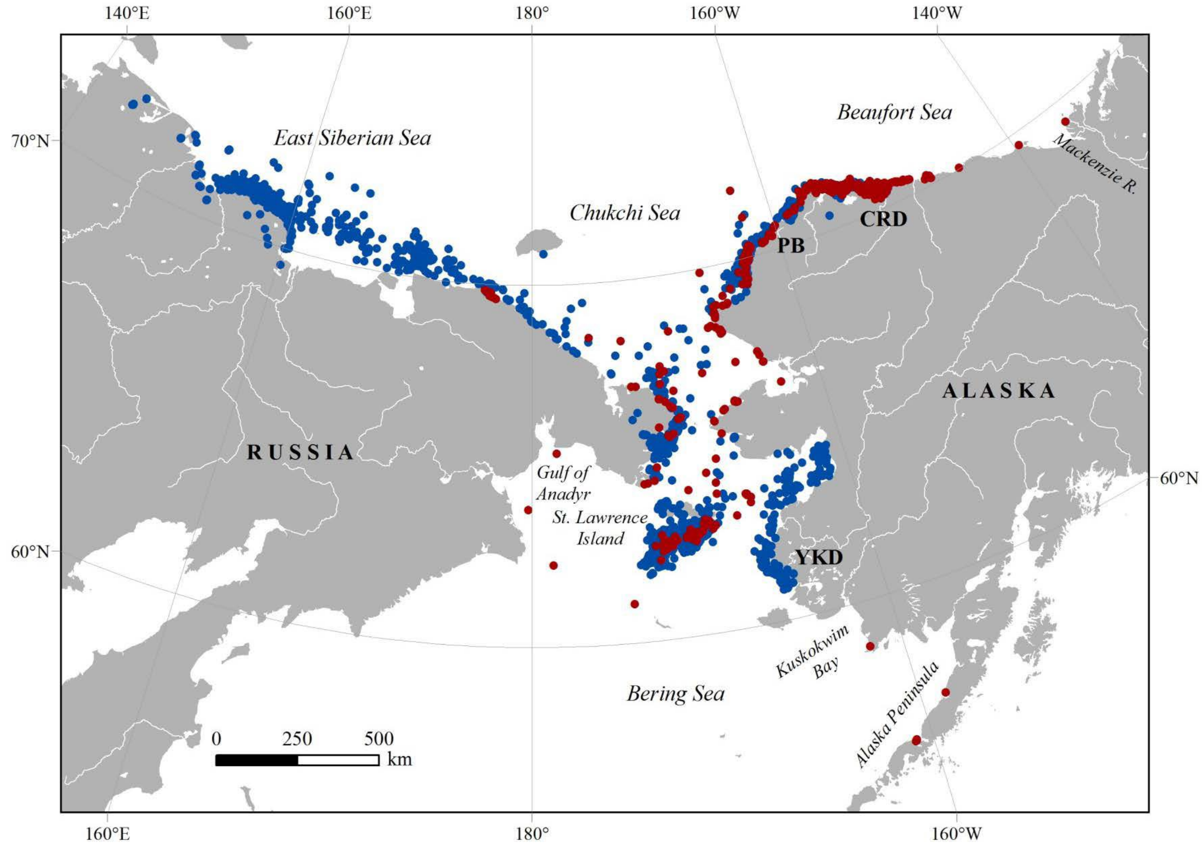

Figure 5.3. Satellite telemetry locations received from 89 adult (blue points, n = 6,813) and 27 juvenile (red points, n = 371) spectacled eiders between 30 May 2008 and 9 August 2012. Satellite transmitters were implanted in spectacled eiders in the Y-K Delta in 2008, at Peard Bay in 2009, and in the Colville River Delta in 2009–2011 (Sexson et al. 2014).

Threats

Ongoing threats to spectacled eiders on the breeding grounds are thought to include lead contamination from ingested spent shotgun pellets, illegal harvest, and predation (USFWS 2010a). Habitat loss and degradation is also increasingly becoming a factor. These threats are summarized below. The most recent 5-year review for the spectacled eider (USFWS 2010a) contains a more comprehensive treatment of the threats to the species, including habitat loss, contamination, overutilization, disease, predation, collisions, and oil spills.

Habitat destruction, modification, or curtailment - The destruction of habitat was not known to be a factor in the decline of the species at listing. No development or other substantial threats to the species' principal breeding habitat on the Y-K Delta were foreseen (58 FR 27476). Nesting habitat on a small portion of the ACP was altered by oil and gas development, causing potential threats from contamination from accidental spills, off-road vehicle use, wetland filling, and indirect effects of human presence, including changes in predator populations (58 FR 27476). Potential threats in the marine environment include toxic contaminants, secondary effects of commercial fish and invertebrate harvests in the Bering Sea, and future oil and gas leases (58 FR 27476). However, in the latest 5-year status review (USFWS 2010a) these impacts to spectacled eider habitat were found to be limited and were not thought to have played a major role in the observed population declines in Alaska (with the exception of lead contamination – see below).

Ingestion of Lead Pellets - Subsistence hunting may result in the deposition of lead shot into wetland habitat, especially near communities on the Y-K Delta and North Slope. Ingestion of lead shot by spectacled eiders could occur during the breeding season, particularly by breeding hens and young birds foraging in shallow tundra ponds. The toxic effects of lead poisoning can be both sublethal and lethal, and vary among individuals (Hoffman 1990). Ingestion of spent lead shot has led to reduced annual survival of spectacled eiders on the Y-K Delta (Franson et al. 1995; Flint and Grand 1997; Flint et al. 1997; Grand et al. 1998; Flint and Herzog 1999). Lead shot was identified as the source of high and harmful lead levels in waterfowl on the North Slope through blood samples, radiographs, necropsy, and lead isotope analysis (Matz and Flint 2009; Miller et al. 2016).

Use of lead shot for hunting waterfowl has been illegal since 1991 in Alaska, and the Service intensified efforts in 1998 to enforce prohibitions against the possession and use of lead shot for migratory bird hunting. Later, the State of Alaska, at the request of regional advisory boards, passed more restrictive regulations that prohibit the use of lead shot for upland game bird hunting on the North Slope and all bird and small game hunting on the Y-K Delta. There are indications that compliance with these regulations has improved as a result of outreach, education, and enforcement. However, compliance varies spatially and temporally; lead shot is still occasionally found for sale in stores in villages in these areas. Since 2016 the Service has documented stores in the North Slope and Y-K Delta stocking and selling lead shot during the spring –summer subsistence migratory bird-hunting season. Furthermore, permafrost under shallow water bodies may contribute to the persistence and availability of lead pellets years after deposition (Flint and Schamber 2010). Thus, although use of lead shot has significantly declined, any spent lead shot in breeding wetlands will remain available to listed eiders for an unknown period into the future.

Oil and gas – The Prudhoe Bay Oil Field is the largest oil field in North America and the nation's largest oil-producing county is Alaska's North Slope Borough (NRRD 2018). Exploratory wells confirmed the presence of oil at Prudhoe Bay in 1968 and production began in earnest with the construction of the Alaska Pipeline in 1977. Oil development has been gradually spreading outward across the ACP from the original hub at Prudhoe Bay. Prudhoe Bay is within the extent of spectacled eider breeding habitat on the ACP. However, aerial surveys have indicated that most breeding pairs occur further to the west; 93% of spectacled eider observations were west of Deadhorse (near Prudhoe Bay) during breeding surveys from 1993 to 2006 (USFWS 2010a), see also Figures 5.2 and 5.3). Given industry's interest in the National

Petroleum Reserve - Alaska (NPR-A) as expressed by lease sales, seismic surveys, drilling of exploratory wells, and the construction of the Alpine field at the eastern end of NPR-A, expansion of industrial development is likely to continue on the ACP further into spectacled eider breeding habitat (Platte and Stehn 2011).

Oil spills from shipping, well blowouts, pipeline leaks, etc. are a potential source of spectacled eider habitat contamination. We are unaware of any significant oil spills that have occurred in the Arctic marine environment from shipping or oil wells, although the potential for accidents exists (e.g., Deepwater Horizon). An accident with an oil tanker such as the Exxon Valdez is currently unlikely in spectacled eider habitat, as oil is piped rather than shipped out of ACP production areas. Regarding pipelines, however, over 200,000 gallons of oil were released from a 0.25-inch hole in a 34-inch pipeline at Prudhoe Bay in 2006. This was the largest spill of oil on Alaska's ACP to date. Smaller spills from pipelines have occurred on the ACP since that time (e.g., in 2009, 13,500 gallons of crude spilled from a frozen pipe in the greater Prudhoe Bay area) (https://en.wikipedia.org/wiki/Prudhoe_Bay_oil_spill). Exposed petroleum hydrocarbons can cause direct mortality to birds through ingestion or oiling, result in habitat degradation, or impact prey species of the spectacled eider.

In addition to the numerous oil wells that have been drilled on the ACP extending out 50 miles to the east and west of Prudhoe Bay, wells have been drilled and are producing from four offshore gravel islands that have been constructed into the Beaufort Sea (one more is also planned for 2019; BOEM 2017). The western most of these islands and closest to higher densities of breeding spectacled eiders, Oooguruk Island, was constructed in 2007.

Pursuant to a new plan by the Secretary of the Interior to open more than 90% of the U.S. outer continental shelf (OCS) to leasing, the Bureau of Ocean Energy Management (BOEM) has also initiated a process to develop the National Outer Continental Shelf Program for 2019-2024. This would reopen oil and gas leasing in the Beaufort and Chukchi seas (BOEM 2018). Although the governor of Alaska asked the Secretary of Interior to scale back the comprehensive offshore leasing proposal for Alaska in early 2018, including removal of the Bering Sea lease area, he requested that the Beaufort and Chukchi seas remain in the proposal (Rosen 2018). Only a handful of exploratory wells have ever been drilled in the Chukchi and Bering seas; no producing wells or production infrastructure yet exists in those areas (BOEM 2016a). As of the last 5-year review, no oil and gas development had occurred within the range of the spectacled eider in Russia, but oil and gas reserves exist there and some level of future development is anticipated (USFWS 2010a).

In summary, lead contamination in spectacled eider habitat has been a significant threat, but is likely declining due to regulations now limiting the use of lead shot. In contrast, oil and gas development has not had a major impact on core spectacled eider habitat historically, but is continuing to expand into spectacled eider breeding habitat. New oil and gas development would be permitted with various protective measures (NSB 2013; BOEM 2016b; BSEE 2017).

Overutilization and harvest - Sport hunting of eiders was closed in 1991 by Alaska State regulations and Service policy. NOAA Fisheries also closed the northern Bering Sea (73 FR 43362) and the Chukchi and Beaufort seas (74 FR 56734) to commercial fishing in 2008.

Subsistence harvest of spectacled eiders was also closed in 1991, although the species had traditionally been harvested for its meat, feathers, and eggs. Discussions with North Slope hunters and observations of Service employees confirm that some spectacled eiders are taken during the subsistence hunt. North Slope hunters report that spectacled eiders often fly in mixed flocks with king and common eiders and are inadvertently shot on occasion. Service biologists and OLE agents in Utqiaġvik have found shot spectacled eiders along the roads, in the possession of hunters, and hanging from game racks. While the accuracy of harvest estimates is unknown and likely affected by several biases, reports of spectacled eider harvest are generally consistent with the species' distribution and anecdotal observations and are therefore reasonable. Numerous unquantifiable biases make precise estimation of harvest rates impossible, but the available data, combined with information on spectacled eider availability, direct observations, and information from local residents, suggest that on the order of tens or hundreds of adult and/or juvenile spectacled eiders are harvested each year in Alaska. In Siberian Russia, eider harvest is not regulated; limited harvest surveys indicate that probably over 10,000 spectacled eiders are shot annually (USFWS 2010a).

Although collection of spectacled eider eggs is not allowed, some number of eggs are likely taken during the subsistence harvest. Egg harvesters target goose nests and eiders sometimes nest near and among colonially-nesting geese. Spectacled eider nests are cryptic and occur at low densities, so they presumably are not targeted by egg collectors, but could be collected incidentally. Egg collection is likely reduced to some extent by subsistence harvest 30-day closures during the spectacled eider nesting season. However, the closure does not encompass the entirety of the nesting season. Although the available information is inadequate to precisely estimate harvest levels, it is possible that tens or possibly low hundreds of spectacled eider eggs are taken annually throughout Alaska. Subsistence egg harvest also occurs in Arctic Russia, but due to limited data, harvest estimates and trends cannot be determined (USFWS 2010a).

Predation - Predation of eggs and ducklings has a large effect on the nesting success of spectacled eiders. Predators include foxes, gulls, jaegers, and ravens. Arctic foxes are a primary predator of eider nests on the Y-K Delta and probably Arctic Russia as well, particularly when vole and lemming populations are low (USFWS 2010a). There is some evidence that predator and scavenger populations have increased on the ACP near human habitation such as villages and industrial infrastructure (Eberhardt et al. 1983; Day 1998; Powell and Backensto 2009). Researchers have proposed that reduced fox trapping, anthropogenic food sources in villages and oil fields, and nesting/denning sites on human-built structures have resulted in increased fox, gull, and raven numbers (Day 1998; USFWS 2010a). These anthropogenic influences on predator populations and predation rates could affect eider populations, but this has not been substantiated. However, the apparent increase in the size of the Y-K Delta population suggests that predation is not currently constraining recovery there. Nevertheless, predation, possibly in combination with other threats such as harvest and lead contamination, may be inhibiting the population growth rate in the ACP population (USFWS 2010a).

Climate change - Global climate change presents a variety of potential threats to spectacled eider habitats identified since listing. For the last several decades, surface air temperatures in the Arctic have warmed at a rate that exceeds the global average and they are projected to continue on that path (IPCC 2007).

Marine environment - Ocean warming is expected to cause changes in species composition in Arctic seas, with a variety of cascading effects. The northward expansion of warmer water has already resulted in sub-Arctic fauna beginning to colonize newly favorable Arctic marine habitats (Overland and Stabeno 2004; Mueter and Litzow 2008). For example, walleye pollock (*Theragra chalcogramma*), a species common in the sub-Arctic that avoids temperatures less than 2° C, have now moved northward into the Arctic zone. Similarly, Arctic cod (*Arctogadus glacialis*) have also moved further north (Stabeno et al. 2007). With the redistribution of species, benthic fauna will face a new set of predators leading to competition with spectacled eiders for food (Coyle et al. 2007). Movement of commercially harvested species such as crabs could bring commercial fishing to the spectacled eider wintering area, where it does not yet occur (USFWS 2010a).

In recent years, late summer sea ice has receded forcing walruses to land in areas such as Ledyard Bay, Alaska, where spectacled eiders molt. Walruses have been observed attacking spectacled eiders (Lovvorn et al. 2010) and they may also compete with them for food resources, such as bivalves.

Future changes in winter sea ice conditions could affect the energy balance of spectacled eiders. Lovvorn et al. (2009) found that availability of ice was important for eiders as a resting platform to conserve energy when not foraging. If a reduction in sea ice results in a reduction of the non-foraging time spent resting on sea ice, the suitability of the single wintering area used by spectacled eiders could be compromised (Lovvorn et al. 2009; USFWS 2010a). Recent research suggests intermediate sea ice conditions in winter are optimal for spectacled eider survival (Christie et al. 2018). This, when combined with General Circulation Model projections for future sea ice cover conditions suggest that spectacled eiders may increase in abundance in the short-term as sea ice conditions moderate, but are likely to decline in the long-term as the Bering Sea becomes ice-free. Population models predict that the onset and severity of population declines would vary considerably between moderated (RCP 4.5) and unabated (RCP 8.5) emissions scenarios (Christie et al. 2018).

In addition, climate change is predicted to cause the Arctic Ocean to experience ice-free periods in summer in the future (Arctic Council 2009). Greater marine access and longer seasons of navigation would likely follow. The most significant potential threat from an increasing number of ships to the Arctic marine environment is the release of oil through accidental or illegal discharge; other threats include collisions of birds and ships, and effects of vessel emissions (USFWS 2010a).

Ocean acidification is likely to affect the prey base of spectacled eiders. Eiders forage in large part on calcifying invertebrates such as bivalves. If widespread aragonite under-saturation due to acidification were to occur as predicted in the Arctic, it could have a major impact on bivalves' ability to form shells (Steinacher et al. 2009). In addition, bivalves are filter feeders and depend on the rain of organic particles from the water column and melting sea ice. Because of the tight link between sea ice algae and the benthos (Grebmeier et al. 2006), disruption of the quantity or quality of sedimenting organic material due to acidification could affect bivalves (McMahon et al. 2006). Ocean acidification is likely to increasingly affect the ecosystem structure in spectacled eider habitat, but the timing, nature and magnitude of these impacts cannot yet be predicted (USFWS 2010a).

Terrestrial environment - Temperatures are rising all across the state, but not uniformly. The changes are largest over northern and western Alaska, where snow and especially sea ice losses are impacting the regional climate. On the North Slope average temperatures from 1969 – 2018 have increased by 5.8 °F (Thoman & Walsh 2019). May air temperatures at weather stations on the Y-K Delta from 1960 to 2009 have increased 2.8° F (Fischer et al. 2009). With increasing air temperatures, there is potential for climate-induced changes to the hydrology of brood-rearing ponds in the ACP and Arctic Russia breeding areas where permafrost is continuous. Breeding habitat on the arctic coast depends on a unique hydrological system, which is in turn dependent upon cold temperatures that maintain continuous and stable permafrost underlying perched (i.e., isolated above the groundwater) lakes (Rovansek et al. 1996). If these patterns change, alterations could occur to breeding habitat, such as the draining or drying of thaw lakes.

In summary, climate change effects discussed here could potentially affect the future status of the spectacled eider. Although some changes in spectacled eider life history have been documented (e.g., earlier nest initiation), and impacts in the future have been predicted based on climate and population models (Christie et al. 2018), evidence has not yet been obtained demonstrating negative effects of climate change on spectacled eiders leading to population-level effects (USFWS 2010a).

Recovery Criteria
The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the ESA is no longer required. Under the Recovery Plan, the species will be considered recovered when each of the three recognized populations (Y-K Delta, North Slope of Alaska (i.e., ACP), and Arctic Russia): 1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs; or, 2) number at least 10,000 breeding pairs over 3 or more years; or, 3) number at least 25,000 breeding pairs in one year. Based on annual aerial breeding pair surveys, the ACP population does not meet the delisting criteria. While the other two breeding populations may be approaching or currently exceed the delisting criteria, the spectacled eider is listed range-wide, not as distinct population segments.

Spectacled Eider Critical Habitat
On February 6, 2001, the Service designated critical habitat for the spectacled eider. Areas designated include portions of the YK-Delta, Norton Sound, Ledyard Bay, and the Bering Sea between St. Lawrence and St. Mathew Islands. Only the Ledyard Bay Critical Habitat Unit (LBCHU) is within the MTR of the Action Area.

The LBCHU was designated to protect molting spectacled eiders. It is used by large numbers of eiders with 33,192 counted by aerial survey in September 1995 (Larned et al. 1995). In particular satellite telemetry data indicates that females who breed on the North Slope primarily use this area for molting (Petersen et al. 1995). We identified marine waters >5 m and ≤ 25 m at mean low water, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community as the physical or biological features essential to the conservation of spectacled eiders which are provided by the LBCHU.

Polar bear

Status and distribution

Due to threats to sea ice habitat, on May 15, 2008, the Service listed the polar bear as threatened under the ESA (73 FR 28212) throughout its range. In the U.S., the polar bear is also protected under the MMPA and the Convention on International Trade in Endangered Species of Wildlife Fauna and Flora.

Polar bears are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year. Polar bears throughout their range are subdivided into 19 recognized subpopulations or stocks (Figure 5.4). The U.S. contains portions of two subpopulations: the Chukchi Sea (CS) (also called the Alaska-Chukotka subpopulation in the U.S.–Russia Bilateral Agreement) and the Southern Beaufort Sea (SBS) subpopulation.

Population size estimates and trends

The most current global population estimate for polar bears is approximately 26,000 individuals (95 % CI = 22,000-31,000; Wiig et al. (2015). Regarding short-term population trends (i.e., approximately one generation), the International Union for Conservation of Nature and Natural Resources, Species Survival Commission (IUCN/SSC) Polar Bear Specialist Group (PBSG) ranked four of the 19 subpopulations as “likely decreased,” including the SBS subpopulation (2001-2010), and eight as “data deficient.” They ranked four as “likely stable,” including the CS subpopulation (2008-2016), one as “stable,” and just two as increasing (i.e., “likely or very likely increased;” (PBSG 2019).

Species biology and life history

Polar bears are the largest living bear species (DeMaster and Stirling 1981) with a longer neck and proportionally smaller head than other ursids. They are sexually dimorphic; females weigh 400 to 700 pounds (lbs) and males up to 1,440 lbs (USFWS 2017a).

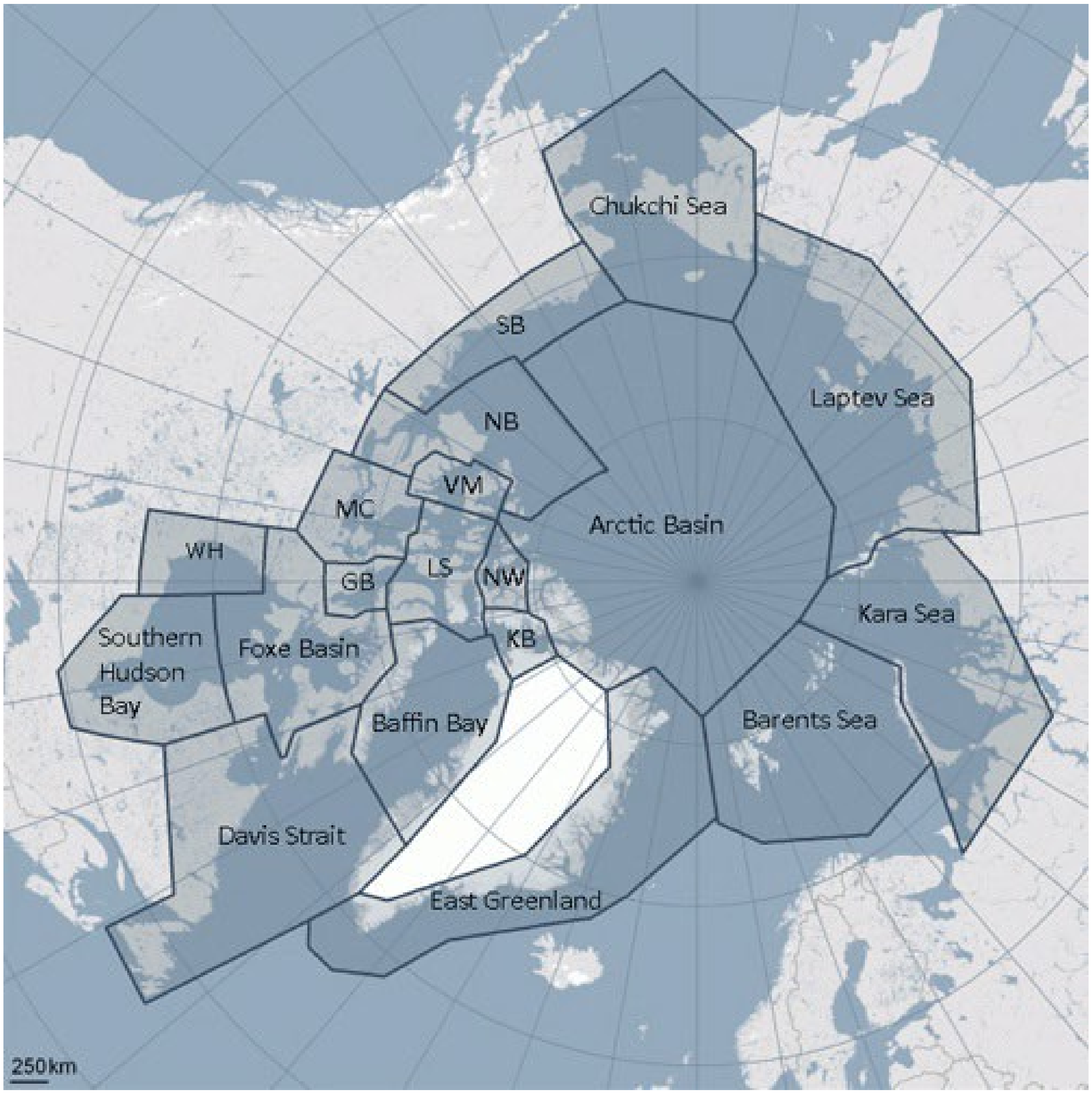

Figure 5.4. Global distribution of polar bear subpopulations as defined by the Polar Bear Specialist Group (Obbard et al. 2010; http://pbsg.npolar.no/en/status/population-map.html). Subpopulations include the Southern Beaufort Sea (SBS), Chukchi Sea, Laptev Sea, Kara Sea, Barents Sea, East Greenland, Northern Beaufort (NB), Kane Basin (KB), Norwegian Bay (NW), Lancaster Sound (LS), Gulf of Boothia (GB), McClintock Channel (MC), Viscount Melville (VM), Baffin Bay, Davis Strait, Foxe Basin, Western Hudson Bay (WH), and Southern Hudson Bay.

Breeding and reproduction – Polar bears are a K-selected species, characterized by late sexual maturity, small litter sizes, and extended maternal investment in raising young. All of these factors contribute to the species' low reproductive rate (Amstrup 2003). Females generally mature and breed for the first time at 4 or 5 years and give birth at 5 or 6 years of age. Litters of two cubs are most common, but 3-cub litters are seen on occasion across the Arctic (Amstrup 2003). The minimum reproductive interval for adult females is three years. Cubs stay with their mothers until weaning, which occurs most commonly in early spring when cubs are 2 1/2 years old. Female bears are available to breed again after their cubs are weaned (USFWS 2017a).

Survival – Polar bears are long-lived and are not generally susceptible to disease or parasites. Due to extended maternal care of young and low reproductive rates, polar bears require high adult survival rates, particularly of females, to maintain population levels (Eberhardt 1985; Amstrup and Durner 1995). Survival rates are generally age dependent, with cubs-of-the-year having the lowest rates and prime-age adults (prime reproductive years are between approximately 5 and 20 years of age) having survival rates that can exceed 90 percent (Regehr et al. 2007a). Survival rates exceeding 90 percent for adult females are essential to sustain polar bear populations (Amstrup and Durner 1995).

Changes in body condition have been shown to affect bear survival and reproduction, which could, in turn, have population-level effects (Regehr et al. 2010; Rode et al. 2010). Survival of polar bear cubs-of-the-year has been directly linked to their weight and the weight of their mothers, with lower weights resulting in reduced survival (Derocher and Stirling 1996; Stirling et al. 1999). Changes in body condition indices were documented in the Western Hudson Bay subpopulation before a statistically significant decline in that subpopulation was documented (Regehr et al. 2007b). Thus, changes in these indices may signal that reductions in survival and abundance are imminent (USFWS 2017a).

Feeding – Polar bears are top predators in the Arctic marine ecosystem. They prey heavily on ice-seals, principally ringed seals (*Phoca hispida*), and to a lesser extent, bearded seals (*Erignathus barbatus*). Areas near ice edges, leads, or polynyas where ocean depth is minimal are the most productive hunting grounds (Durner et al. 2004). Bears occasionally take larger animals, such as walruses (*Odobenus rosmarus*) and belugas (*Delphinapterus leucas*) (Kiliaan and Stirling 1978).

Bowhead whale carcasses, leftover after subsistence harvest, have been available to polar bears as a food source on the North Slope since the early 1970s (Koski et al. 2005). The use of whale carcasses as a food source likely varies among individuals and years. Stable isotope analysis of polar bears in 2003 and 2004 suggested that bowhead whale carcasses comprised 11%-26% (95% CI) of the diets of sampled polar bears in 2003, and 0%-14% (95% CI) in 2004 (Bentzen et al. 2007).

Threats to the polar bear

Because the polar bear depends on sea ice for its survival, loss of sea ice due to climate change is its largest threat worldwide, although polar bear subpopulations face different combinations of human-induced threats (73 FR 28212; Obbard et al. 2010). The largest direct human-caused loss of polar bears is from subsistence hunting, but for most subpopulations where subsistence hunting of polar bears occurs, it is a regulated and/or monitored activity (Obbard et al. 2010). A thorough account of subsistence hunting, sport harvest, poaching, defense-of-life removals, and the management systems controlling these direct removal activities can be found in USFWS (2017b). Other threats include accumulation of persistent organic pollutants in polar bear tissue, tourism, human-bear conflict, and increased development in the Arctic (Obbard et al. 2010).

Climate change – As stated in the Polar Bear Conservation Management Plan (PBCMP) (USFWS 2016a), polar bears evolved over thousands of years to life in a sea ice-dominated ecosystem and depend on sea ice for essential life functions. Climate-induced habitat degradation and loss are negatively affecting some polar bear subpopulations, and unabated global warming is expected to reduce the worldwide polar bear population (Obbard et al. 2010). Patterns of increased temperatures, earlier spring thaw, later fall freeze-up, increased rain-on- snow events (which may cause dens to collapse), and potential reductions in snowfall are also occurring. Loss of sea ice habitat due to climate change is identified as the primary threat to polar bears (73 FR 28212; Schliebe et al. 2006; Obbard et al. 2010).

The sea ice ecosystem supports ringed seals and other marine mammals that comprise the polar bear's prey base (Stirling and Archibald 1977; Smith 1980, 1985; Iverson et al. 2006). Sea ice cover is shown to be strongly, negatively correlated with surface temperature, which is increasing at about 3 times the global average in the Arctic (Comiso 2012). Declines in sea ice area more pronounced in summer than winter (NSIDC 2011a; b). The mean linear rate of decline for August sea ice extent is 29,000 square miles per year, or 10.4 percent per decade since 1979 relative to the 1981 to 2010 average (NSIDC 2018). Thus, average Arctic sea ice extent in August is approximately 40% less now than 40 years ago. Positive feedback systems (i.e., sea-ice albedo) and naturally occurring events, such as warm water intrusion into the Arctic and changing atmospheric wind patterns, can cause fragmentation of sea ice, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi- year ice, and declining thickness and quality of shore-fast ice (Parkinson et al. 1999; Rothrock et al. 1999; Comiso 2003, 2006; Fowler et al. 2004; Lindsay and Zhang 2005; Holland et al. 2006; Serreze et al. 2007; Stroeve et al. 2008).

Loss of access to prey – The decline of sea ice habitat due to changing climate is affecting the ability of polar bears to forage in several ways. Sea ice provides a platform for hunting and feeding, seeking mates and breeding, denning, resting, and for long-distance movement. Polar bears depend on sea ice to hunt seals, and temporal and spatial availability of sea ice is predicted to decline. Once sea ice concentration drops below 50 percent, polar bears have been documented to abandon sea ice for land, where access to their primary prey is almost entirely absent, or they may retreat northward with more consolidated pack ice over the polar basin, which is likely less productive foraging habitat (Whiteman et al. 2015). In either case, polar bears are likely to have reduced access to prey resources (Whiteman et al. 2015). Ware et al. (2017) found that polar bears are increasingly occurring on ice over less-productive waters in summer. Although polar bears occasionally capture ringed seals in open water (Furnell and Oolooyuk 1980), typically ice seals in open water are inaccessible to polar bears (Harwood and Stirling 1992). Thus, species experts do not believe that polar bears will readily adapt to the loss of sea ice by adopting other hunting methods, such as hunting seals in ice-free water (Stirling and Derocher 1993; Derocher et al. 2004).

Effects of climate change on polar bear prey species – Ice seals, principally ringed seals, and to a lesser extent bearded seals, are the primary prey of polar bears, although other food sources are occasionally exploited (USFWS 2017a). Climate change and the loss of Arctic sea ice are expected to affect ice seal populations significantly, and in response in 2012 the NMFS listed the

Arctic subspecies of ringed seal (*Phoca hispida hispida*) and the Beringia DPS of the bearded seal (*Erignathus barbatus nauticus*) as threatened species under the ESA (77 FR 76706; 77 FR 76740).

Ice seal population dynamics reflect a complex mix of biotic and abiotic factors (Pilfold et al. 2015), making it difficult to accurately assess the effects of changes in sea ice. However, several mechanisms by which a warming environment have affected ice seals, or plausibly should be expected to, have been identified. An adequate snow layer providing insulation around birth lairs is crucial for thermoregulation and survival of young pups (Stirling and Smith 2004). Pups in lairs with thin snow roofs are also more vulnerable to predation than pups in lairs with thick roofs (Hammill and Smith 1991; Ferguson et al. 2005), and when lack of snow cover has forced birthing to occur in the open, nearly 100% of pups died (Smith and Lydersen 1991; Smith et al. 1991). Rain-on-snow events during the late winter are increasing in frequency and can damage or eliminate snow-covered pupping lairs (ACIA 2005). Exposed pups are then vulnerable to hypothermia and predation by polar bears and arctic foxes (*Alopex lagopus*) (Stirling and Smith 2004). Pupping habitat on landfast ice (McLaren 1958; Burns 1970) and drifting pack ice (Wiig et al. 1999; Lydersen et al. 2004) can also be affected by earlier warming and break-up in the spring, which shortens the length of time pups have to grow and mature (Kelly 2001; Smith and Harwood 2001).

Although the rate and extent of population-level response of ice seals to changes in sea ice conditions remain unclear, effects to ice seal populations will certainly affect polar bear populations. Polar bear populations fluctuate with prey abundance (Stirling and Lunn 1997), and regional declines in ringed and bearded seal numbers and productivity have been linked to marked declines in the associated polar bear subpopulations (Stirling and Øritsland 1995; Stirling 2002).

Redistribution of polar bears in response to changes in sea ice – Several studies have shown that changes in sea ice, including the timing of melt in spring and freeze-up in fall, correlate with changes in the distribution of polar bears and their body condition or other indices of fitness. In Western Hudson Bay, sea ice break-up now occurs approximately 2.5 weeks earlier than it did 30 years ago because of increasing spring temperatures (Stirling et al. 1999; Stirling and Parkinson 2006), which is also correlated with when female bears come ashore and when they are able to return to the ice (Cherry et al. 2009). Similarly, changes in summer sea ice conditions have resulted in an increase in the time spent on shore during summer and the proportion of the population on shore in the Southern Beaufort Sea and Chukchi Sea subpopulations (Rode et al. 2015; Atwood et al. 2016a; b). Rode et al. (2015) also found that changes in sea ice likely explain shifts in summer distribution of the Chukchi Sea subpopulation, from use of both Alaskan and Russian coastal areas before reductions in sea ice, to almost exclusive use of coastal areas in Russia after reductions in sea ice.

Changes in the distribution of polar bears in response to changes in sea ice may increase exposure to some threats. If bears spend more time on land during the open water period, there is potential for increased disease transmission (Kirk et al. 2010; Prop et al. 2015; Wiig et al. 2015), particularly where bears concentrate at dwindling food resources (e.g., remains of subsistence-harvested whales at Barter Island, Cross Island, and Point Barrow). Aggregations could also increase the number of individuals exposed in the event of oil spills (BOEM 2014). Increased use of onshore habitat by polar bears has also led to an increase in human-polar bear conflicts (Dyck 2006; Towns et al. 2009). In two studies from northern Canada, researchers found that the majority of polar bears killed in defense of human life occurred during the open water season (Stenhouse et al. 1988; Dyck 2006). Thus, as more bears come on shore during summer, remain on shore longer, and become increasingly food-stressed, the risk of human conflict increases along with a probable increase in defense-of-life kills.

Demographic response – Reduced access to preferred prey (i.e., ice seals; Thiemann et al. 2008) is likely to have demographic effects on polar bears. For example, in the Southern Beaufort Sea subpopulation, the period when sea ice is over the continental shelf has decreased significantly over the past decade, resulting in reduced body mass and productivity (Rode et al. 2010, 2014) and likely reduced population size (Bromaghin et al. 2015).

Changes in movements and seasonal distributions caused by climate change have been shown to affect polar bear nutrition and body condition (Stirling and Derocher 2012). Declining reproductive rates, subadult survival, and body mass have occurred because of longer fasting periods on land resulting from progressively earlier ice break-ups (Stirling et al. 1999; Derocher et al. 2004). Rode et al. (2010) suggested that declining sea ice has resulted in reduced body size and reproductive rates in the Southern Beaufort Sea subpopulation, and Regehr et al. (2007a) found that reduced sea ice habitat correlated with a reduction in the number of yearlings produced per female. In the Western Hudson Bay subpopulation, sea ice related declines in vital rates led to reduced abundance and declining population trends (Regehr et al. 2007b).

To date, however, researchers have documented demographic effects of sea ice loss in only a few of the 19 polar bear subpopulations (Regehr et al. 2007a; Rode et al. 2012). Rode et al. (2014) found that even though sea ice loss during summer had been substantial in the Chukchi Sea, polar bears in that subpopulation had not yet exhibited concomitant declines in body mass or productivity.

Reduced denning success – Climate change could negatively influence polar bear denning (Derocher et al. 2004). Insufficient snow would prevent den construction or result in use of poor sites where the roof could collapse (Derocher et al. 2004). Changes in the amount and timing of snowfall could also impact the thermal properties of dens, and because cubs are born helpless and remain in the den for three months before emergence, major changes in the thermal properties of dens could negatively impact cub survival (Derocher et al. 2004). Unusual rain events are projected to increase throughout the Arctic in winter (Liston and Hiemstra 2011), and increased rain in late winter and early spring could cause den collapse (Stirling and Smith 2004). The proportion of bears denning on ice has decreased for some subpopulations (Atwood et al. 2016b) and not others, but the consequences of these shifts to cub survival are unknown.

While polar bears can successfully den on sea ice (Amstrup and Gardner 1994; Fischbach et al. 2007), for most subpopulations, maternity dens are located on land (Derocher et al. 2004). Female polar bears can repeatedly return to specific denning areas on land (Harington 1968; Ramsay and Stirling 1990; Amstrup and Gardner 1994). For bears to access preferred denning areas on land, pack ice must drift close enough or freeze sufficiently early to allow pregnant females to walk or swim to the area by late October or early November (Derocher et al. 2004). As distance increases between the pack ice edge and coastal denning areas, it will become increasingly difficult for females to access terrestrial denning locations unless they are already on or near land. Distance between the ice edge and shore is one factor thought to limit denning in western Alaska in the CS subpopulation (Rode et al. 2015). Increased travel distances could negatively affect denning success and ultimately population size of polar bears (Aars et al. 2006).

For example, over the last two decades, the Southern Beaufort Sea subpopulation has experienced a marked decline in summer sea-ice extent, along with pronounced lengthening of the open-water season (Stroeve et al. 2014; Stern and Laidre 2016). The dramatic changes in extent and phenology of sea-ice habitat have coincided with evidence suggesting use of terrestrial habitat has increased during open-water periods and prior to denning.

In addition to increased use of land during the open-water season, Southern Beaufort Sea polar bears have also increasingly used land for maternal denning. Olson et al. (2017) examined the choice of denning substrate (land compared to sea ice) by adult females between 1985 and 2013 and determined that the frequency of land-based denning increased over time, constituting 34.4 percent of all dens from 1985 to 1995, 54.6 percent from 1996 to 2006, and 55.2 percent from 2007 to 2013. Additionally, the frequency of land denning was directly related to the distance that sea ice retreated from the coast. From 1985 to 1995 and 2007 to 2013, the average distance from the coast to 50 percent sea ice concentration in September (when sea ice extent reaches its annual minimum) increased 351 ± 55 km (218.10 ± 34.17 mi), while the distance to 15 percent sea ice concentration increased by 275 ± 54 km (170.88 ± 33.55 mi). Rode et al. (2018) determined that reproductive success was greater for females occupying land-based dens compared to ice-based dens, which may be an additional factor contributing to an individual's increase of land-based den sites.

Under most climate-change scenarios, the distance between the edge of the pack ice and land will increase during summer. Bergen et al. (2007) found that between 1979 and 2006, the minimum distance polar bears traveled to denning habitats in northeast Alaska increased by an average rate of 3.7-5.0 miles per year, have nearly doubled since 1992, and would likely increase threefold by 2060. Comiso (2003) predicted that under future climate change scenarios (i.e., by the 2050s), pregnant female polar bears will be unable to access many of the most important denning areas in the north coast of the central Beaufort Sea (Derocher et al. 2004).

Shipping and transportation – A decline in Arctic sea ice has increased the navigability of Arctic waters, with previously ice-covered sea routes now opening in summer, allowing access for commercial shipping, natural resource development, and tourism. Potential effects include fracturing of sea ice, disturbance of polar bears and their prey, increased human-polar bear encounters, introduction of waste/ litter and toxic pollutants into the environment, and increased risk of oil spills (PBRS 2015; USFWS 2017a). Although shipping is expected to increase in Arctic waters in response to declining sea ice, the PBCMP concluded that trans-Arctic shipping poses minimal risk to polar bears in the long-term (USFWS 2016a). Arctic nations are increasingly working cooperatively to track changes in shipping and manage possible increases in environmental impacts (USFWS 2017a).

Oil and gas development – Polar bears overlap with both active and planned oil and gas operations throughout their range. Impacts on polar bears from industrial activities, such as oil and gas development, may include: disturbance from increasing human-bear interactions, resulting in direct displacement of polar bears, preclusion of polar bear use of preferred habitat (most notably, denning habitat); and/or displacement of primary prey. At the time of listing, the greatest level of oil and gas activity occurring within polar bear habitat was in the United States (Alaska). The Service determined that direct impacts on polar bears from oil and gas exploration, development, and production activities had been minimal and did not threaten the species overall. This conclusion was based primarily on: 1) the relatively limited and localized nature of the development activities; 2) existing mitigation measures that were in place; and 3) the availability of suitable alternative habitat for polar bears (USFWS 2017a).

Although oil and gas exploration, development, and production throughout the Arctic has declined since the time of the listing, offshore oil and gas activities may increase due to a decline in summer sea ice (USFWS 2016a, 2017b). Plans are also underway for new oil and gas development and infrastructure in polar bear habitat (e.g., natural gas pipeline from Mackenzie Delta to southern Canada, exploration offshore from Greenland, Russia, and Alaska [Beaufort Sea]), and proposed offshore and onshore lease sales. In the United States, potential effects on polar bears are in part mitigated through: 1) development of activity-specific human-bear interaction plans (to avoid disturbance), 2) safety and deterrence training for industry staff, 3) bear monitoring and reporting requirements, and 4) implementation of project-specific protection measures (e.g., 1 mile buffers around den sites) as a requirement of Marine Mammal Protection Act Authorizations.

Contaminants – In the final rule listing the polar bear as a threatened species, the Service identified three categories of contaminants in the Arctic that present the greatest potential threats to polar bears and other marine mammals, these are persistent organic pollutants (POPs), heavy metals, and petroleum hydrocarbons (PCBs) (73 FR 28288-28291). In the PBCMP (USFWS 2016a), the Service concluded that contaminant concentrations were not thought to have population level effects on most polar bear populations, but noted that contaminants may become a threat in the future, especially in subpopulations experiencing declines related to nutritional stress brought on by sea ice loss and environmental changes. Moreover, a recent comprehensive review of the exposure and fate of contaminants in polar bears in the circumpolar Arctic found that legacy POPs including polychlorinated biphenyls, chlordanes and perfluorooctane sulfonic acid (PFOS), other perfluoroalkyl compounds and brominated flame retardants are the most common compounds found in polar bears (Routti et al. 2019).

Petroleum hydrocarbons/oil spills – Oil spills could potentially affect polar bears through: 1) affecting their ability to thermoregulate if their fur is oiled, 2) lethal or sublethal effects of ingestion of oil from grooming or eating contaminated prey, 3) habitat loss or decreased availability of preferred habitat; and 4) impacts to the abundance or health of prey. At the time of listing, no major oil spills had occurred in the marine environment within the range of polar bears and the Service determined the probability of a large oil spill occurring in polar bear habitat was low. We also noted that, in Alaska: 1) previous operations in the Beaufort and Chukchi seas have been conducted safely, and spill effects on wildlife and the environment have been minimized; 2) regulations exist to require pollution prevention and control; and 3) plans are reviewed by both leasing and wildlife agencies to ensure appropriate species-specific protective measures for polar bears are included. However, we also noted that increased oil and gas development coupled with increased shipping elevated the potential for spills, and if a large spill were to occur, it could have significant impacts to polar bears and their prey, depending on the size, location, and timing of the spill.

Persistent Organic Pollutants (POPs) – Persistent organic pollutants are organic chemicals resistant to biodegradation, and can affect apex predators such as polar bears that have low reproductive rates and high lipid levels because POPs tend to bioaccumulate and biomagnify in fatty tissues. While the levels of some contaminants, such as PCBs, generally seem to be decreasing in polar bears, others, such as hexachlorocyclohexanes, were relatively high, and newer compounds, such as polybrominated diphenyl ethers and perflouro-octane sulfonates, posed a potential future risk to polar bears. The effects of these contaminants at the population level are relatively unknown (USFWS 2017a).

Metals – The most toxic or abundant elements in marine mammals are mercury, cadmium, selenium, and lead. Of these, mercury is of greatest concern because of its potential toxicity at relatively low concentrations and its tendency to bioaccumulate and biomagnify in the food web (73 FR 28291). In the final rule to list the polar bear (73 RF 28212) the Service noted that although mercury found in marine mammals often exceed levels that have caused effects in terrestrial mammals, most marine mammals appear to have evolved mechanisms that allow tolerance of higher concentrations of mercury (AMAP 2005). Although population-level effects are still widely undocumented for most polar bear subpopulations, increasing exposure to contaminants may become a more significant threat in the future, especially for declining polar bear subpopulations and/or bears experiencing nutritional stress (USFWS 2017a).

Ecotourism – Polar bear viewing and photography are popular forms of tourism that occur primarily in Churchill, Canada; Svalbard, Norway; and the north coast of Alaska (near the communities of Kaktovik and Utqiaġvik). In the final listing rule for the polar bear, the Service noted that, while it is unlikely that properly regulated tourism will have a negative effect on polar bear subpopulations, increasing levels of public viewing and photography in polar bear habitat might lead to increased human-polar bear interactions. Tourism can also result in inadvertent displacement of polar bears from preferred habitats or alter natural behaviors (Lentfer 1990; Dyck and Baydack 2004; Eckhardt 2005). Conversely, tourism can have the positive effect of increasing the worldwide constituency of people with an interest in polar bears and their conservation (USFWS 2017a).

Polar bear critical habitat
The polar bear was listed as a threatened species throughout its range, but the regulatory authority to designate critical habitat (50 CFR 424.12(h)) is limited to areas of U.S. jurisdiction, which in the case of the polar bear includes Alaska and adjacent territorial and U.S. waters. The Service designated 484,734 square kilometers of critical habitat for the polar bear in 2010 (75 FR 76086).

Description of Polar Bear Critical Habitat

Designation of critical habitat requires, within the geographical area occupied by the polar bear, identification of the physical or biological features (PBFs) essential to the conservation of the species that may require special management or protection. We identified the following three PBFs essential to the conservation of the polar bear:

1) Sea-ice habitat used for feeding, breeding, denning, and movement, which is further defined as sea-ice over waters 300 m or less in depth that occurs over the continental shelf with adequate prey resources (primarily ringed and bearded seals) to support polar bears.
2) Terrestrial denning habitat, which includes topographic features, such as coastal bluffs and riverbanks, with suitable macrohabitat characteristics. Suitable macrohabitat characteristics are:
    a) Steep, stable slopes (range 15.5–50.0 degrees), with heights ranging from 1.3 to 34 m, and with water or relatively level ground below the slope and relatively flat terrain above the slope;
    b) Unobstructed, undisturbed access between den sites and the coast;
    c) Sea-ice in proximity to terrestrial denning habitat prior to the onset of denning during the fall to provide access to terrestrial den sites; and
    d) The absence of disturbance from humans and human activities that might attract other polar bears.
3) Barrier island habitat used for denning, refuge from human disturbance, and movements along the coast to access maternal den and optimal feeding habitat, including all barrier islands along the Alaska coast and their associated spits, within the range of the polar bear in the United States, and the water, ice, and terrestrial habitat within 1.6 km of these islands.

Considering the three PBFs, and the quantity and spatial arrangement of them necessary to support conservation of the polar bear, we designated the following three critical habitat units, each of which contains at least one of the PBFs:

Unit 1, Sea Ice Habitat – Sea ice habitat covers approximately 464,924 km^2 of primarily marine habitat extending from the mean high tide line of the Alaska coast seaward to the 300 m depth contour, and spans west to the international date line, north to the Exclusive Economic Zone, east to the US–Canada border, and south to the southern limit of the known distribution of the Chukchi Sea polar bear subpopulation. Sea ice is used by polar bears for the majority of their life cycle for activities such as hunting seals, breeding, denning, and traveling.

Unit 2, Terrestrial Denning Habitat – Terrestrial denning habitat occurs within approximately 14,652 km^2 of land along the northern coast of Alaska from the Canadian border west to near Point Barrow. It encompasses approximately 95 percent of the known historical terrestrial den sites from the Southern Beaufort Sea subpopulation (Durner et al. 2009a). The inland extent of denning distinctly varies between two longitudinal zones, with 95 percent of known dens between the Alaska/Canada border and Kavik River occurring within 32 km of the mainland coast, and 95 percent of dens between the Kavik River and Utqiaġvik occurring within 8 km of the mainland coast. The inland boundary of the Terrestrial Denning Unit reflects this difference in the distribution of known den sites, with the boundary drawn at 32 km inland between the Alaska/Canada border and the Kavik River and 8 km inland between the Kavik River and Utqiaġvik.

Unit 3, Barrier Island Habitat – Barrier island habitat covers approximately 10,575 km^2 of barrier islands and the associated complex of spits, water, ice, and terrestrial habitats within 1.6 km of barrier islands. There is significant overlap between this unit and the Terrestrial Denning and Sea Ice units. Similar to the Sea Ice Unit, the Barrier Island Unit extends from near the Alaska/Canada Border to near Hooper Bay in southwestern Alaska but only occurs where barrier islands exist.

Exclusions within Designated Polar Bear Critical Habitat – Within the Terrestrial Denning and Barrier Island units, critical habitat does not include manmade structures (e.g., houses, gravel roads, airport runways and facilities, pipelines, well heads, generator plants, construction camps, sewage treatment plants, hotels, docks, seawalls, and the land on which they were constructed) that existed on the effective date of the rule. The communities of Utqiaġvik and Kaktovik were also excluded.

6. ENVIRONMENTAL BASELINE

The environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Baseline of spectacled eiders in the terrestrial Action Area

Spectacled eiders nest and raise broods in the Action Area at low density from late May through late October. In summer, spectacled eiders are widely distributed near lakes or coastal margins throughout the North Slope with a trend toward higher abundance near the coast, north of Teshekpuk Lake, and within the Utqiaġvik Triangle. Within the Action Area, spectacled eiders nest primarily in non-patterned wet meadows, and in wetland complexes containing emergent grasses and sedges (Anderson and Cooper 1994; Anderson et al. 2009). After hatching, spectacled eider hens with broods occupy deep *Arctophila* and shallow *Carex* habitat (Safine 2011). There is no overlap between terrestrial designated critical habitat for spectacled eiders and the Action Area.

Factors which may have contributed to the current status of spectacled eiders in the Action Area include but are not limited to, long-term habitat loss through development and disturbance, environmental contaminants, increased predator populations, subsistence harvest, collisions with structures, research, and climate change. These impacts are occurring throughout much of the species' range, including within the Action Area.

Habitat loss through development and disturbance
The Action Area is located in north eastern NPR-A, where industrial development, human habitation, and disturbance have been limited to date. The community of Nuiqsut and CPAI's existing developments of CD 5, GMT-1, and GMT-2 are the only year-round human habitation in or near the Action Area. Nonetheless, as a consequence of these existing developments and human habitation, it is likely that spectacled eiders in eastern NPR-A have experienced some loss of reproductive potential resulting from direct and indirect habitat loss. However, the degree to which spectacled eiders can reproduce in disturbed areas or move to other less disturbed areas to reproduce, is unknown.

Environmental contaminants
Deposition of lead shot in tundra wetlands and shallow marine habitat where waterfowl, including spectacled eiders, forage is considered a threat to spectacled eiders. Lead poisoning of spectacled eiders has been documented on the YK-Delta (Franson et al. 1995; Grand et al. 1998) and in Steller's eiders on the ACP (Trust et al. 1997; Service unpublished data). Waterfowl hunting with lead shot is prohibited in Alaska, and for hunting all birds on the North Slope. However, it may persist in the environment and may still be used by hunters in some areas (Service, unpublished data). Lead deposition in tundra wetlands would likely be limited to areas adjacent to the community of Nuiqsut and frequently used travel corridors, and the concentration of lead presumably would decline with increasing distance from these areas. Although the use of lead shot appears to be declining, residual lead shot may be present in the environment and be available to waterfowl for an unknown period into the future.

Other contaminants such as globally distributed heavy metals, may also affect spectacled eiders. For example, spectacled eiders sampled in winter near St. Lawrence Island exhibited high concentrations of metals, as well as subtle biochemical changes (Trust et al. 2000). Spectacled eiders breeding, making local movements, staging or migrating through the Action Area may have experienced limited exposure to petroleum hydrocarbons, heavy metals, and other contaminants from existing industry developments. However, the risk of exposure to contaminants and their potential affects to spectacled eiders in the Action Area have not been fully quantified.

Increased predator populations
Predator and scavenger populations have likely increased near rural communities and industrial infrastructure on the ACP in recent decades (Eberhardt et al. 1983; Day 1998; Powell and Backensto 2009). Reduced fox trapping, anthropogenic food sources in rural communities, and an increase in availability of nesting/denning sites at human-built structures may have resulted in increased numbers of arctic foxes (*Alopex lagopus*), common ravens (*Corvus corax*), and glaucous gulls (*Larus hyperboreus*) in developed areas of the ACP (Day 1998). For example, ravens are highly efficient egg predators (Day 1998), and have been observed depredating Steller's eider nests near Utqiaġvik (Quakenbush et al. 2004). Ravens also appear to have expanded their breeding range on the ACP by using manmade structures for nest sites (Day 1998). Given the anthropogenic influence of Nuiqsut and the existing CD5 and GMT

developments, spectacled eiders in the vicinity of these areas of human habituation have likely been impacted by increased predators although the severity of impacts are difficult to quantify. Nonetheless, as the number of structures and anthropogenic attractants associated with industrial development and human habitation on the North Slope increase, reproductive success of spectacled eiders may decrease.

Subsistence harvest
Although local knowledge suggests spectacled eiders were not specifically targeted for subsistence, an unknown level of harvest occurred across the North Slope prior to listing spectacled eiders under the ESA (Braund et al. 1993). Harvest of spectacled eiders was closed in 1991 by Alaska State regulations, and outreach efforts have been conducted by the Service, the BLM, and the North Slope Borough to encourage compliance. However, annual harvest data indicate that at least some spectacled eiders continue to be inadvertently or deliberately taken during subsistence activities on the North Slope. Annual intra-Service consultations are conducted for the Migratory Bird Subsistence Hunting Regulations, and although estimates are imprecise, harvest of all migratory bird species, including spectacled eiders, is reported annually.

Instances of inadvertent harvest would likely be concentrated near Nuiqsut, and we expect the frequency of inadvertent harvest would decline with increasing distance from the community as access becomes more difficult. Furthermore, due to low density of spectacled eiders in the Action Area, harvest of this species is likely uncommon.

Collisions with structures
Migratory birds suffer considerable mortality from collisions with man-made structures (Manville 2005) including light poles, buildings, drill rigs, guyed towers or poles, and overhead powerlines. Birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). There is also evidence that lights on structures increase collision risk (Reed et al. 1985, Russell 2005, numerous authors cited by Manville 2000). Anderson and Murphy (1988) monitored bird behavior and strikes to a 12.5 km power line in the Lisburn area (the southern portion of the Prudhoe Bay oil fields) during 1986 and 1987. They documented line strike mortality in 18 different species of birds, including at least one eider. Results indicated that strike rate was related to flight behavior, in particular the height of flight. Johnson and Richardson (1982) in their study of migratory bird behavior along the Beaufort Sea coast reported that 88% of eiders flew below an estimated altitude of 10 m (32 ft) and well over half flew below 5 m (16 ft). This tendency to fly low puts eiders at risk of striking even relatively low objects in their path.

An unknown level of collision risk remains for the life of man-made structures. Several factors confound accurate collision estimates for spectacled eiders, including: 1) temporal changes in eider density and distribution, 2) lack of understanding how feature configurations contribute to avian collisions, and 3) how variations in weather and lighting conditions effect probability of collisions. However, some design considerations may reduce or eliminate collision risk for listed eiders, including shielded lighting to limit outward-radiating light and minimize potential attraction and/or disorienting effects to eiders, and avoiding use of guyed towers and overhead lines, and marking lines with bird flight diverters when overhead lines or guy wires are unavoidable.

Research
Field-based scientific research has increased in the Arctic in response to interest in climate change and its effects on Arctic ecosystems. While some activities have no impact on spectacled eiders (e.g., project timing occurs when eiders are absent or employs remote sensing tools), aerial surveys, on-tundra activities, or remote aircraft landings may disturb spectacled eiders. Many of these activities are considered in intra-Service, or project-specific, consultations with BLM, the National Science Foundation, or other Action Agencies.

Climate change
The environmental baseline includes consideration of ongoing and projected changes in climate which have consequences for listed species in the Action Area. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation; IPCC 2007). In our analyses, we use our best professional judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

High latitude regions, such as Alaska's North Slope, are thought to be especially sensitive to effects of climate change (Quinlan et al. 2005; Schindler and Smol 2006; Smol et al. 2005). While climate change will likely affect individual organisms and communities, it is difficult to predict with certainty how these effects will manifest. Biological, climatological, and hydrologic components of the ecosystem are interlinked and operate on varied spatial, temporal, and organizational scales with feedback between components (Hinzman et al. 2005).

There are a wide variety of changes occurring across the circumpolar Arctic. Arctic landscapes are dominated by freshwater wetlands (Quinlan et al. 2005), which listed eiders depend on for forage and brood rearing. As permafrost thaws, some water bodies are draining (Smith et al. 2005; Oechel et al. 1995), or drying due to increased evaporation and evapotranspiration during prolonged ice-free periods (Schindler and Smol 2006; Smol and Douglas 2007). In addition, productivity of some lakes and ponds is increasing in correlation with elevated nutrient inputs from thawing soil (Quinlan et al. 2005; Smol et al. 2005; Hinzman et al. 2005; Chapin et al. 1995) and other changes in water chemistry or temperature are altering algal and invertebrate communities, which form the basis of the Arctic food web (Smol et al. 2005; Quinlan et al. 2005).

With reduced summer sea ice coverage, the frequency and magnitude of coastal storm surges has increased. During these events, coastal lakes and low lying wetlands are often breached, altering soil/water chemistry as well as floral and faunal communities (USGS 2006). When coupled with softer, semi-thawed permafrost, reductions in sea ice have significantly increased coastal erosion rates (USGS 2006), which may reduce available coastal tundra habitat over time.

Changes in precipitation patterns, air and soil temperatures, and water chemistry are also affecting terrestrial communities (Hinzman et al. 2005; Prowse et al. 2006; Chapin et al. 1995), and the range of some boreal vegetation species is expanding northward (Callaghan et al. 2004). Climate-induced shifts in distributions of predators, parasites, and disease vectors may also have significant effects on listed species. Climate change may also cause mismatched phenology among listed eider migration, development of tundra wetland invertebrate stocks, fluctuation of small mammal populations, and corresponding abundance of predators (Callaghan et al. 2004).

In summary, the impacts of climate change are on-going and the ultimate effects on spectacled eiders within the Program Area are unclear. Some species may adapt and thrive under changing environmental conditions, while others decline or suffer reduced biological fitness; it is unknown how spectacled eider populations may be affected in the short and long term.

Baseline of spectacled eiders in the offshore Action Area

Chukchi and Bering seas – Spectacled eiders occur along the MTR during migration. In spring, spectacled eiders move through leads in the sea ice consistent with patterns exhibited by other sea duck species that migrate from wintering areas in the Bering Sea to breed in coastal Alaska (Sexson et al. 2014). In summer and autumn, post-breeding males, non-breeding individuals, and/or failed nesting females return to open waters along the Chukchi Sea coast, and may remain in these areas to molt. Large numbers of molting spectacled eiders are present in the Ledyard Bay Critical Habitat Unit (LBCHU) from late June through late October (Larned et al. 1995; Petersen et al. 1999).

A recent study in which spectacled eiders were marked with satellite telemetry devices at coastal areas adjacent to Peard Bay and in the Colville River Delta has provided information regarding how the species uses the eastern Chukchi Sea (approximately within 70 km of the coast of northern Alaska) during migration (Sexson et al. 2014; Sexson 2015). Spectacled eiders used this area during pre-breeding migration, breeding, post-breeding migration, and/or post-fledging dispersal. Adult males that used the eastern Chukchi Sea during post-breeding migration arrived in early July and departed in early September, although departure dates varied substantially, ranging from 4 July to 5 October (Sexson et al. 2014). Consequently, sustained occupancy among adult males during post-breeding migration ranged from 30–97 days (Sexson et al. 2014). Adult females that used the eastern Chukchi Sea during post-breeding migration arrived in August and departed in October (Sexson et al. 2014), although the timing of arrival during post-breeding migration varied considerably; arrival occurred as early as 15 July and as late as 28 September. Consequently, the duration of sustained occupancy among adult females during post-breeding migration ranged from 16–84 days. Juveniles that fledged in tundra wetlands near or adjacent to the Beaufort Sea arrived in the eastern Chukchi Sea in early October and stayed for 13–29 days before departing by late October. Thus, spectacled eiders use the eastern Chukchi Sea continuously from pre-breeding staging through post-fledgling dispersal.

Beaufort Sea – Use of the Beaufort Sea by spectacled eiders varies over time and by breeding status, and is in part controlled by ice cover on the sea surface (Schamel 1978, TERA 2002, Fischer and Larned 2004). Breeding male spectacled eiders generally depart the terrestrial environment in late June when females begin incubation (Anderson and Cooper 1994, Bart and Earnst 2005). Use of the Beaufort Sea by departing males is variable as indicated by satellite telemetry studies (TERA 2002). Of 14 males implanted with transmitters, only 4 spent an extended period of time (11–30 days), in the Beaufort Sea (TERA 2002). Preferred areas were near large river deltas such as the Colville River where open water is more prevalent. Some appeared to move directly to the Chukchi Sea over land, although the majority moved rapidly (average travel of 1.75 days) over nearshore waters from breeding grounds to the Chukchi Sea (TERA 2002).

Female spectacled eiders generally depart the breeding grounds later, when much more of the Beaufort Sea is ice-free, allowing for more extensive use of the area. Females spent an average of 2 weeks in the Beaufort Sea (range 6-30 days) with the western Beaufort Sea the most heavily used (TERA 2002). Females also appeared to migrate through the Beaufort Sea an average of 10 km farther offshore than the males (Petersen et al. 1999). This offshore migration route and the greater use of the Beaufort Sea by females is attributed to decreased sea ice later in summer when females migrate through the region (Petersen et al. 1999; TERA 2002).

Factors which may have contributed to the current status of spectacled eiders in the MTR include but are not limited to, environmental contaminants, collisions with offshore or coastal structures and vessels, and climate change. These impacts are occurring throughout much of the species' range, including within the MTR.

Environmental contaminants
Due to the lack of industrial development and minimal human presence and vessel traffic in the region, the Chukchi Sea is currently largely in natural condition. Current industrial impacts are minimal and pollution and/or sediments occur at very low levels in the area. The majority of water flowing into this marine environment is not subject to human activity or stressors and is considered unimpaired (ADEC 2003). Furthermore, there are no Section 303(d) impaired waterbodies identified within the Arctic Subregion by the State of Alaska. Background hydrocarbon concentrations in the Chukchi Sea appear to be biogenic (naturally occurring) and on the order of 1 part per billion or less; concentrations in the Hope Basin and Chukchi Sea are entirely biogenic in origin and are typical of levels found in unpolluted marine water and sediments. A study of heavy metals in sediments collected from portions of the eastern Chukchi in the 1990's (Naidu 2005) found concentrations were low and the environment was considered "pristine."

While no large spills of crude oil have occurred in the Beaufort Sea, small spills of refined petroleum products do occur. These spills decrease habitat quality and pose a risk to migrating eiders. However, there are detailed oil spill contingency plans associated with each industry development, and rapid spill response measures limit the area impacted by spills. Furthermore, wildlife hazing during spill response reduces the probability that spectacled eiders contact spilled product. Similar to the Chukchi Sea, the area of the Beaufort Sea within the MTR is likely minimally impacted by spills or other contaminants.

Collisions with offshore or coastal structures
There are several oil facilities, currently operating or planned, along the Beaufort Sea coast (e.g., Nanashuk, Ooguruk, and North Star). These facilities have likely resulted in small-scale, localized impacts on individual spectacled eiders as is described in the Biological Opinions issued for these projects (USFWS 2006, 2011, 2019). Onshore and offshore structures at these developments pose a potential collision risk for spectacled eiders moving through the MTR. As described above in *Collisions with Structures*, birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). There is also evidence that lights on structures increase collision risk (Reed et al. 1985; Manville 2000; Russell 2005). Johnson and Richardson (1982), in their study of migratory bird behavior along the Beaufort Sea coast, reported that 88% of eiders flew below an estimated altitude of 10 m (32 ft) and well over half flew below 5 m (16 ft). Thus, structures of almost any height pose a collision risk to migrating eiders.

Collisions with vessels
As described above, migratory birds suffer considerable mortality from collisions with anthropogenic objects including vessels. For example, 22 spectacled eiders were killed in a collision event with a ground fishing vessel near Saint Lawrence Island in late fall 2019 (Anchorage Fish and Wildlife Conservation Office and Migratory Bird Management pers. comm.). However, impacts of vessel collisions on listed eiders are difficult to quantify because: 1) collisions are often episodic, and those resulting from light attraction in inclement weather may be particularly so, such that observations collected on a few vessels in a single year may not be representative of collisions in general, 2) monitoring for collisions is difficult and an unknown number of collisions may go undetected, even by trained bird observers, and 3) low visibility often coincides with increased collisions (Ronconi et al. 2015), which may increase the number of undetected collisions. Therefore, although spectacled eider collisions with vessels at sea are known to occur, the collective impacts of collisions on spectacled eiders in the MTR are difficult to quantify.

Baseline of spectacled eider critical habitat in the Action Area
There is no overlap between terrestrial designated critical habitat for spectacled eiders and the Action Area. The MTR passes adjacent to the Ledyard Bay Critical Habitat Unit (LBCHU) designated to protect molting spectacled eiders, and a critical habitat unit used by wintering spectacled eiders south of St. Lawrence Island (Figure 6B), but it does not overlap with the eastern Norton Sound spectacled eider critical habitat unit.

Several key environmental factors, such as good water quality and lack of contamination, contribute to what can be considered the current environmental conditions of the LBCHU. The LBCHU is currently largely in natural condition, free of physical modification or significant water or sediment pollution; and its physical and biological processes are functioning and promote production of a rich and abundant benthic community upon which spectacled eiders feed when they occupy LBCHU.

In wintering critical habitat south of Saint Lawrence Island, spectacled eiders' preferred food resources may be in decline and organic deposition and benthic biomass in this area have declined steadily since the late 1980s (66 FR 9146). A long-term trend in benthic communities continues: The formerly abundant bivalve *Macoma calcarea* has declined relative to another clam *Nuculana radiata*, which has 76% lower lipid content and 26% lower energy density (J.R. Lovvorn, Univ. Wyoming, pers. comm. 2000). The average length and mass of bivalves has also declined in the long term. Because nearly all spectacled eiders spend each winter occupying an area of ocean less than 50 km (27.0 nautical miles) in diameter, they may be particularly vulnerable to environmental changes that appear to be impacting the benthic communities in this area.

Baseline of the polar bear in the Action Area

Both the Southern Beaufort Sea (SBS) and Chukchi Sea (CS) polar bear subpopulations occur within the Action Area. The subpopulations overlap in the western Beaufort and eastern Chukchi Sea region (Figure 6.1), but can be distinguished by animal movement data and tissue contaminants (Amstrup et al. 2004a; Amstrup et al. 2005). The SBS subpopulation also ranges beyond the U.S. into Canada. The highest number of polar bears in the Action Area occurs on land during fall and winter when some polar bears enter the coastal environment as they abandon melting sea ice, forage for terrestrial food, or search for suitable den sites (pregnant females). Oliktok Dock has a history of polar bear activity, likely due to the coastal location of the facility, the use of coastal areas as thoroughfares by transient bears, and few adjacent barrier islands that could serve as alternative travel routes for transient bears. For these reasons, the vicinity of Oliktok Dock is the portion of the Action Area where polar bears occur with the highest frequency.

Most denning in Alaska occurs by the SBS subpopulation, due to the relative proximity of the Beaufort Sea's ice edge to terrestrial habitat during fall when some pregnant females come ashore. Historically, no polar bear dens have been found within the terrestrial Action Area although small numbers of dens have been found within the MTR and just outside the terrestrial Action Area (Figure 6.2; BLM 2020a). Suitable denning habitat within the Action Area primarily occurs along the Colville, Ublutuoch, and Kalikpik rivers, and Uvlutuuq and Kayyaaq creeks near the Beaufort Sea coast (Figure 6.2). Bears may also spend some time on land while transiting to other areas. If bears come ashore due to fall storms, melting sea ice, and/or ocean currents, they may remain along the coast or on barrier islands for several weeks until sea ice returns. Polar bears do not use the Chukchi Sea and adjacent Alaska coastline in the same manner they use the Beaufort Sea and the adjacent North Slope (MMM-USFWS, pers. com.). Interactions with polar bears in the SBS subpopulation could occur both onshore and offshore and would likely be related to seasonal variation in sea ice cover and extent. The CS subpopulation occurs only in the MTR portion of the Action Area (Figure 6.1).

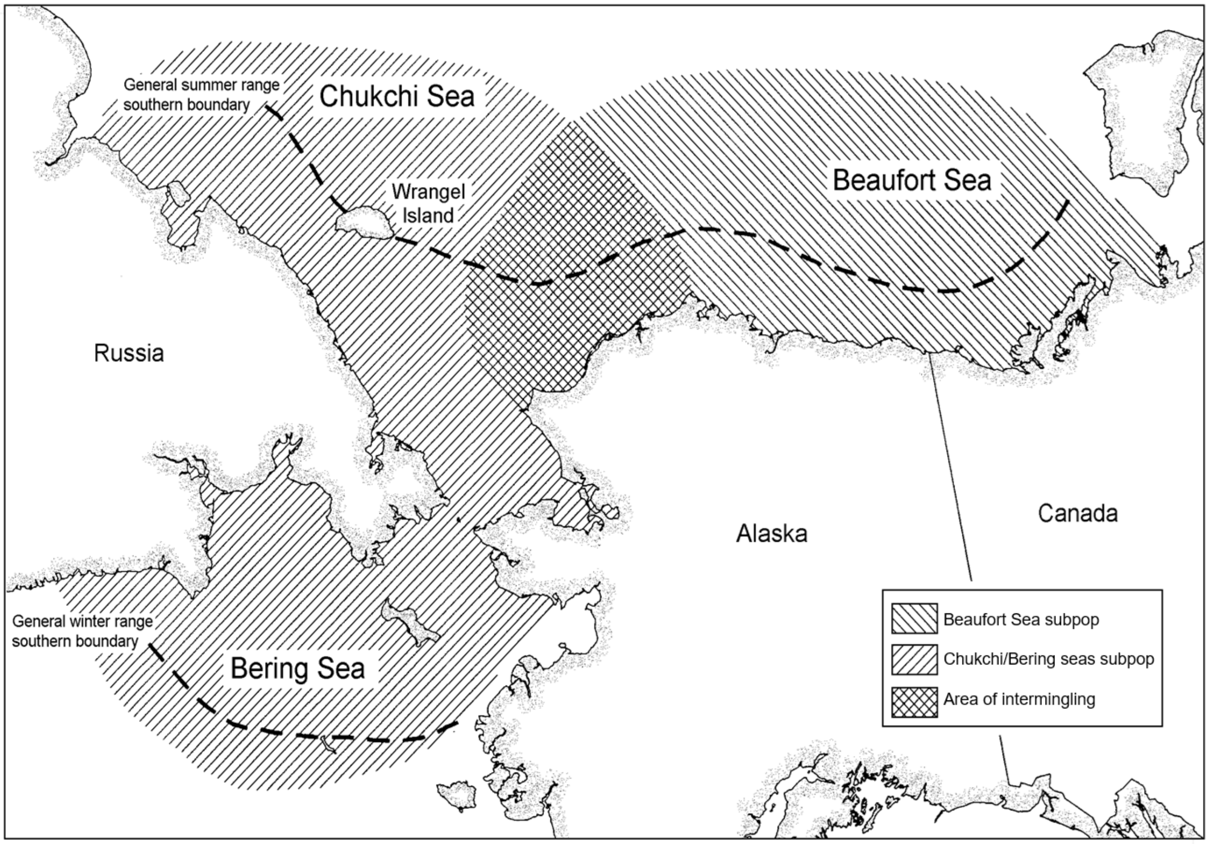

Figure 6.1. Range of polar bear subpopulations in Alaska.

The SBS subpopulation had an estimated population size of approximately 900 bears in 2010 (Bromaghin et al. 2015). This represents a significant reduction from previous estimates of approximately 1,800 in 1986 (Amstrup et al. 1986) and 1,526 in 2006 (Regehr et al. 2006). In addition, analyses of over 20 years of data on size and body condition of bears in this subpopulation demonstrated declines for most sex and age classes and significant negative relationships between annual sea ice availability and body condition (Rode et al. 2010). This evidence suggests that the SBS subpopulation is currently declining due to sea ice loss (USFWS 2017b).

Polar bears in the SBS subpopulation historically spent the entire year on the sea ice hunting for seals, with the exception of a relatively small proportion of adult females that would come ashore during autumn and overwinter to den. However, over the last two decades, the SBS subpopulation has experienced a marked decline in summer sea-ice extent, along with a pronounced lengthening of the open-water season (period of time between sea ice break-up and freeze-up; Stroeve et al. 2014; Stern and Laidre 2016). The dramatic changes in the extent and phenology of sea-ice habitat have coincided with evidence suggesting that use of terrestrial habitat has increased during summer and prior to denning.

The CS subpopulation is widely distributed on the pack ice of the northern Bering, Chukchi, and eastern Siberian seas (Garner et al. 1990; Garner et al. 1994; Garner et al. 1995). The constant movement of pack ice influences the movement of polar bears, and this makes obtaining a reliable population size estimate from mark and recapture studies challenging. For example, polar bears of this subpopulation move south with advancing ice during fall and winter and north in advance of receding ice in late spring and early summer (Garner et al. 1990). The most recent estimate of the CBS subpopulation is approximately 2,900 bears (Regehr et al. 2018) based on extrapolation from capture-recapture, radio telemetry and count data. U.S. capture-recapture research conducted in spring of 2008 through 2011 indicated that CBS animals have good body condition and reproduction, suggesting capacity for positive population growth despite sea ice loss (Rode et al., 2014). Regehr et al. (2018) also calculated survival probabilities for Chukchi Sea bears, with survival for adult males and adult females estimated to be 0.89 and 0.90, respectively, and for subadult males and females to be 0.71 and 0.79, respectively.

In the Action Area, the greatest factor impacting the status of polar bears is loss of sea ice resulting from climate change. Other contributing factors include, but may not be limited to: subsistence hunting, industry activities conducted pursuant to MMPA authorizations, scientific research, and environmental contaminants.

Climate change and sea ice loss
Global climate change and its effects in the Arctic are likely to have serious consequences for the worldwide population of polar bears and their prey (Amstrup et al. 2007; Amstrup et al. 2008; Hunter et al. 2010; Atwood et al. 2015). The associated reduction of summer Arctic sea ice is expected to be a primary threat to polar bear populations (Stirling and Derocher 2012), and projections indicate continued climate warming at least through the end of this century (IPCC 2013). The Service issued a Polar Bear Conservation Management Plan (USFWS 2016a). In it, the Service reaffirms the 2008 ESA-listing decision, that the decline of sea ice habitat due to changing climate, driven primarily by increasing atmospheric concentrations of greenhouse gases, is the primary threat to polar bears.

Climate change is expected to impact polar bears in a variety of ways. The timing of ice formation and breakup will impact seal distributions and abundance, and, consequently, how efficiently polar bears can hunt seals. Reductions in sea ice are expected to increase the polar bears' energetic costs of traveling, as moving through fragmented sea ice and swimming in open water requires more energy than walking across consolidated sea ice (Cherry et al. 2009; Pagano et al. 2012; Rode et al. 2014). Research has linked declines in summer sea ice to reduced physical condition, growth, and survival of polar bears (Bromaghin et al. 2015).

Habitat loss due to declining Arctic sea ice throughout the polar bear's range has been identified as the primary cause of population decline and is expected to continue for the foreseeable future (73 FR 28212). Amstrup et al. (2007) projected a 42% loss of optimal summer polar bear habitat by 2050. They concluded that if current Arctic sea-ice declines continue, polar bears may eventually be excluded from onshore denning habitat in the Polar Basin Divergent Region. Amstrup et al. (2007) projected the SBS subpopulation may be extirpated within the next 45–75 years, if sea-ice declines continue at current rates. Further projections confirmed sea ice decline is the most influential driver of adverse population outcomes for polar bears, and predict the adverse consequences of sea ice loss may become more pronounced as early as mid-century if greenhouse gas emissions remain unabated (Atwood et al. 2015).

The occurrence of polar bears along the Beaufort Sea coast has increased in recent years (Schliebe et al. 2008, Atwood et al. 2016a) in correlation with the distance of pack ice from the coast at that time of year (i.e., more bears are observed onshore when the leading edge of the ice is further offshore; Schliebe et al. 2006). We expect this trend to continue in the future, and surmise that an increasing number of bears onshore for longer periods of time during the open water season may increase the potential for human-bear conflicts from industrial development or other human activities. Additionally, in recent years when sea ice has retreated far from the Beaufort Sea coast, researchers have observed polar bears swimming in open water, far from the nearest sea ice or land, presumably placing them at risk of exhaustion (Durner et al. 2011; Pagano et al. 2012). In the fall of 2004, four drowned polar bears were observed in the Beaufort Sea during a BOEM coastal aerial survey program (Monnett and Gleason 2006).

Schliebe et al. (2008) determined that an average of 4% of the SBS subpopulation of polar bears were on land in autumn during 2000 to 2005, and the percentage increased when sea ice was farther from the coast. More recently, Atwood et al. (2016a; b) determined the percentage of radio-collared adult females coming ashore in summer and fall increased from 5.8% to 20% between 2000 and 2014. Over the same period, the mean duration of the open-water season increased by 36 days and the mean length of stay on land by polar bears increased by 31 days (Atwood et al. 2016a; b). While on shore, the distribution of polar bears is largely influenced by the opportunity to feed on the remains of subsistence-harvested bowhead whales. Most polar bears aggregate at three sites along the coast, Utqiaġvik, Cross Island, and Kaktovik (Rogers et al. 2015; McKinney et al. 2017; Wilson et al. 2017).

In addition to increased use of land during the open-water season, polar bears in the SBS subpopulation have also increasingly used land for maternal denning. Olson et al. (2017) examined the choice of denning substrate (land compared to sea ice) by adult females between 1985 and 2013 and determined that the frequency of land-based denning increased over time, constituting 34.4% of all dens from 1985 to 1995, 54.6% from 1996 to 2006, and 55.2% from 2007 to 2013. Additionally, the frequency of land denning was directly related to the distance that sea ice retreated from the coast. From 1985 to 1995 and 2007 to 2013, the average distance from the coast to 50% sea ice concentration in September (when sea ice extent reaches its annual minimum) increased 351 ± 55 km (218.10 ± 34.17 mi), while the distance to 15% sea ice concentration increased by 275 ± 54 km (170.88 ± 33.55 mi). Rode et al. (2018) determined that reproductive success was greater for females occupying land-based dens compared to ice-based dens, which may be an additional factor contributing to the increase in land-based denning. However, this increase in the proportion of dens occurring in the terrestrial environment may increase the potential for disturbance at dens from industrial development and other human activities.

Subsistence harvest
The Inuvialuit-Inupiat Polar Bear Management Agreement, a Native-to-Native agreement, between the Inupiat from Alaska and the Inuvialuit in Canada was created for the SBS stock of polar bears in 1988. Polar bears harvested from the communities of Utqiaġvik, Nuiqsut, Kaktovik, Wainwright, and Atqasuk are currently considered part of the SBS stock and thus are subject to the terms of the Inuvialuit-Inupiat Polar Bear Management Agreement. The agreement

establishes quotas and recommendations concerning protection of denning females, family groups, and methods of harvest.

In 1988, the Inuvialuit-Inupiat Council (Council) established a sustainable harvest quota of 80 bears for the SBS stock. In 2011, the Council reduced the quota to 70 polar bears based on a reduced population estimate, and in 2015 the Council further reduced the quota for bears harvested in Canada to reflect a change in the boundary between the Northern and Southern Beaufort Sea Stock. The current harvest limit under the agreement is 56 bears (35 in the U.S and 21 in Canada) per year (U.S. Fish and Wildlife Service - Marine Mammals Management Office pers. comm.). This limit is implemented through voluntary means in the U.S. and through regulatory means in Canada.

Industry activities conducted pursuant to Marine Mammal Protection Act Authorizations: Incidental take and incidental harassment authorizations – The current Beaufort Sea Incidental Take Regulations (ITRs; 81 FR 52318; § 18.128) describe mitigation, monitoring, and reporting requirements of oil and gas operators that are applied to active operations in the central Beaufort Sea portion of the Action Area. The Beaufort Sea ITRs encompass a larger portion of the range of the SBS stock than the Action Area and have been important in mitigating impacts to polar bears from oil and gas activities on the North Slope.

Deterrence activities and intentional take authorizations – In addition to the regulatory program allowing for incidental take of polar bears described above, the MMPA also provides a mechanism for managing human-polar bear interactions in order to promote conservation of bears while protecting human safety. This Deterrence Program, under section 101(a)(4)(A) of the MMPA, provides Letters of Authorization (LOAs) that allow the use of deterrence actions to prevent polar bears from damaging private property or endangering personal safety. Under this authority, Federal, State and local government employees may deter polar bears for the welfare of the animal when acting in the course of their official duties, and private persons (such as employees of the oil and gas industry) may enter into cooperative agreements with the Service to carry out deterrence measures when acting in their capacity as designated persons under such an agreement and in full compliance with its terms and conditions. This program strives to: 1) prevent bears from associating food with humans and communities, 2) “condition” bears to avoid humans, human activities and communities, 3) promote movement of bears by actively redirecting them into corridors, such as coastal travel routes, 4) minimize extended use of areas near communities, and 5) minimize bear entry into communities.

Importantly, the program mandates “active deterrence actions must not result in the death or serious injury of any marine mammal,” and requires an application that includes: (a) a detailed plan of operations, (b) a site-specific plan to monitor effects of the activity on polar bears present during activities, and (c) a site-specific polar bear interaction plan that outlines steps the applicant will take to limit animal-human interactions, increase site safety, and minimize impacts to polar bears. The program does not allow for the deterrence of polar bears for convenience or to aid project activities, and prior to conducting deterrence activities operators must make reasonable efforts to reduce or eliminate attractants (e.g., garbage, human waste, and food); move personnel to safety; ensure the bear has escape route(s); and begin with the lowest level of force or intensity that is effective and increase the force or intensity only as necessary to achieve the desired result. The program also contains specific training, monitoring, and reporting requirements to minimize risk and impacts to polar bears. This program has been in place for decades, and although deterrence actions result in negative impacts to individual bears on rare occasions, proper implementation of deterrence actions under this program effectively reduces the need for lethal take of polar bears, and thus as a whole contributes to the conservation of polar bears.

For example, between January 1, 2001, and December 31, 2016, the entire North Slope oil and gas industry reported 2,731 observations of 4,371 individual polar bears. Of these, 848 (19%) were deterred. Of those deterred, the vast majority were subjected to noise or visual stimuli (e.g., vehicle horns, engine noise, yelling, spotlights, sirens, or discharge of cracker shells) intended to direct bears away from facilities or human activities. On rare occasions, when less intrusive methods fail, "direct contact" rounds such as bean bags or rubber bullets are used. During 640 deterrence events by industry on the North Slope from January 1, 2001, to December 31, 2016, 42 polar bears were hazed with bean bags and 6 with rubber bullets. The number of polar bears hazed with bean bags or rubber bullets annually ranged from 0 to 11; the average was 3 polar bears per year. Injuries or lethal impacts are exceptionally rare. In 2011, a polar bear died because personnel mistakenly used a crackershell to deter a bear at close range rather than a beanbag round (Kimberly Klein, Incidental Take Coordinator, Marine Mammals Management Office, US Fish and Wildlife Service. Pers. Comm.).

Scientific research

Polar bear research takes place throughout the terrestrial and offshore portions of the Action Area. In general, the long-term goal of research programs is to gain information on the ecology and population dynamics of polar bears to help inform management decisions, especially in light of climate change. These activities may cause short-term disturbance and/or minor injuries (e.g., sedation, tissue sampling, marking, etc.) to individual polar bears targeted in survey and capture efforts, and may incidentally disturb other individuals. In rare cases, research efforts may lead to serious injury or death of polar bears. Polar bear research is authorized through Division of Management Authority (DMA) permits issued under the MMPA. These permits include estimates of the maximum number of bears likely to be impacted by disturbance or minor capture-related injuries, and include a condition to halt research if a specified number of deaths (limited to small numbers) occur during the life of the permit. Research DMA permits are typically issued for a five-year period.

Environmental contaminants

Exposure to environmental contaminants may affect polar bear survival or reproduction. Three main types of contaminants in the Arctic are thought to pose the greatest potential threat to polar bears: petroleum hydrocarbons, persistent organic pollutants (POPs), and heavy metals. To date, no large oil spills from oil and gas activities have occurred in marine waters of Arctic Alaska. However, contamination of the Arctic and sub-Arctic regions through long-range transport of pollutants has been recognized for over 30 years (Bowes and Jonkel 1975; Proshutinsky and Johnson 2001; Lie et al. 2003).

Arctic ecosystems are particularly sensitive to environmental contamination due to: 1) the slower rate of breakdown of POPs including organochlorine compounds (OCs), 2) relatively simple food chains, and 3) the presence of long-lived organisms with low rates of reproduction and high lipid levels that favor bioaccumulation and biomagnification. Consistent patterns between OC and mercury contamination and trophic status have been documented in Arctic marine food webs (Braune et al. 2005), and the highest concentrations of POPs in Arctic marine mammals have been found in seal-eating walruses and polar bears near Svalbard (Norstrom et al. 1988; Muir et al. 1999; Andersen et al. 2001). While polar bears may come into contact with contaminants in the Action Area if they are not properly disposed of or secured, this has occurred very rarely.

Furthermore, contaminant concentrations are not presently thought to have population-level effects on most polar bear populations. However, increased exposure to contaminants has the potential to operate in concert with other factors, such as nutritional stress from loss or degradation of sea ice habitat, decreased prey availability and accessibility, or lower recruitment and survival rates. These combined stressors could ultimately have negative population level effects on polar bears.

Baseline of polar bear critical habitat in the Action Area
The Action Area includes portions of each of the three polar bear critical habitat units. The proposed Action would primarily occur within terrestrial denning habitat, but, in the event of unexpected circumstances, spilled oil or other petroleum products could also reach the sea ice and barrier island critical habitat units.

Habitat loss
Historically, habitat used for terrestrial denning by polar bears in the Action Area has been subject to industry development and/or support infrastructure including Oliktok Dock, and the Mustang, Alpine and Greater Moose's Tooth Developments (Figure 6.2). However, existing anthropogenic infrastructure was exempted from inclusion in critical habitat at the time of designation (75 FR 76086). Therefore, permanent alteration of the physical and biological features of terrestrial denning habitat in the Action Area, since designation in 2010, has been relatively limited, although some new development and expansion of existing industry infrastructure in or adjacent to the Action Area have occurred (e.g., the Mustang and Nanushuk Developments and Nuiqsut Spur Road). The Action Area has also been subject to localized short-term human disturbance from seasonal ice roads, and access by researchers, recreational and subsistence users. At a larger spatial scale, globally distributed pollutants and climate change have diminished the quality of polar bear critical habitat; however, estimating the magnitude of these effects within the Action Area is difficult. Each of these factors are discussed in further detail below.

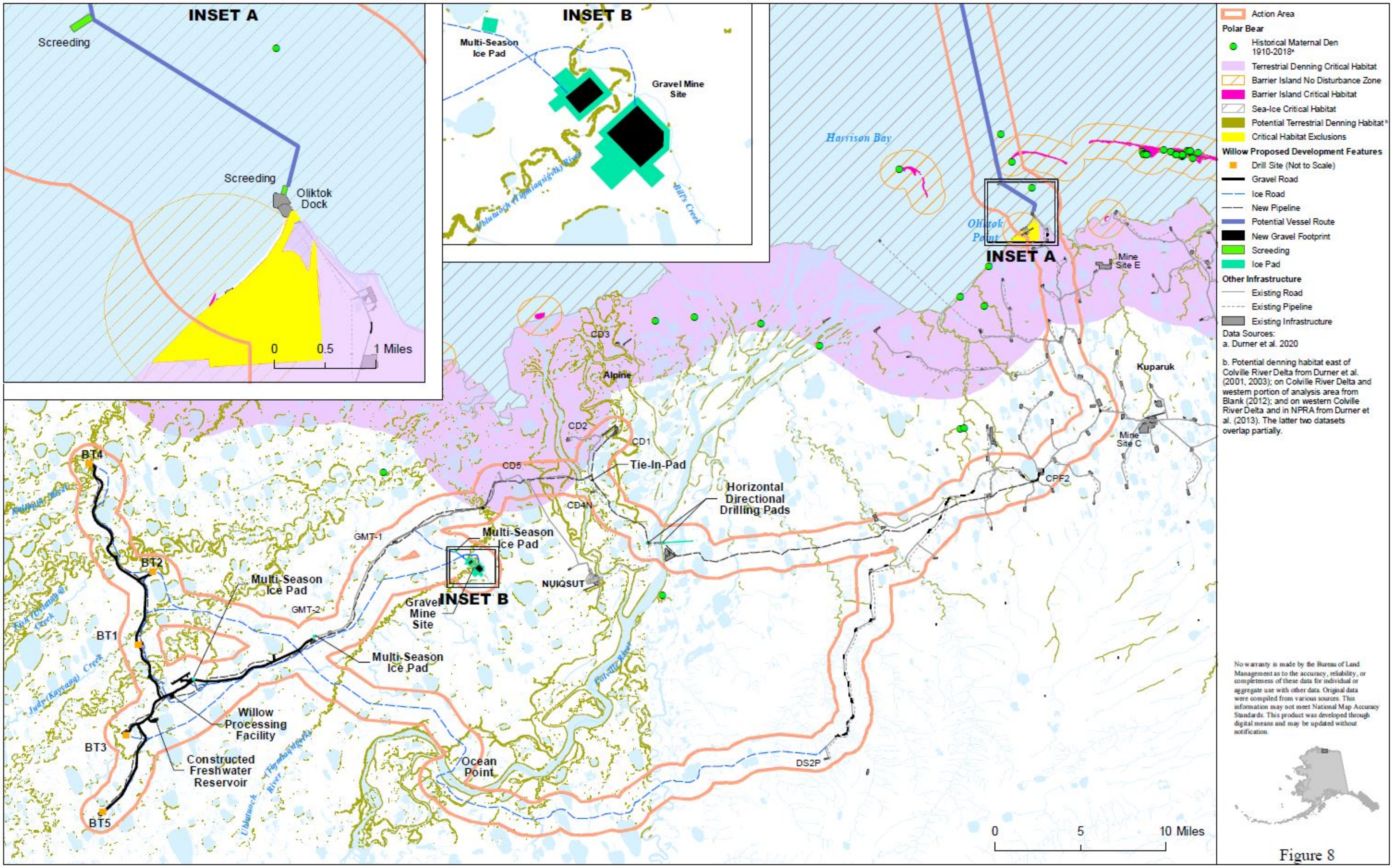

Figure 6.2. Characteristic polar bear terrestrial denning habitat, designated critical habitat, and historical dens in relation to the proposed Willow Development, and existing industry developments in the Action Area.

Environmental contaminants
Exposure to environmental contaminants may affect polar bear survival or reproduction, as discussed above in the *Baseline of Polar Bears*. Thus, the presence of contaminants within polar bear critical habitat could affect the conservation value of the habitat.

Petroleum hydrocarbon contamination from oil and gas development has had a limited effect on the environmental baseline of polar bear critical habitat. A single large spill has been reported for the Chukchi and Beaufort seas: in August 1988, 68,000 gallons (1,619 barrels) of heating fuel were spilled by a tanker 3–6 miles north of the barrier islands off Brownlow Point approximately 150 km southeast of the Action Area. However, no large spills from oil and gas activities have occurred in Arctic Alaska. Some small terrestrial spills have occurred, although they have been infrequent, small in number, and thus far, have affected a limited area. Although polar bears in Arctic Alaska and designated polar bear critical habitat in Alaska have unquestionably been affected by exposure to environmental contaminants, at this time we have no reason to believe the critical habitat's ability to support polar bears has been affected.

Climate change
Climate change is contributing to the rapid decline of sea ice throughout the Arctic, and some of the largest declines are predicted to occur in the Chukchi and southern Beaufort seas (Durner et al. 2009b in USFWS 2010b). This directly affects the PBFs of sea ice, which provide feeding, breeding, denning, and traveling habitat for polar bears. Decreased quality and quantity of sea ice may increase the importance of barrier islands and terrestrial habitat for foraging, denning, and resting. For example, Schliebe et al. (2006) demonstrated an increasing trend in the number of observed polar bears using terrestrial habitats in the fall. Additionally, Fischbach et al. (2007) hypothesized that reduced availability of older, more stable sea ice is contributing to the observed decrease in the proportion of female polar bears denning on sea ice in northern Alaska.

Climate change may also affect the availability and quality of denning habitat on land. Durner et al. (2006a; b) found that 65% of terrestrial dens found in Alaska between 1981 and 2005 were on coastal or island bluffs. These areas are suffering rapid erosion and slope failure as permafrost melts and wave action increases in duration and magnitude. In all areas, dens are constructed in autumn snowdrifts (Durner et al. 2003). Changes in autumn and winter precipitation or wind patterns (Hinzman et al. 2005) could significantly alter the availability and quality of snowdrifts for denning.

7. EFFECTS OF THE ACTION ON LISTED SPECIES

This section of the BO provides an analysis of the effects of the action on listed species and critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

Effects to spectacled eiders
Adverse effects to spectacled eiders in the terrestrial environment from the proposed Willow MDP could potentially occur through long-term habitat loss, disturbance from new infrastructure and on-tundra aircraft landings, increased predators, spills, collisions with structures, and inadvertent harvest. Additionally, spectacled eiders in the Marine Transit Route (MTR) could be affected by disturbance, spills, and/or collisions with vessels. The likelihood of each of these factors affecting spectacled eiders is evaluated in more detail below.

Effects in the terrestrial Action Area
Long-term habitat loss – Winter travel
According to the proposed schedule (BLM 2020a), single-season ice roads and pads to support construction, drilling and operations during the first nine years of the Willow MDP could damage tundra vegetation, and indirectly affect nesting habitat for spectacled eiders. Research indicates damage from winter trails occurs on higher, drier sites with little or no damage in wet or moist tundra areas (Pullman et al. 2003) when ice roads or snow trails are used. Jorgenson (1999) found impacts were limited to isolated patches of scuffed high microsites and crushed tussocks. Similarly, Yokel and VerHoef (2012), found disturbance from seismic and ice road activity was greatest in drier, shrubby habitat than in moist habitat. McKendrick (2003) studied several riparian willow areas and found although some branches were damaged, the affected plants survived. Spectacled eiders prefer to nest in low moist tundra areas (Anderson and Cooper 1994, Anderson et al. 2009), and we anticipate limited damage in these habitats from winter routes associated with the Willow MDP. Therefore, we do not anticipate significant long-term habitat loss from single-season winter routes and ice pads associated with construction, drilling and operations, and conclude these activities are not likely to adversely affect spectacled eiders.

Long-term habitat loss – Gravel excavation and fill and MSIPs
Direct, permanent habitat loss would result from the extraction or placement of gravel fill for infrastructure associated with the Willow MDP, impacting a total of 625.1 acres (2.54 km^2) of wetlands:

- Approximately 459.2 acres (1.86 km^2) would be permanently impacted by gravel fill for roads, pads, boat ramps, access roads, the airstrip, and Oliktok Road curve widening;
- Approximately 149.6 acres (0.61 km^2) would be permanently impacted by the Tiŋmiaqsiuġvik mine site; and
- Roughly 16.3 acres (0.07 km^2) would be permanently impacted by the CFWR.

In addition to permanent gravel fill, construction of the Willow MDP would be facilitated by 7 multi-season ice pads (MSIPs) totaling roughly 114.8 acres (0.46 km^2; BLM 2020a; 2020b). Two 10-acre MSIPS would be located adjacent to Willow MDP infrastructure or facilities (BLM 2020a), and 5 MSIPs totaling 94.8 acres (0.38 km^2) would be located adjacent to the Tiŋmiaqsiuġvik mine site for staging equipment and overburden, and a work camp (Figure 3.3; BLM 2020b). These insulated ice pads would be constructed in winter, remain in place over the following summer, to be re-used during the next winter and allowed to melt during breakup of the second summer. The duration of an MSIP at any given location would be no more than 18 months (BLM 2020a).

Although these pads reduce permanent impacts from gravel fill, quantitative effects to wetland vegetation can be long-term (ABR 2015), but generally are not well documented. For example, early site visits to a former MSIP in place over the summer of 2002 in northern NPR-A, documented mostly dead vegetation inside the former pad footprint, with extensive damage to *Eriophorum vaginatum* (tussock cottongrass), and little regrowth (ABR 2015). Following monitoring and eventual active rehabilitation with fertilizer application in 2010, the site achieved an objective performance standard of ≥ 60% total live vascular cover compared to adjacent reference tundra in 2014, more than a decade after MSIP removal (ABR 2015).

Quantitative monitoring of other former MSIPs on the North Slope has either not been performed or reports are unavailable. Therefore, although limited, ABR's 2015 report is the best available information documenting tundra recovery post-MSIP. While employing MSIPs reduces the need for gravel extraction and permanent fill, and data indicate eventual recovery of vegetation, impacts to affected tundra habitat can be severe and prolonged (ABR 2015). The severity of impacts likely varies with location and vegetative community, and may be reduced by improved MSIP construction practices. Nonetheless, we adopt a conservative approach in evaluating the impacts of MSIPs on nesting spectacled eiders, and assume each MSIP would render the affected tundra un-suitable for nesting for the life of the project.

In addition to permanent and longer-term habitat loss from gravel fill and MSIPs, we also anticipate indirect habitat loss via disturbance would occur within a 200 m (656.2 ft.) zone of influence surrounding new development from on-pad activities, road operations, and maintenance activities. The two principal mechanisms through which disturbance can adversely affect eiders on their breeding grounds are:

1. Displacing adults and/or broods from preferred habitats during pre-nesting, nesting, brood rearing, and migration; and
2. Displacing females from nests, exposing eggs or small young to inclement weather and predators.

In the discussion below, we provide an assessment of potential loss of spectacled eider production resulting from estimated impacts to nesting habitat from the Willow MDP.

Effects to nesting spectacled eiders

Broad-scale aerial surveys conducted in multiple years allow us to estimate how density of listed eiders varies across the landscape. These estimates were developed at a coarse regional scale and are not site- or habitat-specific; however, they reasonably reflect the density of breeding spectacled eiders in the Willow MDP Action Area. Observations during aerial surveys of the ACP in 2012–2015 indicate spectacled eider density within the Action Area was low, ranging from 0 to 0.055 spectacled eiders/km^2 (USFWS 2015), with a mean density of 0.021 spectacled eiders/km^2 across the Action Area as a whole. This estimate was then adjusted for imperfect detection by assuming ~75% of spectacled eiders are seen during aerial surveys (Wilson et al. 2017a), which resulted in an estimated 0.03 spectacled eiders/km^2. Last, assuming one potential nest for every two adults, we divided estimated density by two to convert the estimate to number of pairs or nests/km^2. Applying this process, we estimate an average density of 0.015 spectacled eider pairs or nests/km^2 across the terrestrial portion of the Action Area.

To evaluate impacts to spectacled eiders from an estimated 2.58 km^2 total development footprint for the Willow MDP, plus a 200-m zone of influence around new infrastructure, we estimated the total affected area (area of fill + zone of influence) of 35.39 km^2 (8,745.16 acres[5]). We then estimated the density of spectacled eiders within the affected area (which is a subset of the terrestrial Action Area as a whole), adjusted for imperfect detection as described above, and estimate density within the affected area to average 0.03 eiders/km^2, or 0.015 eider pairs or nests/km^2. By multiplying the average annual density of spectacled eider breeding pairs in the Action Area (0.015 eider pairs or nests/km^2) by the size of the total impacted area (35.39 km^2), we estimate a potential loss of 0.53 nests/year, totaling 16 nests over the 30-year life of the project.

Disturbance from aircraft landings and on-tundra activities

Summer aircraft landings and associated ground-based activities (e.g., surveys, stick picking and/or other debris removal) could disturb nesting and brood-rearing spectacled eiders in the Action Area. For example, landing close to a nest would likely flush a female and prevent her from returning for as long as the aircraft and associated human activity remain near the nest, exposing the nest or young to predators or inclement weather. Furthermore, aircraft landings and associated activities may also disturb or fragment hens with broods, although we assume these impacts would be minor and temporary because hens with broods are mobile and could move away from disturbance.

An absence of empirical data makes it difficult to estimate the effect of aircraft landings and tundra-based activities upon nesting and brood-rearing listed eiders. Our estimates are therefore based on a series of assumptions. Landing close to a nest would likely flush the incubating female and prevent her from returning for as long as the aircraft and associated human activity remain near the nest. We assume that all hens within a 600-m radius of a landing site will be flushed, and nests will subsequently be at increased risk of abandonment or depredation. Because the likelihood of a nesting hen flushing, and her reluctance to return to the nest, would presumably decrease as distance from human activity increases, we assume no effects to nesting hens outside of this 600-m radius. We also assume the 600-m radius centered on the landing site would encompass the area affected by associated on-tundra activities, and after landing, project personnel would conduct work over an unspecified area.

Using the assumptions described above, we estimate potential effects of aircraft and human disturbance on eider nest success would occur within a 600-m radius, or 1.13 km^2 area, at each landing site, and multiply this area of impact by the number of landings expected annually (maximum 96; BLM email 10 April, 2020)). We then use our assumption regarding distance over which take-offs/landings may affect eider nests, combined with estimates of eider density (0.03 spectacled eiders/km^2 or 0.015 nests/km^2), to estimate the number of nests potentially subject to disturbance over the 30-year project life. Finally, because not all nests subjected to disturbance

[5] Two of the seven planned MSIPs would be subsumed by the zone of influence of adjacent gravel infrastructure (Figure 3.1). However, five MSIPs near the Tiŋmiaqsiuġvik mine site would be outside the disturbance area. Therefore, the combined footprint of these MSIPs (0.38 km^2) are included in the collective direct impact area and zone of influence (36.88 km^2).

would be expected to fail, we multiply the estimated reduction in nest success by the number of nests potentially disturbed, to estimate the total number of nest failures that could result from aircraft activities Associated with the Willow MDP.

Biases in assumptions – Our assumptions in this analysis contain a number of biases, likely contributing to an inflated (i.e., conservative) estimate of loss of production due to disturbance associated with the proposed activities.

1. Our estimate of the number of nests within a 600-m radius (1.13 km^2) of aircraft landing sites, is based on the assumption each listed eider pair sighted during the ACP aerial surveys subsequently nests; however, an unknown proportion of these pairs may not nest. Thus, our initial estimate of nest density may be biased high.
2. The area impacted by helicopter sites may be smaller than the 1.13 km^2 zone of influence used in the effects analysis. We assume the 1.13 km^2 zone of influence includes potential nest disturbance from on-tundra activities beyond the discrete location of the landing site, although this area may be smaller if activities take place within a smaller footprint. Therefore, it is possible that helicopter landings/takeoffs would disturb nesting hens within a much smaller zone of influence around the landing site (although the radius of this zone is unclear and likely varies among sites). Thus, our calculations may overestimate the number of nests potentially disturbed.
3. We base our estimates of the magnitude to which disturbance may decrease nest success on studies in which researchers intentionally flushed eiders from nests, whereas in the proposed action, project personnel would not deliberately flush hens.
4. We are unable to separate activities into those that occur during the nesting, brood-rearing, and post-fledging periods based on the information available to us; therefore, we have assumed that all activities have similar impacts on nest success regardless of timing.

For these reasons, we have likely overestimated impacts of disturbance associated with the proposed activities on nest success. Nonetheless, these estimates are based on the best information available. Our calculations are presented in Appendix A.

Using the approach described above and detailed in Appendix A, we estimate loss of production from a total of 10 spectacled eider nests due to disturbance associated with on-tundra aircraft landings over the 30-year life of the project.

Increased predators

As discussed in the *Environmental Baseline* for spectacled eiders, abundance of predators and scavengers has increased near industrial infrastructure to the east of the Action Area. In particular, ravens have expanded their breeding range on the ACP by using manmade structures for nesting and perching. Therefore, as the number of structures and anthropogenic attractants associated with development increase, reproductive success of listed eiders may decrease.

Estimating the effects of predators on spectacled eider production in the Action Area is extremely difficult. We expect structures associated with the Willow MDP would increase the number of potential nesting and perching sites for ravens, and increased availability of anthropogenic food sources may also attract predators to the Action Area. However, measures requiring proper waste management and disposal, and methods of discouraging predators from sheltering or building nests at facilities (i.e., ROPs A-1, A-2, and A-8 in the *Description of the Proposed Action*) would reduce potential increases in predators responding to anthropogenic attractants, potential subsequent depredation of spectacled eider nests, and thereby diminish adverse effects to spectacled eiders from increased predator populations.

Spills

In the terrestrial Action Area, accidental spills of produced water, seawater, produced or refined oil, other petroleum products, or hazardous materials could occur during all phases of the Willow MDP originating from the WPF, WOC, airstrip, satellite pads, Tiŋmiaqsiuġvik mine site, terrestrial pipelines, vehicles, and heavy equipment operating in the Action Area. Exposure to oil, petroleum products, or other hazardous substances may impact spectacled eiders in several ways, depending on the volume, location, and timing of a spill, and severity of exposure. For example, waterfowl directly contacting even small amounts of oil may lose the hydrophobic, insulative properties of their feathers and suffer impaired thermoregulation. These birds may become wet, hypothermic, or potentially drown (Jenssen 1994). Birds sublethaly exposed to oil may also suffer reduced reproductive success. Mortality of embryos and nestlings follows exposure to even small amounts of hydrocarbons (light fuel oil, crude oil, or weathered oil) transferred to eggs or ducklings from adults with lightly oiled plumage (Parnell et al. 1984; Hoffman 1990; Szaro et al. 1980; Stubblefield et al. 1995). Furthermore, waterfowl ingesting oil in the course of normal foraging or preening behaviors may experience toxicological effects including gastrointestinal irritation, pneumonia, dehydration, red blood cell damage, impaired osmoregulation, immune system suppression, hormonal imbalance, inhibited reproduction, retarded growth, and abnormal parental behavior (Albers 2003; Briggs et al. 1997; Epply 1992; Fowler et al. 1995; Hartung and Hunt 1966; Peakall et al. 1982). Birds also bioaccumulate hydrocarbons and are vulnerable to both acute and sublethal effects from contaminated food supplies (Albers 2003).

Spills during construction – During the construction phase, BLM expects the likelihood of very small to small terrestrial spills of refine petroleum products (< 10 to < 99.9 gallons) would be low to medium (e.g., during fuel transfers; BLM 2020a). Small spills would be localized, likely of short duration, and be quickly contained and remediated (BLM 2020a). The likelihood of medium to medium-large spills (100 to 9,999.9 gallons e.g., tanker truck accident) would be very low. A spill of this size would also be expected to be mostly localized, of short duration, and be quickly contained. The likelihood of large spills (10,000 to 100,000 gallons; e.g., complete loss from a bulk tanker) would be very low. The spatial extent of a large spill would vary with the season and circumstances, but could affect up to 0.5 acres of adjacent habitat (BLM 2020a). Very large spills (> 100,000 gallons) are not expected to occur during construction (BLM 2020a), and therefore, are impacts from very large spills on spectacled eiders are not reasonably certain to occur.

Consequences of spills during construction would be avoided and minimized by compliance with BLM's ROPs A-4, A-5, and project-specific Oil Discharge Prevention and Contingency (ODPCP), Spill Prevention Control and Countermeasures (SPCCP), and Facility Response Plans FRP).

Spills during drilling and operations – During the drilling and operations phases, BLM expects the likelihood of wellhead spills would be low to very low. Although unlikely, the size of a wellhead spill could range from very small to large but would likely be contained within the boundaries of gravel infrastructure (BLM 2020a).

Pipeline spills – Spills from facility piping (i.e., infield and on-pad pipelines) could be very small to very large in size, although the likelihood of spills in these categories ranges from very high to very low, respectively (BLM 2020a). Pipeline spills would be expected to be limited to the inside of piping facilities or be contained within the boundaries of gravel infrastructure (BLM 2020a).

Spills from other pipelines (e.g., production, seawater, and export pipelines) could range from very small to very large, and the duration could be very short or prolonged (e.g., days or weeks) depending on the type of spill or location. However, the likelihood of spills from pipelines is expected to be low to very low. Very small spills would be localized and quickly contained, although large spills could impact a few acres of adjacent tundra (BLM 2020a). The location and timing of a pipeline spill would also influence the spatial extent of the spill; a larger spill during snow free periods could reach freshwater systems and impact a larger area downstream. For example, a pipeline spill at a stream crossing could reach the channels of Uvlutuuq Creek or Kalikpik River, particularly during periods of flooding. However, if spilled material were to enter freshwater lakes or streams, the relatively low flow and convoluted nature of streams in the area would preclude most spilled material from reaching the Beaufort Sea coast. Furthermore, in the unlikely event of a large spill, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a petroleum product spill (BLM 2020a). Finally, because the likelihood of very large pipeline spills would be very low (BLM 2020a), impacts from spills of this nature on spectacled eiders are not reasonably certain to occur.

Aboveground storage tanks (ASTs) – Due to volume of ASTs, spills originating from these structures could range from very small to very large, although the likelihood of any spill from an AST would be low to very low (BLM 2020a). Furthermore, due to required secondary containment, in the unlikely event of a complete AST failure, spilled material would be expected to be contained by the secondary containment, or at the worst, within the boundaries of gravel infrastructure, and would not impact adjacent tundra (BLM 2020a).

Very large oil spills (VLOS) – The likelihood of a VLOS (e.g., from a shallow-gas or well blowout) would be very low (i.e., approaching zero; BLM 2020a), although an unlikely event, such a spill would have a longer duration compared to other spills and could impact up to 25 acres of surrounding tundra habitat (BLM 2020a). If released oil were to enter adjacent freshwater streams or channels during snow-free periods, the impacts could occur over a broader spatial scale. However, oil from a very large spill such as a blowout would be unlikely to reach Beaufort Sea coast due to the inland location of Willow satellite pads and production infrastructure. For example, BT4, the closest satellite pad to the coast, would be approximately 17.5 river miles from the coast (via the Kalikpik River) and the other satellite pads are at least 50 river miles from the coast (via the Iqalliqpik Creek basin; BLM 2020a). Because freshwater systems in the Action Area are highly convoluted, spilled oil would likely spread slowly, become stranded along streambanks and be recovered. Similar to pipeline spills, in the unlikely event of a VLOS, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a VLOS (BLM 2020a). Finally, because the likelihood of a VLOS would be very low (approaching zero), impacts from this nature of spill on spectacled eiders are not reasonably certain to occur.

Similar to spills during construction, the consequences of spills during drilling and operations would be avoided and minimized by compliance with BLM's ROPs A-4, A-5, and appropriate project-specific spill prevention and response plans.

Hazardous materials spills – In addition to potential oil and other spills discussed above, spills of hazardous materials could occur during Willow MDP drilling and operations. Hazardous materials associated with the Willow Development would include, but not be limited to, biocides (within the seawater system to kill micro-organisms which cause corrosion), corrosion inhibitors, methanol, antifreeze, other glycols, acids, lube oils, used oil, and hydraulic fluids. These materials would be stored inside buildings, or in ASTs within secondary containment.

Hazardous material spills could range from small to medium, and based on historical North Slope industry data, the likelihood of a hazardous material spill occurring during the 30-year project life would be very high (BLM 2020a). However, potential hazardous materials spills would be expected to be very small (< 10 gallons) with localized impacts, and be identified and responded to quickly, in compliance with the project-specific Hazardous Substance Contingency Plan (HSCP; ROP A-3), ODPCP, SPCCP, and FRP. Required 110 % secondary containment would also be expected to contain a spill to the immediate area, and hazardous materials spills would not be expected to extend beyond gravel or ice infrastructure (BLM 2020a).

Spill effects summary

Due to the low density of spectacled eiders in the terrestrial portion of the Action Area, we expect the likelihood of spectacled eiders encountering oil from terrestrial spills in the Action Area would be low. Small spills would be more likely to occur than medium or large spills, and we expect the majority of small spills would occur on production pads, be confined to a small area, and be remediated quickly. Very large spills would not be reasonably certain to occur. Furthermore, compliance with ROPs A-3, A-4, A-5 (including requirements for immediate response and notification of Federal agencies), and CPAI's project-specific ODPCP, SPCCP, HSCP, and FRP, would avoid or reduce most impacts to spectacled eiders from potential spills. Although disturbance of spectacled eiders could occur during spill response efforts, this disturbance is expected to be minor and temporary as eiders would be expected to move away to a safe distance.

Given historical North Slope spill data (ADEC 2019), some spills would be likely during the Willow MDP despite continued improvements in engineering design and greater emphasis on prevention and response. However, because 1) spills are expected to be uncommon and most would be low volume, 2) spectacled eider density in the Action Area is low, 3) because most spills would be low volume, impacts would be localized, and spilled material would be contained and remediated quickly, 4) eiders would likely avoid disturbance associated with areas of active response, and 5) material handling, spill prevention, and response measures required by the BLM through ROPs and respective spill prevention response and contingency plans include numerous measures to minimize impacts to spectacled eiders in the event of a spill; we anticipate the consequences of spills would, at most, impact low numbers of spectacled eiders over the predicted 30-year life of the Willow MDP.

Collisions with structures
As discussed in the *Environmental Baseline*, migratory birds are at risk from collisions with human-built structures. Spectacled eiders migrating east during spring and west during summer/fall would be at risk of colliding with onshore Willow MDP structures. These structures include light poles, buildings, drill rigs, and booms.

Satellite telemetry studies from the eastern ACP indicated male spectacled eiders depart early in summer and generally remain close to shore, sometimes crossing overland, during westward migration (TERA 2002; see also Petersen et al. 1999). However, we anticipate spectacled eider collision risk with structures from mid-May through late July would be greatly reduced by the visibility of structures during 24 hours of daylight in the project area. When females and juveniles migrate during late summer/fall, decreasing daylight and frequent foggy weather conditions could increase collision risk. Longer nights increase the duration that eiders are vulnerable to collisions with unseen structures, and may compound susceptibility to attraction and disorientation from project lighting. However, we expect collision risk with structures would be reduced by the BLM's ROPs E-10 and E-21, which include lighting plans that would shield outward-radiating light and minimize potential disorienting and attracting effects to eiders, avoidance of overhead lines, and communication tower configurations that would reduce collision risk to the extent practicable (e.g., co-location of towers adjacent to structures and avoidance of guys wires).

There is little empirical information that can be used to assess the frequency and number of collisions of spectacled eiders with oil and gas facilities on the ACP to date. Industry employees occasionally report observations of bird fatalities at facilities, including collisions, but the reported observations have a number of associated biases that prevent their use in numerically estimating collisions. However, of > 500 bird fatalities reported at North Slope oil and gas facilities between 2000 and early 2020, only three pertain to spectacled eiders colliding with oil and gas facilities in the onshore environment. Although multiple biases likely cause observed and reported cases of mortality to underestimate the actual number of mortalities, the limited number of observed spectacled eider fatalities suggests that spectacled eider collisions with onshore oil and gas infrastructure occur rarely.

Overall, we anticipate the likelihood of collisions of spectacled eiders with Willow MDP structures would be low because 1) Willow MDP structures are located inland from the coast and spectacled eiders occur at low density in the Action Area, 2) good visibility of project structures in late spring and early summer due to extended daylight would likely reduce collision risk, 3) facility lighting would be designed to reduce the potential for attracting or disorienting eiders in flight (BLM ROP E-10), 4) lines for power or communication would be buried or suspended on VSMs, except in rare circumstances where specific conditions are met (BLM ROP E-21) and 5) guy wires on communication towers would be avoided to the extent practicable, and marked with bird flight diverters if they are unavoidable (BLM ROP E-21). Therefore, given the factors described above, we anticipate few (< 4) adult or fledged juvenile spectacled eiders could be killed or injured due to collisions with onshore Willow MDP structures over the 30-year life of the development.

Inadvertent harvest
Because the Project Description includes subsistence ramps meant to improve access to surrounding undeveloped areas, spectacled eiders would be at risk of potential increased harvest during subsistence activities. As discussed in the Environmental Baseline, annual harvest data indicate that at least some spectacled eiders continue to be inadvertently or deliberately taken during subsistence activities on the North Slope, despite local knowledge suggesting spectacled eiders are not specifically targeted for subsistence. Spectacled eiders often fly in mixed flocks with king and common eiders, and due to similarities in size and female/juvenile plumage, they may be subject to misidentification and inadvertent harvest.

However, undeveloped areas of the North Slope, including the Action Area, have long been used for subsistence purposes despite the absence of permanent infrastructure granting access, and we anticipate the Action Area will continue to be used for subsistence purposes regardless of improved access facilitated by Willow MDP infrastructure. Therefore, we consider inadvertent harvest related to Willow MDP infrastructure would likely be in lieu of, rather than additive to, harvest associated with traditional access points.

Instances of inadvertent harvest would likely be concentrated nearest Nuiqsut, and we expect the frequency of inadvertent harvest would decline with increasing distance from the community, and distance from permanent infrastructure as access becomes more difficult. Furthermore, although inadvertent harvest of spectacled eiders resulting from improved access granted by Willow MDP infrastructure would be conceivable, due to low density of spectacled eiders in the Action Area (0 to 0.055 spectacled eiders/km^2; USFWS 2015), harvest of this species would be rare. Therefore, we do not anticipate an appreciable increase in inadvertent harvest associated with enhanced access from Willow MDP infrastructure.

Effects in the offshore Action Area
Disturbance from vessels
During the Willow MDP construction phase, barges and support vessels could encounter and disturb spectacled eiders within the MTR. However, because 1) spectacled eiders occur at low density throughout the offshore Action Area, 2) few vessels would operate at any given time, including lightering at Oliktok Dock, and 3) because sealift operations are only expected over four years (BLM 2020a); we expect project vessels would encounter very few individuals. We also expect disturbance from sealift operations to be minor and temporary because 1) barges and tugs would move slowly (< 14 knots) through the MTR, and 2) spectacled eiders can respond to vessel disturbance by moving away to a safe distance. Because disturbance to non-breeding, migrating, or marine foraging spectacled eiders would be so minor that injury or death is not expected, effects of vessel disturbance on these individuals would be insignificant.

Spills
BLM (2020) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel), and be localized and of short duration. Given spill prevention and response measures in place, the likelihood of small

spills in the MTR would be very low to low and these spills would be limited to the vicinities of Dutch Harbor (e.g., during fuel transfers) and Oliktok Dock (e.g., during module delivery).

A medium to very large spill would conceivably be possible if a tug or barge were to run aground, sink, or have its compartments breached. The duration and spatial extent of this type of spill could range from one to several days depending on the location, sea state, and proximity to shore-based response. However, given that all vessels associated with the Willow MDP would follow established shipping routes, the likelihood of such an accident would be very low (BLM 2020a). Furthermore, given that the duration and frequency of vessel traffic in the MTR would be limited (i.e., sealift operations would take place during a 4 year subset of the construction phase), the likelihood of a spill of this nature would be very low, and therefore, such spills are not reasonably certain to occur.

Spectacled eiders in the MTR could conceivably be impacted by small spills during vessel re-fueling, module delivery, or small watercraft operations. However, the BLM has indicated spills during these operations would be uncommon, localized and of short duration (BLM 2020a). Therefore we anticipate impacts to spectacled eiders from small spills would be minor. Furthermore, because larger spills (>100 gallons) resulting from the limited vessel operations would be extremely unlikely, impacts from large spills on spectacled eiders in the MTR are not reasonably certain to occur.

Collisions with vessels

Spectacled eiders would also be at risk of colliding with vessels in the MTR. Using the best available information, we estimated collision risk for spectacled eiders from barge and support traffic. We used king and common eiders as surrogates for Steller's and spectacled eiders due to their greater abundance, using observations of vessel collisions collected by biological observers in a structured monitoring and reporting effort. To do that, we used observed collisions of king and common eiders with vessels in the Chukchi Sea. We first calculated a *per capita* risk of collision per vessel operating during a single season in the Chukchi Sea, based on collisions during Royal Dutch Shell's (Shell) 2012 Exploratory Program, and the estimated number of eiders migrating through the region. We then multiplied the estimated *per capita* collision rate (collisions per eider per vessel per season) by the estimated abundance of spectacled eiders, based on estimates from aerial surveys on the Arctic Coastal Plain. We then approximated the number of collisions expected for spectacled eiders from approximately 404 total vessel trips[6] through the MTR. Finally, because project vessels could theoretically operate over a longer period each season than the duration of Shell's 2012 open-water campaign, we adjusted the calculations to estimate collisions over an extended operations period. A typical open-water season in Arctic waters is approximately 150 days. We expect the proposed barging operations would be of shorter duration (likely much shorter) than the length of a typical open-water season, but the timing of barge operations would be difficult to estimate precisely due to several factors

[6] The applicant estimates a total of 33 barges and 53 ocean-going tugs would operate in the MTR within the range of spectacled eiders during 4 years of construction. Additionally, 318 support vessel trips (e.g., support vessels, screeding barges, etc.) would take place near Oliktok Dock. Therefore, spectacled eider collision risk is estimated to be:

33 barges + 53 ocean-going tugs + 318 Oliktok support vessels = collision exposure from 404 vessel trips

including seasonal variation in sea ice conditions and marine forecasts. Therefore, lacking greater certainty in project timing, we conservatively extrapolated our estimate to cover a full open-water season. We believe this significantly overestimates the number of days that vessels would be underway and present in waters where spectacled eiders occur, and therefore represents a substantial overestimation of collision risk to spectacled eiders. Our calculations are presented in Appendix A.

Using the approach described above and detailed in Appendix A, we roughly estimate 6 adult or fledged juvenile spectacled eiders would be injured or killed through collisions with vessels. While acknowledging the limitations of applying observations from vessels operating in one area to vessels that differ in size and structure operating in different areas, our estimates are based on the best information available and we believe are likely to substantially overestimate collision risk.

Summary
In summary, appreciable adverse effects to spectacled eiders from increased predator populations, spills, and inadvertent harvest are not anticipated. However, adverse effects to spectacled eiders could occur through habitat loss and disturbance, including on-tundra activities, and collisions with Willow structures and vessels resulting from the Proposed Action. Over the 30-year project, we estimate:

- Loss of production from 16 nests due to long-term habitat loss and associated disturbance;
- Loss of production from 10 nests due to on-tundra activities; and
- Loss of 10 adult or fledged juvenile spectacled eiders injured or killed from collisions attributed to the Proposed Action, including 4 due to collisions with structures and 6 due to collisions with vessels.

Because the most recent population estimate for North Slope-breeding spectacled eiders is 5,108 (SE = 725; E. Osnas, USFWS, pers. comm; Wilson et al. 2017a), we would not anticipate population-level effects from loss of production of 26 spectacled eider nests and 10 adult or fledged juvenile spectacled eiders over the 30-year life of the Willow MDP.

Effects to spectacled eider critical habitat
The Service designated critical habitat for spectacled eiders on March 8, 2001 (66 FR 9145). Terrestrial critical habitat occurs on the YK-Delta and marine critical habitat occurs in eastern Norton Sound, Ledyard Bay (both are molting areas), and south of Saint Lawrence Island (wintering habitat). We anticipate sealift operations associated with the Willow MDP would have no effect on terrestrial critical habitat for spectacled eiders.

Although barges and tugs associated with the Willow MDP would follow established MTRs that ordinarily avoid critical habitat (BLM 2020a), because the MTR passes adjacent to LBCHU, barges or tugs could conceivably enter this unit during inclement weather or other emergencies. However, we expect these instances would be rare. Primary constituent elements (PCEs) of eastern Norton Sound and LBCHU include marine waters greater than 5 m (16.4 ft) and less than or equal to 25 m (82.0 ft) in depth at mean lower low water (MLLW), along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community. PCEs of critical habitat south of St. Lawrence Island include marine waters less than or equal to 75 m (246.1 ft) in depth, along with the associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community (66 FR 9146).

We do not anticipate a few vessels rarely passing through the LBCHU would affect the physical or biological features for which critical habitat was designated. Last, given the size of LBCHU and the expected rarity of vessels passing through, we do not anticipate vessel traffic associated with the Willow MDP would appreciably affect spectacled eider access to, or use of, LBCHU such that the function and conservation value of the LBCHU for spectacled eiders would be reduced.

Accidental spills during sealift operations would likely be limited to small spills originating from fuel transfers in the vicinities of Dutch Harbor and Oliktok Dock. Wintering habitat south of St. Lawrence Island, the nearest critical habitat unit to Dutch Harbor, is 800 km away. Furthermore, sealift operations would not take place from October through April when the wintering area is used by spectacled eiders (BLM 2020a). Therefore, it is extremely unlikely that any oil from re-fueling spills would be carried into designated critical habitat, and we do not anticipate adverse impacts to spectacled eider critical habitat from small spills. Although conceivable, larger spills from vessels operating in the MTR would be very unlikely, and are not considered reasonably certain to occur.

Because 1) impacts to terrestrial critical habitat from the Proposed Action are not expected, 2) impacts to the physical and biological features of the LBCHU are not expected from rare incursions by vessels *en route* to Oliktok Dock, 3) disturbance to eiders within designated marine critical habitat is expected to be infrequent and limited to minor short-term disturbance, and 4) due to geographic and temporal separation, impacts from spills during refueling of vessels are not anticipated; collective impacts to spectacled eider critical habitat from the Proposed Action are expected to be insignificant. Therefore, we conclude the proposed Willow MDP is not likely to adversely affect designated spectacled eider critical habitat.

Effects to polar bears

In this section we evaluate potential effects of the proposed action to polar bears. First, we review how polar bears use the Action Area, dividing the discussion between denning and non-denning bears. We use this approach because these categories of use occur at different times of year and involve different members of the population; and because denning polar bears are more sensitive to disturbance, and are less capable of moving away from disturbance or other impacts and may experience greater impacts from being displaced. In our review, we highlight distribution and timing of use by bears, which is useful in considering potential exposure to impacts caused by industry activities. Second, we briefly review the anticipated activities of industry (referring the reader back to the Project Description, above, and the BA for more detail). Here, too, we highlight location and seasonal timing, again to help describe potential exposure or the intersection between the activities of polar bears and industry. We then review factors that would serve to increase or decrease potential impacts, including characteristics of the proposed action and/or other existing regulatory programs. Last, we discuss the potential mechanisms of impact to polar bears from the Willow MDP, which include disturbance, human-polar bear interactions, exposure to spilled oil or other contaminants, and subsistence harvest.

Polar Bear Use of the North Slope of Alaska

Maternal Denning

Polar bears breed on sea ice from March to June, peaking in early April through mid-May (Schliebe et al. 2006). Pregnant females later move from areas and habitats occupied in late summer and autumn, which are generally on pack ice but increasingly on shore as sea ice conditions in late summer deteriorate (Rode et al. 2015), to prospect for den sites in suitable denning habitat in late October or early November (Derocher et al. 2004). Females excavate a den in drifted snow in fall or early winter (Amstrup and Gardner 1994), enter the den in late November, give birth in late December, and emerge in late March or April (Ramsay and Stirling 1990). After emerging from dens, most females with cubs remain near dens (within 100 m; Smith et al. 2007) for several days (range 1–18 days [Streever and Bishop 2014]; mean 6–8 days [Smith et al. 2007]) before permanently abandoning the den site.

Polar bears from the SBS subpopulation den on drifting pack ice, shorefast ice, and land (Amstrup and Gardner 1994), both terrestrial dens, which can occur on barrier islands, along the coast, or inland, and ice-based dens can occur within the Action Area, although ice-based denning would take place when the MTR is not in use (Figure 6.2). Key characteristics of maternal denning habitat are surface anomalies or topographic features that collect drifting snow in autumn and early winter, as dens require snow accumulations at least 2.0 m deep (Liston et al. 2015). Terrestrial dens occur on barrier islands and on the lee side of coastal bluffs and banks lining rivers, streams or lakes (Amstrup and Gardner 1994; Durner et al. 2001, 2003, 2006a; Fischbach et al. 2007; summarized by USFWS 2010b and USFWS 2016a).

Historical records of polar bear den sites provide insight into the characteristics of suitable denning habitat, the distribution and extent of suitable habitat, the distribution of known den sites, and the number of dens estimated to occur in the Action Area. Durner et al. (2001, 2003, 2006a) identified characteristic habitat features of terrestrial maternal den sites and mapped suitable denning habitat across the North Slope. Although terrestrial habitat with features suitable for denning is broadly distributed on the ACP, it is also relatively scarce. For example, in NPR-A, habitat with features suitable for denning comprises roughly 0.1 percent of the total area (Durner et al. 2013).

Records of polar bear den sites include dens found by several means, including targeted den searches, dens found incidentally during other human activities, and dens found by tracking female polar bears wearing collars with radio transmitters. Because targeted den searches and incidental observations overemphasize den sites near villages or industrial sites (where dens are more likely to be encountered by humans) while underemphasizing dens in more remote areas, dens found by tracking females wearing radio collars, particularly those tracked by satellites, reduce or avoid biases associated with dens found opportunistically. Based on den locations females with radio collars, Figure 7.1 illustrates the variation in density of terrestrial den sites across the North Slope.

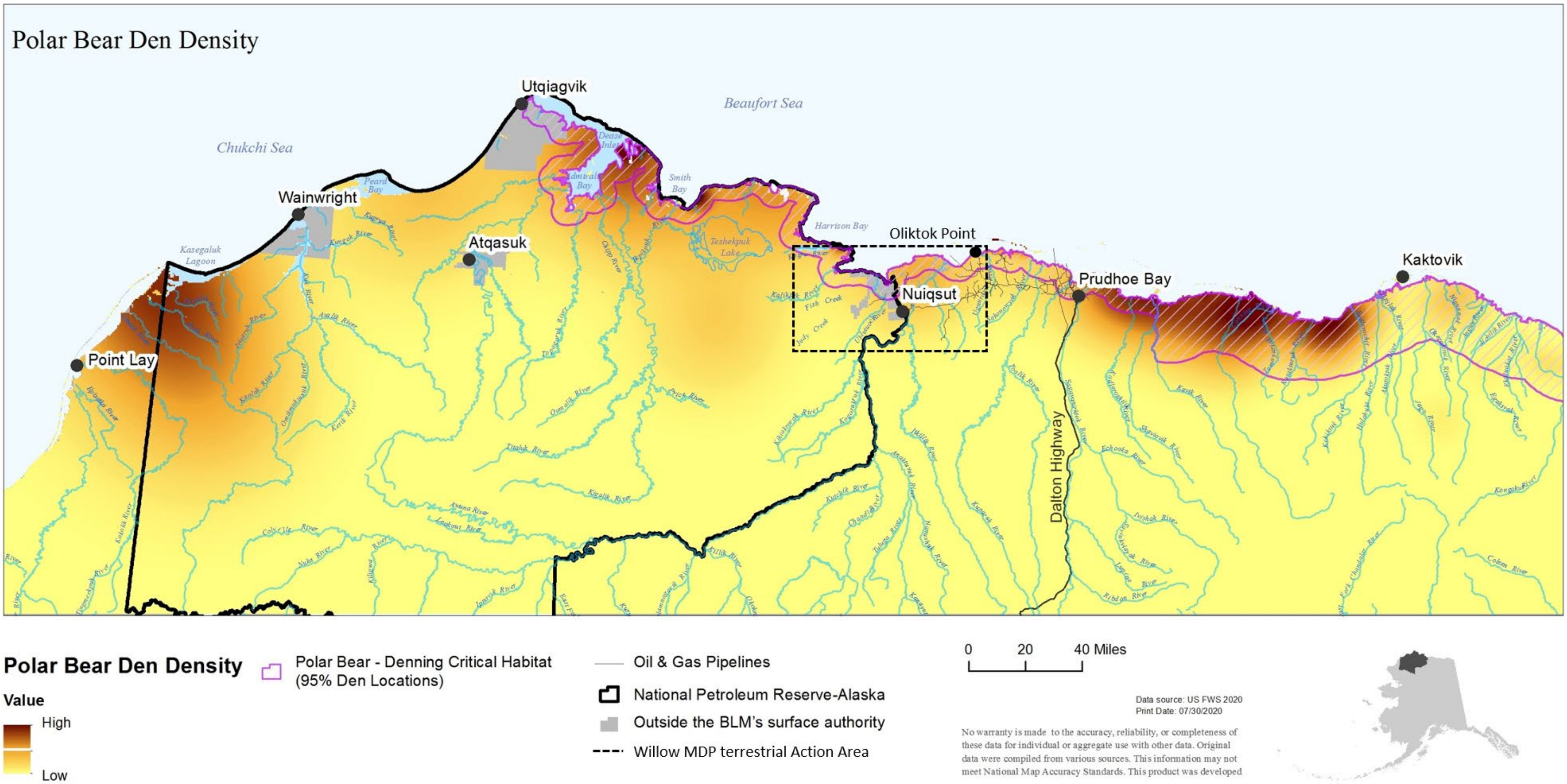

Figure 7.1. Relative density of polar bear maternal dens on the North Slope of Alaska (map derived from den density analysis from USFWS, Marine Mammals Management, with land management boundaries added by BLM).

Olson et al. (2017), using radio collar data from 2007–2013, found that 55% (16 of 29) of females from the SBS subpopulation denned on land. More recent observations indicate the distribution of maternal dens in the Beaufort Sea region is shifting, from west to east on sea ice, and landward, from sea ice to onshore, in response to decreasing quality and stability of sea ice as arctic regions warm (Fischbach et al. 2007). As these trends continue, it may become increasingly difficult for females to access terrestrial denning habitat in autumn and early winter as the distance between pack ice and coastal areas increases (Derocher et al. 2004; USFWS 2016a; Olson et al. 2017). Continuing changes in sea ice will likely affect the future distribution of dens as the widening distance between the edge of pack ice and land reduces access to terrestrial denning habitat (Derocher et al. 2004; Rode et al. 2015; USFWS 2016a).

Non-denning polar bears
Polar bears of the SBS subpopulation historically spent the majority of the year on sea ice (Amstrup 2000; Atwood et al. 2016a). Amstrup (2000) noted that for the Chukchi and Beaufort Sea areas of Alaska and northwest Canada, <10% of radio relocations were on land, the majority of which were females occupying maternal dens during winter. However, polar bears also use terrestrial habitat on the ACP during late summer and fall, particularly where and when sea ice conditions are poor. Schliebe et al. (2008) reporting on weekly aerial surveys of the coast between Utqiaġvik and the Canada border in September–October of 2000–2005, noted up to 8.6 bears per 100 km, or 122 polar bears total. Relative to estimates of the number in the SBS subpopulation at that time, Schliebe et al. (2008) estimated that an average of 3.7% (up to a maximum of 8%) of polar bears in the SBS subpopulation occurred along the coast of Alaska during this interval. The number observed increased when ice was farther from the coast, suggesting that continued deterioration of sea ice conditions will cause increased use of terrestrial habitat in late summer and fall. Density was over six times higher in areas where subsistence-hunted whale carcasses were available, with the highest number (69% of total bears onshore) near Kaktovik, Cross Island, and near Utqiaġvik (Schliebe et al. 2008). Wilson et al. (2017) analyzed results from the same surveys but included later years and a longer interval (2000–2014), and reported the mean number of bears onshore was 140 (95% CI: 127–157). Bears were more likely to occur in coastal areas with early ice retreat, whale carcasses, and barrier islands. Comparing counts to estimates of population size, Wilson et al. (2017) estimated 15% of the SBS subpopulation occurred along the Alaska coastline during any given week from late August to late October. There was no trend in the number of bears using the coast, but the highest number occurred in 2012, corresponding to the year with lowest sea ice extent.

Atwood et al. (2016a) also examined use of the Beaufort Sea coast by polar bears in late summer and fall in the same interval (2000–2014), using information from radio-collared female polar bears. They found a marked decline in sea ice during September in the southern Beaufort Sea and the average duration of the open-water season increased by 36 days. Although most individuals remained on sea ice during summer, the proportion of the population coming ashore tripled, from 5.8% to 20% in 15 years (with a high of 37% in 2013). Bears that came ashore did so earlier (5 days earlier per decade, on average), departed later (7 days later per decade, on average) and stayed longer (7 days longer per decade, on average), and these changes related to declines in sea ice extent and changes in sea ice phenology. Including radio-tracking information from the late 1990s, when use of terrestrial habitat during open-water season was rare and limited to short intervals, the average time bears stayed on land increased by 31 days (Atwood et al. 2016a). Importantly, Atwood et al. (2016a), using radio telemetry data, found an increase in the proportion of the SBS subpopulation coming ashore, although Wilson et al. (2017), using counts in the same area in the same time interval, did not detect an increase in the absolute number along the shore. Multiple possible explanations exist, but Wilson et al. (2017) concluded that no detectable trend in the number counted comports with an increasingly larger proportion of a subpopulation (as found by Atwood et al. [2016a]) that was declining in abundance (from approximately 1,500 in 2004, to 900 in 2010, as found by Bromaghin et al. [2015]).

Polar bears of the SBS subpopulation are also increasingly being found on-shore in winter, possibly in response to greater numbers of bowhead whale carcasses on-shore after autumn subsistence hunts. Herreman and Peacock (2013) used genetic mark-recapture methods near Utqiaġvik to document use, turnover, and the number, age, and sex of polar bears visiting carcasses, and estimated that 228 individual bears fed at the bone pile in the winter of 2010–2011 (November to February), possibly representing up to 15% or more of the SBS subpopulation. Extending their observations made near Utqiaġvik to bone piles elsewhere on the North Slope (i.e., Cross and Barter islands), Herreman and Peacock (2013) observed that increasing food subsidies from subsistence harvest remains may benefit polar bears but could also increase the risk of polar bears being killed in defense of life by hunters, residents, tourists, or industry workers.

Industry Activities
When evaluating potential effects of the Willow MDP on polar bears, we considered measures BLM and CPAI would implement to reduce impacts to polar bears. The Proposed Action is discussed in detail in the Project Description, above, but in summary, the project components relevant to impacts to polar bears include construction of a gravel road from the existing GMT-2 development, WPF, WOC, five gravel drill pads, gravel infield and access roads, an airstrip, pipelines, the Tiŋmiaqsiuġvik gravel mine site, CFWR, seasonal ice roads, MSIPs, modifications to Oliktok Dock and annual barge lightering, and vessel operations during construction. In total, the Proposed Action would impact approximately 619.2 acres (2.51 km^2) through gravel extraction and fill and construct roughly 4,657.1 acres (18.85 km^2) of ice infrastructure (including roads, pads, and MSIPs)[7] within the onshore Action Area (Figures 3.1 and 3.3).

Factors Serving to Reduce Effects
Protections Inherent in the Project Description
The potential for impacts to polar bears and polar bear critical habitat is limited by the fact that the majority of the Action Area is farther inland than polar bears generally occur, including both transient (non-denning) individuals and females that are prospecting for natal den sites and/or establishing dens. The exceptions are the barge lightering and module deliveries at Oliktok Dock, but these Willow MDP-specific activities would be a small subset of existing operations at the Oliktok facility, thereby reducing the potential for appreciable additional impacts to polar bears. Similarly, the majority of the Action Area lies outside the boundaries of designated polar bear critical habitat, again with the exception of the facilities at Oliktok Dock and associated vehicle and vessel traffic, and portions of barrier islands adjacent to the MTR. However, the

[7] Total proposed gravel footprint would include 453.2 acres of fill + extraction of 166.0 acres (including 149.7 acres for mine site excavation and 16.3 acres for the CFWR). The total proposed ice infrastructure footprint would include 3,590.7 acres for ice roads + 951.6 acres for single-season ice pads + 114.8 acres for MSIPs (BLM 2020a; 2020b).

dock and road existed at the time critical habitat was designated and therefore this infrastructure was exempted from designation. Thus, continued use and minor modifications to these pre-existing, exempted facilities does not require evaluation from the standpoint of potential impacts to critical habitat.

MMPA

BLM would not approve project activities absent documentation of compliance under the MMPA. Such documentation shall consist of a LOA, IHA and/or written communication from the USFWS and/or NMFS confirming that a take authorization is not warranted (PDC 4). There are two regulatory programs implemented under authority of the MMPA that substantially limit potential impacts of the proposed action to polar bears. These programs, one giving the Service the authority to allow incidental (non-intentional) take of polar bears, and one that provides a mechanism for managing human-polar bear interactions to promote conservation of bears while protecting human safety, are summarized below.

Incidental Take Program -- Section 101(a)(5) of the MMPA gives the Service authority to allow the incidental, but not intentional, taking of marine mammals. Under this authority, "upon request by citizens of the United States who engage in a specific activity (other than commercial fishing) within a specified geographical region, the Secretary shall allow, during periods of not more than five consecutive years each, the incidental but not intentional, taking by citizens while engaging in that activity within that region, small numbers of marine mammals of a species or population stock" if it is found that "the total of such taking during each five-year (or less) period concerned will have a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses." If those conditions are met, the Service, acting on behalf of the Secretary, issues an incidental take regulation (ITR) setting forth: (a) permissible methods of taking; (b) means of effecting the least practicable adverse impact upon the species or stock and its habitat, and the availability of the species for subsistence harvest; and (c) requirements for monitoring and reporting (more detail is available at U.S.C. 1371(a)(5)(A) and 50 C.F.R. 18.27).

The terms "negligible impact," "small numbers," and "unmitigable adverse impact" are defined at 50 CFR 18.27. "Negligible impact" is defined as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival. "Small numbers" is defined as a portion of a marine mammal species or stock whose taking would have a negligible impact on that species or stock. However, we do not rely on that definition, as it conflates the terms "small numbers" and "negligible impact," which we recognize as two separate and distinct requirements. Instead, in our small numbers determinations, we evaluate whether the number of marine mammals likely to be taken is small relative to the size of the overall stock.

"Unmitigable adverse impact" is defined as an impact resulting from the specified activity that:

1. Is likely to reduce the availability of the species or stock to a level insufficient for a harvest to meet subsistence needs by:
    a. Causing the marine mammals to abandon or avoid hunting areas,
    b. Directly displacing subsistence users, or

c. Placing physical barriers between marine mammals and the subsistence hunters; and

2. Cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

The term "least practicable adverse impact" is not defined in the MMPA or its enacting regulations. We ensure the least practicable adverse impact by requiring mitigation measures that are effective in reducing the effects of the proposed activities, but are not so restrictive as to make conducting the activities unduly burdensome or impossible to undertake and complete.

Since 1993, the oil and gas industry operating in the Beaufort Sea and adjacent northern coast of Alaska has requested, and been issued, ITRs for incidental take of polar bears in specific areas during specified activities. Under these ITRs, companies, groups, or individuals proposing to conduct specified activities, may request a "letter of authorization" (LOA) granting authorized non-lethal, incidental Level B take of polar bears. Requests must include an operations plan for the activity, a polar bear interaction plan, and site-specific monitoring and mitigation plan that specifies the procedures to monitor and mitigate the effects of the activities on polar bears. Each LOA is conditioned on specific circumstances for the activity and location to ensure the activity and level of take are consistent with the ITRs.

The most recent set of ITRs for the Beaufort Sea region were issued in August, 2016 (81 FR 52276-52320) and apply for a period of 5 years. A new set of ITRs, which could apply for up to 5 years, could be issued only if doing so would again meet the "small number" and "negligible impact" standards at the stock (SBS subpopulation) scale. Additionally, promulgation of an ITR that would allow incidental take under the MMPA is a Federal action and therefore is subject to section 7 of the ESA, which entails assessment of the current status of the species and critical habitat, environmental baseline, cumulative effects, and effects of the action. Thus, every 5 years or less, when a new ITR is promulgated to evaluate and authorize incidental take of polar bears, activities that would be likely to cause incidental take are reviewed relative to the standards of the MMPA.

The substantive standards applied during the MMPA incidental take authorization process are in certain respects more stringent (more protective for polar bears) than those applied during ESA consultation. To comply with the "negligible impact" standard under the MMPA, the proposed action "cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock…" To avoid "jeopardy" under the ESA, the proposed action cannot result in "an appreciable reduction in the likelihood of both the survival and recovery of the listed species." Thus, the MMPA is more protective than the ESA in terms of the threshold for allowable impacts (adverse effect under the MMPA versus appreciable reduction in the likelihood of survival and recovery under the ESA) and the scale at which unallowable population-level impacts would occur (stock level for the MMPA versus the listed species level for the ESA). Hence, impacts that can be allowed under the incidental take provisions of the MMPA are not likely to jeopardize the continued existence of a marine mammal species per 7(a)(2) of the ESA.

Deterrence -- In addition to the regulatory program allowing for incidental take of polar bears described above, the MMPA also provides a mechanism for managing human-polar bear interactions in order to promote conservation of bears while protecting human safety. This

Deterrence Program, authorized under section 101(a)(4)(A) of the MMPA, provides Letters of Authorization (LOAs) that allow the use of deterrence actions to prevent polar bears from damaging private property or endangering personal safety. Under this authority, Federal, State and local government employees may deter polar bears for the welfare of the animal when acting in the course of their official duties, and private persons (such as employees of the oil and gas industry) may enter into cooperative agreements with the Service to carry out deterrence measures when acting in their capacity as designated persons under such an agreement and in full compliance with its terms and conditions. This program strives to: 1) prevent bears from associating food with humans and communities, 2) "condition" bears to avoid humans, human activities and communities, 3) promote movement of bears by actively redirecting them into corridors, such as coastal travel routes, 4) minimize extended use of areas near communities, and 5) minimize bear entry into communities.

Importantly, the program mandates that "active deterrence actions must not result in the death or serious injury of any marine mammal," and requires an application that includes: (a) a detailed plan of operations, (b) a site-specific plan to monitor effects of the activity on polar bears present during activities, and (c) a site-specific polar bear interaction plan that outlines steps the applicant will take to limit animal-human interactions, increase site safety, and minimize impacts to polar bears. The program does not allow for the deterrence of polar bears for convenience or to aid project activities, and prior to conducting deterrence activities operators must make reasonable efforts to reduce or eliminate attractants (e.g., garbage, human waste, and food); move personnel to safety; ensure the bear has escape route(s); and begin with the lowest level of force or intensity that is effective and increase the force or intensity only as necessary to achieve the desired result. The program also contains specific training, monitoring, and reporting requirements to minimize risk and impacts to polar bears. This program has been in place for decades, and although deterrence actions result in negative impacts to individual bears on rare occasions, the use of deterrence actions effectively reduces the need for lethal take of polar bears, and thus as a whole contributes to the conservation of polar bears.

For example, from January 1, 2001, through December 31, 2016, the oil and gas industry on the North Slope reported sightings of 4,371 polar bears, of which 848 (19%) were deterred. Of those deterred, the vast majority were subjected to noise or visual stimuli (e.g., vehicle horns, engine noise, yelling, spotlights, sirens, or discharge of cracker shells) intended to direct bears away from facilities or human activities. On rare occasions, when less-intrusive methods failed, "direct contact" rounds such as bean bags or rubber bullets were used. During 640 deterrence events by industry on the North Slope from 2001–2016, 42 polar bears were deterred with bean bags and 6 with rubber bullets. Injuries or lethal impacts are exceptionally rare. In 2011, a polar bear died because personnel mistakenly used a crackershell rather than a beanbag round to deter a bear at close range.

In sum, the Service manages two distinct but related programs under authority of the MMPA for polar bears in Alaska where human activities, including oil and gas development, take place. Combined, these programs entail a comprehensive review of the various mechanisms through which oil and gas activities directly or indirectly affect polar bears, which are evaluated when 1) reaching small numbers and negligible impact determinations, 2) crafting project-specific measures to avoid or minimize impacts in LOAs, and 3) providing monitoring and reporting requirements.

The Service has a long track record of implementing these programs in the Beaufort Sea region. During the 16-year interval between January 1, 2001, and December 31, 2016, 519 LOAs were issued for oil and gas work on the North Slope, and polar bears were observed during activities associated with 173 (33%) of the LOAs. Industry reported 2,731 observations of 4,371 polar bears, although some reports include multiple observations of the same bears, so this total overestimates the number of individual bears encountered. Analysis of reports indicated that of bears encountered, 1,064 (24%) experienced Level B take including 236 Level B takes by incidental disturbance, 818 Level B takes by deterrence, and 8 Level B takes for which the cause was not reported. There were two Level A takes and 66 polar bears encountered for which the outcome was unknown. Based on this evaluation, combined with a detailed description of activities proposed for August 5, 2016, through August 5, 2021, we concluded that impacts of incidental take would affect only small numbers of polar bears, would result in a negligible impact to the SBS subpopulation, and would not have an unmitigable adverse effect upon the availability of polar bears for subsistence users.

The Service would need to make these same findings with respect to polar bears in the Action Area prior to issuing a new set of ITRs and associated Letters of Authorization for incidental take of polar bears associated with any specific oil and gas activity under the ITRs. The Service's reviews of applications for Letters of Authorization would account for site-specific characteristics of the Action Area and any updated information concerning changing environmental conditions and changes to the status of the polar bear, and would identify the means of effecting the least practicable adverse impact upon the SBS stock of polar bear, and its habitat.

Summary of Factors Serving to Reduce Effects

In summary, the Proposed Action would primarily occur in areas of low polar bear abundance and denning activity, and includes mitigation measures that would directly or indirectly reduce impacts to polar bears. Importantly, BLM's commitment to ensure compliance with the MMPA by requiring MMPA incidental take authorizations, and/or written communication that a take authorization is not warranted, prior to engaging in project activities, ensures that these standards would apply, thereby limiting potential impacts of the project to those in compliance with the protective limitations of the MMPA, which is a more restrictive standard than the ESA. Additionally, obtaining MMPA authorization requires that take caused incidentally or through intentional deterrence actions, would impact no more than small numbers of the SBS stock, and that such taking would have no more than a negligible impact upon the SBS stock.

Action-specific effects on polar bears

Disturbance

Activities associated with the Willow MDP could potentially disturb polar bears, impacting denning and non-denning individuals. Disturbance could result from noise associated with human activities including use of vehicles, aircraft, vessels or machinery, or by creating obstructions to movements. Disturbance could originate from stationary or mobile sources. Stationary sources could include construction, maintenance, repair, operations at staging pads, production and processing facilities, gas flaring, and drilling operations. Mobile sources could include vessel and aircraft traffic, ice and gravel road construction, mine site development and operations, vehicle traffic, the movement of modules and other equipment to and from staging facilities, drilling, and dredging and screeding.

Willow MDP activities could affect denning polar bears by obstructing or altering movements of pregnant females as they prospect for den sites; by disturbing females at den sites before cubs are born, which could force the female to search for an alternate site; or, by causing premature den or den site abandonment after cubs are born, which could cause the immediate death of cubs or reduced probability of survival over time, which would be difficult to detect or measure. Records from the North Slope (and elsewhere) suggest variable response to disturbance near dens, with some bears successfully denning near infrastructure or mobile sources of disturbance (such as ice road construction and use), while others have abandoned dens outright or prematurely (81 FR 52292; BLM 2019). Some polar bears have apparently become habituated to nearby activities (Smith et al. 2007) but the extent to which habituation to disturbance could reduce impacts is unknown (Amstrup 1993). BLM's ROP C-1 requires polar bear den surveys before winter oil and gas activities commence, and impose a one-mile (1.6-km) operational exclusion zone around detected dens, restricting the timing and types of such activities, thereby minimizing or avoiding disturbance to denning bears identified by the surveys. These measures would be applied to activities in the Willow MDP Action Area.

The majority of the Willow MDP Action Area is farther inland than where most polar bear dens occur, with the exception of the coastal area near Oliktok Dock (Figure 6.2). Durner et al. (2009b) reported that in northern Alaska, west of the Kavik River, 95% of all historical confirmed and probable dens occurred within 4.5 km (2.8 mi) of the Beaufort Sea coast. The majority of the proposed Willow MDP infrastructure would be greater than 10 km from the coast. For example, BT4, the closest permanent Willow infrastructure to the coast is roughly 15 km inland. The Tiŋmiaqsiuġvik mine site would also be roughly 15 km from the coast, and the mine and associated access ice road would only be utilized over six years during the construction phase (BLM 2020a).

However, small numbers of dens have been documented within or just beyond the discrete boundary of the Action Area within the last 100 years; almost all were concentrated in coastal areas, near Oliktok Dock, and nearby barrier islands (Figure 6.2). This history suggests that it is possible that one or more polar bears could attempt to den within the Action Area over the 30-year life of the project.

BLM ROPs C-1 and 3 require den detection surveys prior to initiating winter operations and the establishment of a 1-mile operational exclusion zone around any detected dens. These ROPs reduce the probability of impacts, but the surveys do not detect 100% of the dens present. Therefore, we evaluated the probability that a den (or family group newly emerged from a den) that was not detected may be exposed to disturbance from the proposed activities. Using a model which uses den simulations based on habitat and the location of project activities we derived an estimate of the number of dens that may be disturbed and hence the number of cubs that could be injured as a result of this disturbance. A complete description of the methods and results of this modelling can be found in Appendix B.

The model estimated a mean take of 2.2 cubs and a median take of 0 cubs (95% CI: 0.0 – 30.0) (lethal or serious injury) over the 30 year period of activity. During the first 9 years of activity, the model estimated a mean level of take of ~0.15 cubs each year and a median of 0, with the maximum annual mean during that period being 0.17 and the median always being 0 (95% CI: 0.0 – 2.0). After the first 9 years of activity, the model estimated an annual mean level of take of 0.075 and a median of 0 (95% CI: 0.0 – 2.0) cubs per year.

However, the model was also used to assess the probability that take would occur. For the 30-year life of the project we estimate that:

- The probability of 0 takes occurring is 0.841 (i.e., there is an 84% probability that 0 takes occur);
- The probability of greater or equal to 1 take occurring is 0.159 (i.e., there is a 15.9% probability that one or more take would occur); and
- The probability of greater or equal to 2 takes occurring is 0.158 (i.e., there is a 15.8% probability that two or more takes would occur).

Therefore, while it is possible that an undetected den or family group could be impacted which would result in injury or mortality to one or more polar bears, given the high probability of zero bears suffering injury or mortality over the life of the project, such a scenario is not reasonably certain to occur.

Information on the distribution of transient (non-denning) polar bears indicates they also generally remain north of the Willow Development area. Similar to denning bears, the probability of transient bear occurrence is highest in the coastal portion of the Action Area, especially at Oliktok Dock. Non-denning polar bears spend the majority of the year on sea ice, although when sea ice retreats in late summer and fall, polar bears occur along the coast and on barrier islands, often congregating where whale carcasses or other food is available (Miller et al. 2006; Schliebe et al. 2008). These bears may be disturbed or temporarily displaced by barges and support vessels during module deliveries to Oliktok Dock, or by equipment transporting modules and materials along the road from Oliktok to the DS2P staging pad. Polar bears regularly cross open water when moving from pack ice to shore, and up to 50% of polar bears encountered during barging activities between Cape Simpson and West Dock from 2005–2007 reacted to barges by moving off ice floes or swimming away (Green and Negri 2005, 2006; Green et al. 2007). Nonetheless, industry records indicate interactions between polar bears and industry activities in open water have been relatively rare (USFWS - Marine Mammals Management Office, *pers. comm.*). Should encounters occur, polar bears would likely move away from the source of disturbance, resulting in minor, temporary changes in behavior.

Aircraft traffic could disturb polar bears in winter during denning or along the coast in late summer/fall. Aircraft activities near denning habitat or occupied dens could cause premature den abandonment or early den departure. Non-denning polar bears observed response to aerial surveys, include short-term changes in behavior, ranging from no response to departing the area in haste. The severity of the response is dependent on distance, flight altitude, type of aircraft (fixed-wing or helicopter), and other factors. There are indications of some degree of tolerance or that some bears may habituate, at least in situations where aircraft follow predictable flight and landing patterns. For example, east of the Action Area, the density of coastal polar bears in late summer is greater near Kaktovik than elsewhere between Utqiaġvik and the Canada border, despite considerable air traffic in and out of the Barter Island Airport, which is located about 4 km from a bone pile where polar bears regularly exploit whale carcasses. It may be that the benefit of accessing the whale remains provides enough incentive to tolerate impacts from aircraft in that situation.

The Willow MDP includes a landing strip at the WOC for year-round use by fixed-wing aircraft and helicopters. Approximately 12,101 total fixed-wing flights and 2,421 total helicopter flights, would take place to and from the WOC and existing Alpine airstrip during all phases of the Willow MDP. However, the proposed WOC landing strip would be approximately 36 km (23 miles) inland, and therefore very few polar bears would be expected to enter the vicinity of the airstrip and subsequently be disturbed by aircraft traffic. The nearest suitable denning habitat (topography capable of forming drifted snow), occurs along Judy Creek, roughly 2.6 km (1.6 m) from the airstrip, and outside the zone where denning polar bears would be expected to experience disturbance from WOC aircraft traffic. Additionally, the airstrip would be oriented parallel, rather than perpendicular, to the general course of Judy Creek, such that approaching and departing aircraft would be unlikely to fly within 1,500 ft of denning habitat. Furthermore, given the very low density of polar bear dens so far inland, we expect polar bears denning near the WOC and landing strip would be extremely unlikely.

Some helicopter operations would take place during summer on undeveloped lands within the Action Area (e.g., stick picking of past season ice road routes). Although small numbers of transient polar bears could be disturbed by summer helicopter operations, appreciable effects would be unlikely because 1) polar bears occur at low density in the Action Area, 2) transient bears can move away from disturbance if necessary, 3) most activities requiring summer helicopter operations would take place along winter routes well inland from the coast, and 4) adherence to minimization measures, such as maintaining a flight altitude of 1,500 feet (ROP F-3) would minimize impacts of disturbance to transient bears.

Industry facilities could also obstruct movements of bears, including pregnant females moving from sea ice into terrestrial areas to prospect for den sites in autumn and early winter, or those of non-denning bears near or along the coast or barrier islands in late summer and autumn. However, polar bears regularly traverse oil and gas facilities along the Beaufort Sea coast to the east of the Action Area (e.g., between Oliktok Point and Prudhoe Bay), crossing roads and causeways in some situations and moving around them in others. As a result, infrastructure appears to present only small-scale, local obstructions that polar bears move through or circumvent, depending on location and other circumstances. Females and cubs returning to sea ice from terrestrial den sites may be more sensitive to disturbance than non-denning bears, due to the nutritional state of the female after months of fasting and the small size and other physiological limitations of cubs after abandoning the natal den. However, impacts to these individuals are considered in the overall assessment (see above) of disturbance impacts on denning bears.

Despite the mechanisms through which the proposed action could cause disturbance of polar bears discussed above, several factors described in the Project Description would serve to limit impacts. Most important is BLM's commitment to require compliance with the MMPA over the life of the project, although this is complemented with several additional minimization measures built into the Project Description.

The Beaufort Sea ITRs have a multi-decadal track record of analyzing potential impacts from oil and gas activities to polar bears and prescribing measures to achieve the least practicable adverse impact. While some impact to polar bears has occurred from such activities, in order to issue new five-year sets of regulations, the Service has had to determine that the predicted level of impact would affect no more than small numbers of polar bears from the SBS stock and have no more than a negligible impact. Given that this determination must be made prior to issuance of each new set of ITRs, it demonstrates that the level of impact is well below a jeopardy level for the overall polar bear species. It is reasonable to assume that any ITRs/LOAs and/or IHAs developed to authorize incidental take from activities authorized under the Proposed Action would achieve similar results. The recurring, project-specific reviews required under the MMPA will enable the Service to account for any unique characteristics of actions associated with the Proposed Project and to respond to future changes in the status of the polar bear. Further, LOAs or IHAs authorizing incidental take from specific actions associated with the Proposed Project would include additional, project-specific requirements and minimization measures as necessary to make determinations under the MMPA. For example, projects proposed in suitable habitat during the denning season (such as ice road construction) could require den searches or timing restrictions to protect dens and aircraft overflights during the non-denning season could include restrictions to avoid areas where bears concentrate. In the unlikely event that a proposed activity could not be designed or minimized in a manner that meets the MMPA's substantive standards, then that project would require modification or additional mitigation, or the incidental take could not be authorized. Therefore, because any action or activity associated with the Proposed Project will require compliance with the MMPA, the effects of disturbance will have to be limited to individual-level impacts to a small number of polar bears that would cause no more than a negligible impact to the SBS stock.

Human-Polar Bear Interactions

Based on the BA, and drawing from experience implementing the most recent ITRs for polar bears for the Beaufort Sea region (81 FR 52276 – 52320), we consider how the proposed action may result in potentially harmful interactions between humans and polar bears, including collisions with vehicles on winter routes or gravel roads, collapse of undetected dens caused by winter equipment movements, attraction of bears to facilities or human activities, and deterrence actions, which could result in injury or death of polar bears in defense of human life. In the following discussion, we will address attraction of polar bears to facilities or human activities, and the potential effects of deterrence actions, in the event they are used.

Traffic on ice roads (and presumably gravel roads) could pose a collision risk to polar bears. However, polar bears generally occur at low density on the landscape, with the notable exceptions occurring along the coast and outside the Action Area (i.e., near Kaktovik, Utqiaġvik, and Cross Island). Furthermore, activities are generally tightly regulated in industry developments, including speed limits on in-field thoroughfares. Therefore, although conceivable, we conclude that vehicle-polar bear collisions would be very unlikely.

Tracked or low-ground pressure vehicles moving over snow in winter could encounter and collapse undetected dens. Although vehicles used on snow are designed to distribute weight over a larger area, dens in drifted snow would be unlikely to withstand any considerable additional weight. Therefore, if equipment were to encounter an undetected den, the den would likely collapse, resulting in injury or death of the cubs and/or female. The likelihood of one or more such events would be proportional to 1) the density of dens in the Action Area, and 2) the area impacted by winter tundra travel.

However, as described above, denning polar bears occur at very low density in the Action Area. Additionally, all ice road-based activities including Tiŋmiaqsiuġvik mine site operations are located at least 15 km inland (Figure 6.2), where polar bear denning is less likely. Furthermore, because 1) CPAI would adhere to BLM's requirement for den detection surveys prior to initiating winter operations and establish a 1-mile operational exclusion zone around any detected dens (ROP C-1) and, 2) the Project Description includes a *Denning Habitat Mitigation Strategy* that specifies proactive (e.g., denning habitat mapping and survey requirements) and reactive protocols (e.g., ice road closures, traffic restrictions, and 24-hour monitoring) to avoid and minimize impacts to denning bears; we expect appreciable disturbance to denning bears from the winter vehicle traffic would be unlikely.

Facilities and human activities, including those associated with industry, occasionally attract polar bears that may be motivated by hunger or curiosity. This could have consequences for bears drawn to human activities if deterrence or defense-of-life actions result. However, proactive measures to identify and minimize attractants are required components of applications for take authorizations under the MMPA, including authorizations for deterrence actions. For example, LOA applications for incidental take under the most recent Beaufort Sea ITRs require "an approved polar bear safety, awareness, and interaction plan on file with Service's Marine Mammals Management Office" and this plan must include a "food, waste, and other 'bear attractants' management plan" (USFWS 2016b). In addition, BLM's ROPs A-1, A-2, A-8, and M-1 specify procedures for avoiding human-wildlife interactions and address food and waste management.

As when evaluating disturbance, we find quantitatively evaluating potential effects of human-polar bear interactions from the proposed action to be constrained by uncertainties regarding future abundance, distribution and response of polar bears. However, the same factors that serve to limit the consequences of disturbance would also limit the consequences of human-polar bear interactions. Considering the distance from the coast of the Proposed Willow Development, we expect few bears would be encountered, and subsequently deterred, as a result of the Proposed Action. Therefore, based on historical interactions between humans and polar bears at industry facilities on the North Slope, combined with the small proportion of hazing actions that result in injury, and the overall positive outcomes of hazing actions, we expect no lethal impacts and ≤ 2 deterrence actions that require the use of contact rounds, causing physical injuries, over the 30-year life of the Proposed Action.

Spills of oil and other petroleum products

Accidental spills of produced water, seawater, produced or refined oil, other petroleum products, or hazardous materials could occur during all phases of the Willow MDP originating from the WPF, WOC, airstrip, satellite pads, Tiŋmiaqsiuġvik mine site, terrestrial pipelines, vehicles, and heavy equipment operating in the Action Area. Spilled contaminants could reach the marine habitat of polar bears (including sea ice) and coastlines (including barrier islands) from vessel spills in marine waters, or spills in terrestrial areas being transported downstream to marine waters, however because these types of spills would be very unlikely (BLM 2020a), impacts on polar bears from spills of this nature are not reasonably certain to occur.

Exposure to oil could impact polar bears in several ways, depending on the volume, location, and timing of a spill, and the severity and manner of exposure. Polar bears could make direct contact with spilled oil or ingest it through grooming fouled fur, nursing, ingesting contaminated prey, or inhaling vapors (Engelhardt 1983). Consequences could include irritation to eyes, mouth, and mucus membranes, irritation and damage to respiratory organs from inhalation, kidney and liver damage from ingestion of contaminated prey (Øritsland et al. 1981), loss of ability to thermoregulate, hair loss, anemia, anorexia, increased metabolic rate, elevated skin temperatures, and stress response (Derocher and Stirling 1991; St. Aubin 1990). Exposure could range from short-term, sub-lethal impacts to long-term impacts on health including death, depending on the substances contacted, the magnitude and duration of exposure, and the health of exposed individuals.

Records of polar bears encountering spilled oil or other toxic substances in Alaska suggest exposure could occur from the Proposed Action, but would likely be infrequent and/or impact small numbers of individual bears. Since 1993, the Service has interacted with the oil and gas industry in northern Alaska to evaluate, regulate, and monitor effects of oil and gas exploration, production, and processing on polar bears. In this interval, large oil spills impacting polar bears have not occurred. One polar bear died in 1988 following exposure to ethylene glycol and dye (Amstrup et al. 1989), and two bears died in 2012 after chemical exposure including Rhodamine B (81 FR 52297). Although this compound is used by the oil and gas industry, it is also used by others on the North Slope, so those events cannot be attributed to industry (81 FR 52297). Between July 1, 2009, and June 30, 2014, spills averaging about 59,000 gallons per year were reported by industry on the North Slope, with approximately 5.6% of the volume comprised of crude oil (81 FR 52299). None of these spills were documented to have injured or killed polar bears.

Spills during construction – As described in the *Effects to Spectacled Eiders* above, during the construction phase, BLM expects the likelihood of very small to small terrestrial spills of refined petroleum products (< 10 to < 99.9 gallons) would be low to medium (e.g., during fuel transfers; BLM 2020a). Small spills would be localized, likely of short duration, and be quickly contained and remediated (BLM 2020a). The likelihood of medium to medium-large spills (100 to 9,999.9 gallons e.g., tanker truck accident) would be very low. A spill of this size would also be expected to be mostly localized, of short duration, and be quickly contained. The likelihood of large spills (10,000 to 100,000 gallons; e.g., complete loss from a bulk tanker) would be very low. The spatial extent of a large spill would vary with the season and circumstances, but could affect up to 0.5 acres of adjacent habitat (BLM 2020a). Very large spills (> 100,000 gallons) during construction would be very unlikely (BLM 2020a). Therefore, impacts on polar bears from very large spills during construction are not reasonably certain to occur.

Consequences of spills during construction would be avoided and minimized by compliance with BLM's ROPs A-4, A-5, and project-specific Oil Discharge Prevention and Contingency (ODPCP), Spill Prevention Control and Countermeasures (SPCCP), and Facility Response Plans

FRP).

Spills during drilling and operations – During the drilling and operations phases, BLM expects the likelihood of wellhead spills would be low to very low. Although unlikely, the size of a wellhead spill could range from very small to large but would likely be contained within the boundaries of gravel infrastructure (BLM 2020a).

Pipeline spills – Spills from facility piping (i.e., infield and on-pad pipelines) could be very small to very large in size, although the likelihood of spills in these categories ranges from very high to very low, respectively (BLM 2020a). Pipeline spills would be expected to be limited to the inside of piping facilities or be contained within the boundaries of gravel infrastructure (BLM 2020a).

Spills from other pipelines (e.g., production, seawater, and export pipelines) could range from very small to very large, and the duration could be very short or prolonged (e.g., days or weeks) depending on the type of spill or location. However, the likelihood of spills from pipelines is expected to be low to very low. Very small spills would be localized and quickly contained, although large spills could impact a few acres of adjacent tundra (BLM 2020a). The location and timing of a pipeline spill would also influence the spatial extent of the spill; a larger spill during snow free periods could reach freshwater systems and impact a larger area downstream. For example, a pipeline spill at a stream crossing could reach the channels of Uvlutuuq Creek or Kalikpik River, particularly during periods of flooding. However, if spilled material were to enter freshwater lakes or streams, the relatively low flow and convoluted nature of streams in the area would preclude most spilled material from reaching the Beaufort Sea coast. Furthermore, in the unlikely event of a large spill, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a petroleum product spill (BLM 2020a).

Aboveground storage tanks (ASTs) – Due to volume of ASTs, spills originating from these structures could range from very small to very large, although the likelihood of any spill from an AST would be low to very low (BLM 2020a). Furthermore, due to required secondary containment, in the unlikely event of a complete AST failure, spilled material would be expected to be contained by the secondary containment, or at the worst, within the boundaries of gravel infrastructure, and would not impact adjacent tundra (BLM 2020a).

Very large oil spills (VLOS) – The likelihood of a VLOS (e.g., from a shallow-gas or well blowout) would be very low (i.e., approaching zero; BLM 2020a), although an unlikely event, such a spill would have a longer duration compared to other spills and could impact up to 25 acres of surrounding tundra habitat (BLM 2020a). If released oil were to enter adjacent freshwater streams or channels during snow-free periods, the impacts could occur over a broader spatial scale. However, oil from a very large spill such as a blowout would be unlikely to reach Beaufort Sea coast due to the inland location of Willow satellite pads and production infrastructure. For example, BT4, the closest satellite pad to the coast, would be approximately 17.5 river miles from the coast (via the Kalikpik River) and the other satellite pads are at least 50 river miles from the coast (via the Iqalliqpik Creek basin; BLM 2020a). Because freshwater systems in the Action Area are highly convoluted, spilled oil would likely spread slowly, become stranded along streambanks and be recovered. Similar to pipeline spills, in the unlikely event of a VLOS, staged spill response equipment and pre-deployed containment boom at key stream locations would reduce the duration and extent of a VLOS (BLM 2020a). Finally, because the likelihood of a VLOS would be very low, impacts on polar bears from a spill of this nature are not reasonably certain to occur.

Similar to spills during construction, the consequences of spills during drilling and operations would be avoided and minimized by compliance with BLM's ROPs A-4, A-5, and appropriate project-specific spill prevention and response plans.

Hazardous materials spills – In addition to potential oil and other spills discussed above, spills of hazardous materials could occur during Willow MDP drilling and operations. Hazardous materials associated with the Willow Development would include, but not be limited to, biocides (within the seawater system to kill micro-organisms which cause corrosion), corrosion inhibitors, methanol, antifreeze, other glycols, acids, lube oils, used oil, and hydraulic fluids. These materials would be stored inside buildings, or in ASTs within secondary containment.

Hazardous material spills could range from small to medium, and based on historical North Slope industry data, the likelihood of a hazardous material spill occurring during the 30-year project life would be very high (BLM 2020a). However, potential hazardous materials spills would be expected to be very small (< 10 gallons) with localized impacts, and be identified and responded to quickly, in compliance with the project-specific Hazardous Substance Contingency Plan (HSCP; ROP A-3), ODPCP, SPCCP, and FRP. Required 110 % secondary containment would also be expected to contain a spill to the immediate area, and hazardous materials spills would not be expected to extend beyond gravel or ice infrastructure (BLM 2020a).

Spills in the MTR – BLM (2020a) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel), and be localized and of short duration. Given spill prevention and response measures in place, the likelihood of small spills in the MTR would be very low to low and these spills would be limited to the vicinities of Dutch Harbor (e.g., during fuel transfers) and Oliktok Dock (e.g., during module delivery).

A medium to very large spill would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached. The duration and spatial extent of this type of spill could range from one to several days depending on the location, sea state, and proximity to shore-based response. However, given that all vessels associated with the Willow MDP would follow established shipping routes, the likelihood of such an accident would be very low (BLM 2020a). Furthermore, given that the duration and frequency of vessel traffic in the MTR would be limited (i.e., sealift operations would take place during a 4 year subset of the construction phase), the likelihood of a spill of this nature would be very low. Therefore impacts on polar bears from a medium to very large spill in the MTR are not reasonably certain to occur.

Impacts to polar bears in the MTR would likely be limited to the vicinity of Oliktok Dock, and bears in this area could conceivably be impacted by small spills during vessel operations and module delivery. However, the BLM has indicated spills during these operations would be uncommon, localized and of short duration (BLM 2020a). Therefore we anticipate impacts to polar bears from small spills would be minor. Furthermore, because larger spills (>100 gallons) resulting from the limited vessel operations would be extremely unlikely, impacts from large spills on polar bears in the MTR are not reasonably certain to occur.

Throughout the broader Action Area, polar bears generally occur at low density, although an average of 140 polar bears (up to 15% of the SBS subpopulation) occur in late summer and fall along the Beaufort Sea coast between Utqiaġvik and the Canada border. The only areas with significant concentrations occur at or near Kaktovik, Cross Island, and Utqiaġvik, none of which are within or near the Action Area. Therefore, although some polar bears could be exposed to spilled contaminants, either in terrestrial, freshwater, or marine environments, based on the limited number and low volume of predicted spills, the distance of most potential spill sources from the coast, and BLMs required spill prevention and response measures; the potential for exposure of polar bears to spilled contaminants is very small.

Additionally, in 2016, the Service, working with numerous partners, developed a detailed species-specific oil spill response (OSR) plan in the event a spill occurs. This plan provides guidance for the Service's Alaskan Regional Spill Response Coordinator in determining potential risk to polar bear populations and advising the Federal On-Scene Coordinator on recommended response measures. The OSR plan includes information on preventative measures to keep bears out of oil, such as early detection and deterrence, as well as guidance on treatment of oiled bears, such as washing and holding protocol. Appendices include information on collecting and removing oiled wildlife carcasses; location/inventory of equipment and supplies; and a list of potential holding facilities and response partners that would be called upon to assist as needed. Service response efforts would be conducted using the standard three-tiered spill-response approach:

1) **Primary response** – identifying bear use areas and making recommendations to the Incident Command System where to focus containment, dispersion, burning, or clean-up of oil to minimize impacts to polar bears;
2) **Secondary response** – using hazing, herding, preventative capture/relocation, or additional methods to remove un-oiled polar bears from affected or potentially-affected areas; and
3) **Tertiary response** – capture, cleaning, treatment, and release of oiled polar bears.

Spill effects summary

Due to the low density of polar bears in the Action Area, particularly inland from the coast where most development and activities associated with the Willow MDP would take place, we expect the likelihood of polar bears encountering contaminants from terrestrial or marine spills in the Action Area would be low. Small spills would be more likely to occur than medium or large spills, but we expect the majority of small spills would occur on production pads, be confined to a small area, and be remediated quickly. Furthermore, compliance with ROPs A-3, A-4, A-5 (including requirements for immediate response and notification of Federal agencies), and CPAI's project-specific ODPCP, SPCCP, HSCP, and FRP, would avoid or reduce most impacts to polar bears from potential spills. Although disturbance of polar bears could occur during spill response efforts, this disturbance is expected to be minor and temporary as bears would be expected to move away to a safe distance.

Given historical North Slope spill data (ADEC 2019), some spills would be likely during the Willow MDP despite continued improvements in engineering design and greater emphasis on prevention and response. However, 1) spills are expected to be uncommon and most would be low volume, 2) polar bear density in the Action Area is low, 3) because most spills would be low volume, impacts would be localized, and spilled material would be contained and remediated quickly, 4) transient polar bears would likely avoid disturbance associated with areas of active response, and 5) material handling, spill prevention, and response measures required by the BLM through ROPs and respective spill prevention response and contingency plans include numerous measures to minimize impacts to polar bears in the event of a spill. Additionally, a polar bear-specific response plan has been developed to guide response efforts in the event that a spill with potential to affect polar bears does occur. Therefore, we don't anticipate adverse effects to polar bears from spills are likely to result from the proposed Action.

Impacts to polar bear prey species

The fecundity or survival rates of polar bears could be affected if the Proposed Action affects polar bear prey populations. Polar bears are top predators in the Arctic marine ecosystem, and in the SBS region they prey primarily on ringed and bearded seals, although other food sources are occasionally important, including beach-cast and subsistence-harvested marine mammal carcasses (USFWS 2016a). NMFS manages ringed and bearded seals under the authorities of the MMPA and ESA. To be in compliance with any MMPA authorizations, only small numbers of animals may be taken and only if there is a negligible impact to the stock. In addition, BLM's ROPs and Stipulations for this project provide measures that would reduce impacts to seals. Given the limited and temporary nature of project activities proposed in areas where seals may occur, coupled with NMFS oversight of the MMPA regulations, and BLMs ROPs and Stipulations we do not anticipate impacts to polar bear prey species would rise to the level of being a significant impact to polar bears.

Subsistence harvest

Because the Project Description includes roadway turnouts with ramps meant to improve subsistence access to surrounding undeveloped areas, polar bears would be subject to potential increased subsistence harvest. However, due to 1) the low density of polar bears in the Action Area, and 2) the proposed infrastructure, including subsistence ramps, would be located inland from the coast, where polar bears occur even less frequently; we anticipate potential subsistence harvest of polar bears throughout the Action Area would be low.

Furthermore, given conservation practices afforded through the 1973 Polar Bear Agreement and Inuvialuit-Inupiat Polar Bear Management Agreement, which established quotas and recommendations concerning protection of denning females, family groups, and methods of harvest, we anticipate increased polar bear harvest due to enhanced subsistence access would be unlikely. Therefore, an appreciable increase in polar bear harvest facilitated by subsistence access ramps associated with the Willow MDP is not anticipated.

Summary

We identify four primary mechanisms by which the proposed action could affect polar bears: disturbance, human-polar bear interactions, spills of oil and other petroleum products, and subsistence harvest. We also identify aspects of the proposed project that would serve to limit potential impacts to polar bears: requirements for den detection surveys prior to initiating winter work, most new infrastructure would be located a significant distance from the coast, and CPAI would follow management plans to minimize human-polar bear interactions and disturbance of dens. In evaluating effects from the proposed Willow MDP, we draw on our experience evaluating, regulating, and monitoring similar activities in northern Alaska where the Service has worked cooperatively with the oil and gas industry since 1993 to implement regulatory programs provided under the MMPA, and to conserve polar bears in the face of considerable industrial development. As described above, the Service conducts periodic (every 5 years) region- and stock-specific review of impacts to ensure regulatory requirements of the MMPA are continuing to be met. The vast majority of impacts caused by industrial activities have been non-injurious and non-lethal, although unintended and unexpected outcomes causing injuries or death have very rarely been documented, and additional injurious or lethal impacts may have occurred but gone undetected or unreported. Examples include defense-of-life actions and possible undetected impacts of disturbance at undetected dens or females abandoning dens with cubs prematurely. Information concerning such events, provided by industry and otherwise available has resulted in continued refinement of the protective measures required of industry. We expect the regulatory programs administered under the MMPA will continue to refine and prescribe permissible methods of taking and other means of effecting the least practicable adverse impacts on polar bears, and thus continue to ensure conservation.

Considering the distance from the coast of most components of the Willow MDP, we expect a few polar bears may experience consequences resulting from the Proposed Action. We estimate that up to two bears may be injured during hazing incidents over the 30-year life of the project. Finally, although modelling suggests it is possible that cubs could suffer injury or mortality as a result of disturbance from project activities over the 30 year project life, this scenario is far from reasonably certain, with an 84.1% probability that no take would occur.

Effects to Polar Bear Critical Habitat

As described above, critical habitat for polar bears includes three units: Unit 1, Sea Ice Habitat; Unit 2, Terrestrial Denning Habitat; and Unit 3, Barrier Island Habitat (75 FR 76086 – 76137). The Action Area includes 1) a subset of the Terrestrial Denning unit 2) transport of materials on barges within the boundaries of the Sea Ice unit (although during the open water season, when sea ice is likely to be absent or broken), and 3) actions (barge transport) that could affect the Barrier Island unit, in the event of contaminant spills into the marine environment. Therefore, we separately consider the Sea Ice, Terrestrial Denning Habitat, and Barrier Island units. For each unit, we consider potential impacts to the physical and biological features (PBFs) of the habitat that were identified within the designation. Also, for the Terrestrial Denning Habitat, we consider whether human presence or activities could compromise the value of critical habitat, because absence of disturbance was described as an attribute of this unit.

Unit 1, Sea Ice Habitat

The Project Description indicates vessel traffic transporting modules and materials through the MTR to Oliktok Dock would pass through marine waters designated as sea ice critical habitat. When designating polar bear critical habitat, we "determined that sea ice that moves or forms over the shallower waters of the continental shelf (300 meters (982.2 feet) or less)," and that contains adequate prey resources (primarily ringed and bearded seals) to support polar bears. Sea ice is an essential physical feature for polar bears in the southern Beaufort, Chukchi, and Bering seas for food and physiological requirements (75 FR 76086 – 76137). Because vessel traffic would be limited to the open water season, we identify that the Proposed Action could affect this essential physical feature through two mechanisms: 1) spills of oil or other contaminants into marine waters that form ice, or 2) impacts to ringed and bearded seals, caused by disturbance or spills of oil or other petroleum products.

It is plausible that oil or other spilled petroleum products could be spilled by vessels using the MTR within the boundaries of the sea ice unit during summer, when ice is absent or broken or absent. If spills were incompletely remediated, oil or other petroleum products could contaminate sea ice after freeze up in fall/winter. Spilled products could also affect ice seals, which are an identified component of sea ice habitat for polar bears. Last, spills in terrestrial and freshwater fluvial environments could be transported downstream to the marine system. BLM (2020) expects most spills during sealift operations in the MTR would be very small to small (< 10 to 99.9 gallons), limited to refined products (e.g., diesel fuel), and be localized and of short duration. Given spill prevention and response measures in place, the likelihood of small spills in the MTR impacting sea ice habitat would be low.

A medium to very large spill would be conceivable if a tug or barge were to run aground, sink, or have its compartments breached. However, given that all vessels associated with the Willow MDP would follow established shipping routes, the likelihood of such an accident would be very low (BLM 2020a). Furthermore, given that the duration and frequency of project-specific vessel traffic through the MTR would be limited to a 4 year subset of the construction phase, the likelihood of a spill of this nature impacting sea ice habitat would be very low.

Several measures included in the Project Description would reduce the likelihood of spills occurring, the magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3, A-4, A-5 (including requirements for prevention, immediate response, and notification of Federal agencies), as well as CPAI's project-specific ODPCP, SPCCP, HSCP, and FRP which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease the response time for containment and remediation, and thereby avoid or minimize effects of a spill on sea ice critical habitat.

BLM's commitment not to approve any project-related activities absent documentation of compliance under the MMPA (e.g., an LOA, IHA, and/or written communication from the USFWS and/or NMFS confirming that a take authorization is not warranted) would provide significant additional protection for polar bears and ice seals. The substantive standards imposed by the MMPA as a prerequisite to issuing incidental take authorizations (i.e., small numbers of take, negligible impacts to the stock, and no unmitigable adverse impact on the availability of the stock for subsistence uses), as well the requirement that any such authorization include "means of effecting the least practicable adverse impact upon the species or stock and its habitat," provide further assurance that Unit 1 of designated polar bear critical habitat would not be appreciably diminished.

Unit 2, Terrestrial Denning Habitat
Terrestrial Denning Habitat comprises roughly 3,620,558 total acres. The Action Area overlaps a very small subset of this total, and the area of overlap is limited to the vicinity of Oliktok Dock and the existing road (Figure 6.2). The dock and road existed at the time critical habitat was designated and are therefore not part of critical habitat. Therefore, no impacts to designated critical habitat for terrestrial denning will result from the proposed project.

Unit 3, Barrier Islands
When designating critical habitat for polar bears, the Service identified barrier islands as a "physical feature essential to the conservation of polar bears in the United States." The unit was described as "barrier island habitat used for denning, refuge from human disturbance, and movements along the coast to access maternal den and optimal feeding habitat, which includes all barrier islands along the Alaska coast, and their associated spits, within the range of the polar bear in the United States, and the water, ice, and terrestrial habitat within 1.6 kilometers (1 mile) of these islands (no-disturbance zone)" (75 FR 76086 – 76137).

Based on the description of barrier islands at designation, we consider the physical feature of barrier islands to include the physical characteristics of islands, accompanied by refuge from disturbance necessary for denning, resting, and unimpeded movements. In this light, we consider the Proposed Action could affect barrier islands through disturbance, and potential spills of oil or other petroleum products reaching barrier islands.

Although polar bears occupying barrier island critical habitat could be subject to disturbance from vessels, we note the MTR passes adjacent to a single barrier island (Figure 6.2). Given that 1) vessel presence in proximity to this barrier island would be infrequent and short-term, 2) project-specific vessel operations would be limited to 4 years during construction, and 3) the affected area is an extremely small proportion of available barrier island critical habitat; we expect disturbance within this unit would be minor and temporary, such that the value of barrier island critical habitat as a refuge from disturbance would not be appreciably reduced.

We find that the same factors we used to evaluate the risk of spills affecting the Sea Ice Unit pertain to the risk of spills affecting barrier islands. Several measures included in the Project Description would reduce the likelihood of spills, the magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3, A-4, A-5 (including requirements for prevention, immediate response, and notification of Federal agencies), as well as CPAI's project-specific ODPCP, SPCCP, HSCP, and FRP which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease the response time for containment and remediation, and thereby avoid or minimize effects of a spill on barrier island critical habitat. Finally, as a result of CPAI's commitment to ensure compliance with the MMPA, periodic re-evaluation of the impacts of the oil and gas industry to polar bears and ice seals would ensure the continued adequacy of spill prevention and response measures. Therefore, collectively we find these measures would provide assurance that the Barrier Island critical habitat Unit would not be appreciably diminished.

8. CUMULATIVE EFFECTS

Under the ESA, cumulative effects are the effects of future State or private activities, not including Federal activities, that are reasonably certain to occur within the Action Area considered in this BO (50 CFR §402.02). Effects from future Federal activities (i.e., activities that require Federal approval, funding, permits or other form of authorization) do not constitute cumulative effects for the purposes of this BO, but would be analyzed in separate consultation under the ESA. The subsections below identify types of activities that may occur in the Action Area in the future, and discusses their potential to cause cumulative effects.

Industry development
Oil and gas development, and associated mechanisms of impact (i.e., habitat loss, disturbance, listed eider collision risk, increased predators, human-polar bear interactions etc.), whether in Federal or State waters or in the terrestrial environment on State, private, Native-owned, or Federal lands, would require Federal permits (e.g., section 404 of the Clean Water Act authorization from the U.S. Army Corps of Engineers [USACE], and National Pollution Discharge Elimination System permits from the Environmental Protection Agency). Therefore, these actions are not considered cumulative effects under the ESA.

Infrastructure expansion
As industry and private sector developments expand so does associated infrastructure (e.g., gravel and ice roads, powerlines, communication towers, landfills, and gravel pits). The scale of potential adverse impacts would depend not only on the amount of growth, but the location as it relates to listed eider nesting habitat. However, the majority of the terrestrial Action Area is classified as wetlands (https://www.fws.gov/wetlands/data/mapper.html). Therefore, a section 404 permit from the USACE would likely be necessary for any infrastructure expansion projects. The issuance of these permits would also trigger consultation under the ESA. Smaller private sector projects may not require a Federal permit, but would also likely result in smaller, if any, impact to listed eiders or polar bears.

Increased marine traffic
As the extent of Arctic sea ice in the summer has declined, and the duration of ice free periods has increased, interest in shipping within and through arctic waters has increased (Brigham and Ellis 2004). Increased shipping along the Northern Sea Route (part of the Northeast Passage that follows Norway and Russia's coast down into the Chukchi and Bering seas), and the Northwest Passage (which follows Canada's eastern coast north along Canada and Alaska's Beaufort Sea coast) could result in increased fragmentation of sea ice habitat and disturbance/injury to marine mammals, increased human-bear encounters, and the introduction of waste/litter, and toxic pollutants, including spilled oil (PBRS 2015). All of these threats could potentially affect polar bears and listed eiders.

The Arctic Council conducted a comprehensive Arctic marine shipping assessment for the Arctic Ocean, focusing on potential impacts of humans and the arctic environment (AMSA; Arctic Council 2009). The AMSA Report includes a comprehensive estimate of the number of ships (excluding naval vessels) operated in the Arctic by year, and identified Arctic natural resource development and regional trade as the key drivers of future Arctic marine activity. The release of oil was identified as one of the most significant environmental threats related to shipping. The report specifically recommended that Arctic countries address impacts on marine mammals from shipping, and work with the International Maritime Organization (IMO) to develop and implement mitigation strategies.

Since then, significant advances have been made in implementing recommendations set forth in the AMSA Report. For example, several reports that identify Arctic marine areas of special ecological and cultural importance have been published (Smith et al. 2010), and voluntary guidelines to reduce underwater noise to avoid adverse impacts on marine biota have been developed (PAME 2015). Additionally, vessel routing and speed restrictions have been recognized as effective measures to mitigate impacts on marine mammals (Brigham and Sfraga 2010). In 2015, the IMO adopted the environmental provisions of the Polar Code, which include standardized safety procedures addressing design, construction, equipment, operational, training, environmental protection standards, and use of designated shipping lanes. The Polar Code was entered into force on January 1, 2017 (IMO 2019).

Reduction in the extent and duration of sea ice may increase the potential for commercial fishing within the MTR portion of the Action Area, but the likelihood and magnitude of these activities are unknown at this time. Future commercial fisheries within the MTR portion of the Action Area would likely be managed by the National Marine Fisheries Service, and the issuance of regulations would require section 7 consultations, and are therefore not considered cumulative effects.

Increased Scientific Research
Scientific research across the Arctic is increasing as concern about effects of climate change in the Arctic grows. While research is often conducted by universities and private institutions, these activities frequently require permit authorizations from the National Science Foundation (NSF) or other Federal agencies (e.g., BLM for research in NPR-A) if scientific activities are related to industry development. Large scale projects that may overlap the MTR are generally funded by the NSF or operate off USCG ice breaking vessels. These activities have been and/or will be considered in separate section 7 consultations.

Recreation
Purely private activities within the Action Area or on nearby private lands meet the definition of cumulative effects under the ESA. Private party access to the proposed Action Area, or users of nearby private lands could disturb a few individual listed eiders or polar bears each year. However, these species occur at such low density, and with increasing scarcity inland from the coast that we expect the likelihood of private party encounters or resulting impacts to listed species would be very low.

Conclusion
In summary, we anticipate the scope and scale of industry development, infrastructure expansion, marine traffic, scientific activities, and recreation in the Action Area will continue, and may increase in the future. Most notably, activities with the potential to affect significant numbers of individuals of listed species (such as industry development and infrastructure

expansion) are expected to require consultation under the ESA; whereas those that may not require consultation (e.g., small private sector projects) would likely have at most, minor impacts to listed species or would entail responsible oversight by local leaders.

9. CONCLUSION

Regulations (51 CFR 19958) that implement section 7(a)(2) of the ESA define "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." We note that we determined the Proposed Action is not likely to adversely affect Alaska-breeding Steller's eiders, the southwest Alaska DPS of northern sea otters, or critical habitat for these two species. Therefore, we do not revisit or provide conclusions for sea otters or critical habitat for sea otters, spectacled eiders, and Steller's eiders here.

Spectacled eiders
We identified loss of nesting habitat (with the associated disturbance) and collision with project structures or vessels as factors with potential to adversely affect spectacled eiders.

Some habitat could be completely and permanently lost when structures or fill render the habitat unusable. Additionally, the capability of immediately adjacent habitat to support eiders may be completely or partially compromised by nearby structures and associated human activity, which could disturb nesting eiders or prevent them from nesting or rearing broods nearby. The full extent of the area affected by disturbance remains unknown, and it is also unknown whether eiders would simply be displaced from this habitat (possibly with reduced productivity) or continue to use it, possibly with reduced fitness. We have determined that habitat loss and disturbance within the adjacent 200-m zone of influence around Willow MDP facilities may adversely affect listed eiders, causing functional loss of 35.05 km^2 of nesting habitat. We estimate this would result in the loss of production from 26 spectacled eider nests over the 30-year life of the project. We also estimate up to a total of 10 adult or fledged juvenile spectacled eiders would be injured or killed in collisions with structures in the terrestrial environment (4) and vessels transporting materials through the marine environment (6).

Thus, collectively, we estimate effects of the Proposed Action would cause the loss of production of up to 26 spectacled eider nests and collisions causing injury or death of 10 adult or fledged juvenile spectacled eiders. Because we predict these impacts to occur over a 30-year interval, and to be imposed upon a North Slope breeding population estimated to include 5,108 adults (SE 725; Wilson et al. 2017a and E. Osnas, USFWS, pers. comm.) and species estimated to include 369,122 (90% CI: 364,190 –374,054; Larned et al. 2012), we would not anticipate population- or species-level responses to result. Therefore, the Service concludes effects of the Proposed Action, considered together with cumulative effects and in the context of the status of the species and environmental baseline, are not reasonably likely to jeopardize the continued existence of spectacled eiders by reducing appreciably the likelihood of survival and recovery of the species in the wild by reducing their reproduction, numbers, or distribution.

Polar bears
In evaluating impacts of the proposed project to polar bears, we have identified potential adverse effects from disturbance and human-polar bear interactions.

We find that a host of construction and production activities associated with the Proposed Action would intermittently incidentally expose small numbers of polar bears of the SBS stock to disturbance. We also find that most of those exposures would not be biologically significant. The spatial and temporal distance between disturbance events would limit the potential for impacts to be biologically significant to individual bears and further reduce the potential for biologically significant impacts to individual bears to compound to effects at the stock level, let alone the species level. We acknowledge the Proposed Action could affect an increasingly higher proportion of the SBS stock of polar bear in the future (due to polar bears' increased use of terrestrial areas as sea ice decreases, a decline in the SBS stock population, or other factors). We also acknowledge that polar bears in the Action Area could become increasingly sensitive to disturbance or other impacts due to food stress or other factors indirectly associated with climate change. Regardless, we anticipate that the activities authorized under the Proposed Action would continue to impact small numbers of individual polar bears within the SBS stock and would not appreciably affect the survival and recovery of the polar bear species as a whole. When considering effects from the Proposed Action in combination with cumulative effects, we arrive at a similar conclusion because any future activities in the Action Area (which is largely Federally-managed land and almost entirely comprised of jurisdictional wetlands) with the potential for significant effects would likely have a federal nexus and therefore would require separate section 7 consultation. Other smaller scale activities, which may not have a federal nexus, would likely have smaller impacts and therefore would not contribute significantly to cumulative effects.

Our analysis also finds that aspects of the Proposed Action would serve to limit the potential for associated gas development actions and activities to impact polar bears. Most new infrastructure would be located a significant distance from the coast and would be directly adjacent to existing infrastructure, and BLM's stipulations and ROPS, as well as wildlife interaction plans would serve to minimize human-polar bear interactions and disturbance to dens. In addition, the Proposed Action also contains protective measures that provide significant minimization of impacts to polar bears, most importantly BLM's commitment to ensure compliance with the MMPA. In consideration of these factors, we predict that up to 2 polar bears may be hazed resulting in non-lethal physical injuries during activities over the 30-year life of the Proposed Action. While it is possible that an undetected den could be impacted by project activities resulting in injury or mortality to cubs, this is not considered reasonably certain to occur.

Based on these factors, and after reviewing the current status of polar bears, the environmental baseline for the Action Area in which the effects of current on-going actions are evaluated, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Action, as proposed, is not likely to jeopardize the continued existence of polar bears by reducing appreciably the likelihood of survival and recovery in the wild by reducing reproduction, numbers, or distribution of this species.

Polar bear critical habitat

Unit 1, Sea Ice

We determined that vessel traffic associated with transporting modules and materials through marine waters designated as sea ice critical habitat could potentially affect sea ice habitat through 1) spills of oil or other petroleum products into marine waters that form ice, or 2) impacts to ringed and bearded seals, caused by disturbance or spills of oil or other petroleum products. More specifically, incompletely remediated spills of oil or other petroleum products could contaminate sea ice after freeze up in fall/winter, spilled products could affect ice seals (an identified component of sea ice habitat), and spills in onshore environments could be transported downstream to the marine system.

However, several measures included in the Project Description would reduce the likelihood of spills occurring, the magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3, A-4, A-5 (including requirements for prevention, immediate response, and notification of Federal agencies), as well as CPAI's project-specific ODPCP, SPCCP, HSCP, and FRP which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease the response time for containment and remediation, and thereby avoid or minimize effects of a spill on sea ice critical habitat.

BLM's commitment not to approve any project-related activities absent documentation of compliance under the MMPA (e.g., an LOA, IHA, and/or written communication from the USFWS and/or NMFS confirming that a take authorization is not warranted) would provide significant additional protection for polar bears and ice seals. The substantive standards imposed by the MMPA as a prerequisite to issuing incidental take authorizations (i.e., small numbers of take, negligible impacts to the stock, and no unmitigable adverse impact on the availability of the stock for subsistence uses), as well the requirement that any such authorization include "means of effecting the least practicable adverse impact upon the species or stock and its habitat," provide further assurance that Unit 1 of designated polar bear critical habitat would not be appreciably diminished.

Unit 2, Terrestrial Denning Habitat

A very small subset of the Action Area overlaps terrestrial denning habitat. However, the area of overlap is limited to existing facilities and infrastructure associated with Oliktok Dock which were exempted from designation. Because the proposed activities are of similar scope to ongoing routine use and upgrades to the Oliktok Dock area, we find that impacts specific to the Willow MDP would not appreciably diminish the Terrestrial Denning critical habitat Unit.

Unit 3, Barrier Islands

We determined the Proposed Action could affect barrier islands through disturbance, and potential spills of oil or other petroleum products reaching barrier islands. However, we expect disturbance within this unit would be minor and temporary.

Furthermore, we find several measures included in the Project Description would reduce the likelihood of spills occurring, the magnitude of spills in the event that one or more do occur, and the likelihood of spills in or near wetlands, where they could be transported to the marine environment. To minimize the potential for an inadvertent spill, CPAI would comply with BLM's ROPs A-3, A-4, A-5 (including requirements for prevention, immediate response, and notification of Federal agencies), as well as CPAI's project-specific ODPCP, SPCCP, HSCP, and FRP which include numerous measures to prevent spills. If a spill should occur, adherence to the measures listed above would decrease the response time for containment and remediation, and thereby avoid or minimize effects of a spill on barrier island critical habitat.

Finally, BLM's commitment not to approve any project-related activities absent documentation of compliance under the MMPA (e.g., an LOA, IHA, and/or written communication from the USFWS and/or NMFS confirming that a take authorization is not warranted) would provide significant additional protection for polar bears. The substantive standards imposed by the MMPA as a prerequisite to issuing incidental take authorizations (i.e., small numbers of take, negligible impacts to the stock, and no unmitigable adverse impact on the availability of the stock for subsistence uses), as well the requirement that any such authorization include "means of effecting the least practicable adverse impact upon the species or stock and its habitat," provide assurance that the Barrier Island critical habitat Unit as a whole would not be appreciably diminished.

Determination
In conclusion, we find that the Proposed Willow MDP contains protective measures that provide significant conservation benefits for polar bear critical habitat by effectively limiting the capacity of Project-related activities to cause adverse effects. In particular, we expect the requirement to obtain MMPA incidental and intentional take authorizations, and/or written communication from the USFWS and/or NMFS confirming that a take authorization is not warranted, prior to engaging in any activity that may take polar bears would contribute to the protection of critical habitat, by minimizing disturbance, which could otherwise affect access to or use of critical habitat for denning, resting, or movements. Based on these factors, and after reviewing the current status of polar bear critical habitat, the environmental baseline for the action area, the effects of the Proposed Action, and the cumulative effects, it is the Service's biological opinion that the Action, as proposed, is not likely to adversely affect polar bear critical habitat.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species by annoying them to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action, is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

BLM has a continuing duty to regulate the activity covered by this ITS. If BLM (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse.

Spectacled eiders

The activities described and assessed in this BO may adversely affect spectacled eiders through loss of nesting habitat and collisions with Willow MDP structures and/or vessels. Methods used to estimate spectacled eider take from habitat loss and collisions are described in the *Effects of the Action* section. Based on these estimates, the Service *exempts loss of production from up to 26 spectacled eider nests, and injury or mortality of up to 10 adults or fledged juveniles attributed to collisions* resulting from the Proposed Action.

Polar bears

We evaluated if the activities described and assessed in this BO may adversely affect polar bears through: disturbance, human-polar bear interactions, spills of oil and other petroleum products, and subsistence harvest. We also considered aspects of the proposed project that would serve to limit potential impacts to polar bears and in particular: requirements for den detection surveys prior to initiating winter work, that most new infrastructure would be located a significant distance from the coast, and CPAI would follow management plans to minimize human-polar bear interactions and disturbance of dens, as well as complying with the ROPs and Stipulations issued by BLM to leaseholders and developers in NPR-A.

Incidental effects to polar bears from the Proposed Action are expected to be in the form of short-term, minor changes in behavior which do not create a likelihood of injury (much less cause injury), or are not reasonably certain to occur and therefore would not constitute harassment or other any form of take as defined by the ESA and implementing regulations (16 U.S.C. 1532 (19), 50 CFR §17.3). However, we anticipate that up to 2 bears may be hazed with non-lethal contact rounds over the life of the project.

The Service cannot authorize take of polar bears under the ESA at this time because such take has not yet been authorized under the MMPA and/or its 2007 Amendments. After take has been authorized under the MMPA, take under the ESA that results from actions conducted in compliance with all requirements and stipulations set forth in the MMPA authorization will be considered by the Service to also be authorized under the ESA. The MMPA authorization will also provide conditions and mitigation measures the applicant must comply with to reduce impacts to polar bears. Recognizing that the MMPA is in certain respects more protective than the ESA, and that the MMPA remains the primary regulatory mechanism for the Service's management of polar bears, the applicable conditions and mitigation measures to be developed and implemented through future MMPA take authorization processes will serve as the reasonable and prudent measures (RPMs) and implementing terms and conditions (T&Cs) for this BO. Therefore, no additional RPMs or T&Cs are provided below for polar bears.

11. REASONABLE AND PRUDENT MEASURES

RPM 1: Contribute to improved understanding of spectacled eider collision risk with Willow Development infrastructure, facilities, and/or vessels.

T&C 1: Observations of collision events in which one or more listed eider, or 3 or more birds of any species[8], appear to have collided with oil and gas infrastructure (i.e., wires, towers, or buildings), or vessels shall be recorded and reported to the USFWS, Fairbanks Fish and Wildlife Conservation Office in an annual report due by December 31, unless listed eider collisions exceed the number exempted by the ITS, in which case, the collision event shall be reported within 48 hours. Reports should include: the date, time of day, weather conditions, number and species of birds involved, and other factors considered to be relevant by the observer, and should include photos of dead birds, top and bottom view, with wings spread, and with the bill and feet visible if possible.

12. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We recommend the following action be implemented:

1. Implement lighting controls to turn off exterior lighting at satellite pads and other unoccupied facilities when personnel are not present, between August 1 and October 31.

We request notification of the implementation of any conservation recommendations by BLM to keep the Service informed of actions minimizing or avoiding adverse effects or benefiting listed species and their habitats.

13. REINITIATION NOTICE

This concludes formal consultation for the Willow MDP. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law), and if:

1. The amount or extent of incidental take for listed species is exceeded over the life of the project;

    a. More than 26 spectacled eider nests lost due to disturbance;

[8] Reporting collisions of non-listed species may be valuable as surrogates in assessing the frequency of collision events, and factors contributing to their occurrence.

b. More than 10 adult and/or fledged juvenile spectacled eider attributed to collisions with Willow MDP structures or vessels; or

c. If human-polar bear interactions result in injury of more than 2 polar bear over the life of the project.

2. New information reveals effects of the action that may affect listed species in a manner or to an extent not considered in this opinion (e.g., if observations in the Willow MDP Action Area indicate levels of human-polar bear interactions, especially the need for hazing, is increasing significantly over time, or is resulting in chronic or repeated interference with normal polar bear behavior).

3. The agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or

4. A new species is listed or critical habitat is designated that may be affected by the action.

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APPENDIX A

Below we provide the approach and calculations used to estimate impacts to listed eiders resulting from collisions with barges associated with the Willow MDP.

Aircraft landings and on-tundra activities
An absence of empirical data makes it difficult to estimate the effect of aircraft landings and tundra-based activities upon nesting and brood-rearing listed eiders. Our estimates are therefore based on a series of assumptions. Landing close to a nest would likely flush the incubating female and prevent her from returning for as long as the aircraft and associated human activity remain near the nest. We assume that all hens within a 600-m radius of a landing site will be flushed, and nests will subsequently be at increased risk of abandonment or depredation. The likelihood of a nesting hen flushing, and her reluctance to return to the nest, is assumed to decrease as distance from human activity increases. We assume no effects to nesting hens outside of this 600-m radius. We also assume the 600-m radius centered on the landing site would encompass the area affected by associated on-tundra activities. After landing, project personnel would conduct work over an unspecified area.

Effects of disturbance associated with the proposed activities could result in reduced production of listed eiders, and we estimate effects of proposed activities on listed eider production using the following multi-step process:

1. Using the assumptions described above, we estimate potential effects of aircraft and human disturbance on eider nest success would occur within a 600-m radius, or 1.13 km^2 area, at each landing site, and multiply this area of impact by the total number of sites expected annually.
2. We then use our assumption regarding distance over which take-offs/landings may affect eider nests, combined with estimates of eider density, to estimate the number of nests potentially subject to disturbance each year.
3. Finally, because not all nests subjected to disturbance would be expected to fail, we multiply the estimated reduction in nest success by the number of nests potentially disturbed, calculated in Step 3, to estimate the total number of nest failures that could result from aircraft activities in 2020.

The applicant estimates 25 to 96 on-tundra helicopter landings each year during the spectacled eider nesting period (BLM email 10 April, 2020). The number of listed eider nests potentially disturbed near landing sites was estimated by multiplying the area impacted at each site (600-m radius, area of 1.13 km^2) by the maximum number of landings proposed each year: 96, and estimated average nest density for spectacled eiders in the Action Area as follows:

1.13 km^2 × 96 sites = 108.48 km^2 affected,
0.015 spectacled eider nests/km^2 × 108.48 km^2 = 1.63 spectacled eider nests potentially disturbed annually, and

1.63 nests disturbed/year × 30 years = 48.82 spectacled eider nests disturbed over the project life

Using Mayfield methods, Bowman and Stehn (2003) estimated nest survival for spectacled eiders on the Y-K Delta in 1994–2002 to be 0.678. At Utqiaġvik, nest survival calculated using Mayfield methods has ranged from 0.20 (95% CI: 0.05–0.42) to 0.62 (95% CI: 0.28–0.83) between 2013 and 2017 (Safine 2011; Graff 2018). Therefore, it is clear that not all nests will survive to hatching and survival rates vary among years and areas.

We would not expect all nests from which females flush to be abandoned or depredated. For example, a site visit including one helicopter landing and human presence lasting 15 minutes would presumably result in lower risk of nest abandonment than a site visit requiring several landings and 8-10 hours of on-tundra activity; however, the difference is difficult to quantify. Human disturbance at spectacled eider nests on the Yukon-Kuskokwim Delta (Y-K Delta) reportedly reduced nest success by a mean of 9.9% (Grand and Flint 1997; Bowman and Stehn 2003). Although the likelihood of nest abandonment or depredation resulting from aircraft landings and on-tundra activities would presumably vary with the number, frequency, and duration of landings, and the type of activities at each site, we assume effects of disturbance on nest success reported on the Y-K Delta would roughly approximate the effects of on-tundra helicopter researcher disturbance from on-tundra helicopter landings associated with the Willow MDP. Therefore, we assume one disturbance event (e.g., a hen is flushed once during landing and does not return before takeoff) could reduce nest success by 9.9% (rounded to 10%). However, in situations where the hen is flushed twice (i.e., the hen is flushed during landing, returns to the nest, and is flushed again during takeoff) we assume the effects would be roughly double, or 19.8% (rounded to 20%). Assuming a worst-case or most impactful scenario, we apply the latter scenario here because the duration of on-tundra activities between landing and takeoff is unknown and may allow sufficient time for the hen to return, potentially resulting in a second flush from the nest.

> 48.82 spectacled eider nests potentially disturbed × 0.20 = 9.76 spectacled eider nests lost due to disturbance

<u>Biases in assumptions</u>
Our assumptions in this analysis contain a number of biases, likely contributing to an inflated (i.e., conservative) estimate of loss of production due to disturbance associated with the proposed activities.

1. Our estimate of the number of nests within a 600-m radius (1.13 km^2) of aircraft landing sites, is based on the assumption each listed eider pair sighted during the ACP aerial surveys subsequently nests; however, an unknown proportion of these pairs may not nest. Thus, our initial estimate of nest density may be biased high.
2. The area impacted by helicopter sites may be smaller than the 1.13 km^2 zone of influence used in the effects analysis. We assume the 1.13 km^2 zone of influence includes potential nest disturbance from on-tundra activities beyond the discrete location of the landing site, although this area may be smaller if activities take place within a smaller footprint. Therefore, it is possible that helicopter landings/takeoffs would disturb nesting hens within a much smaller zone of influence around the landing site (although the radius of this zone is unclear and likely varies among sites). Thus, our calculations may overestimate the number of nests potentially disturbed.

3. We base our estimates of the magnitude to which disturbance may decrease nest success on studies in which researchers intentionally flushed eiders from nests, whereas in the proposed action, project personnel would not deliberately flush hens.
4. We are unable to separate activities into those that occur during the nesting, brood-rearing, and post-fledging periods based on the information available to us; therefore, we have assumed that all activities have similar impacts on nest success regardless of timing.

For these reasons, we have likely overestimated impacts of disturbance associated with the proposed activities on nest success. Nonetheless, these estimates are based on the best information available. Using this process, we estimate loss of production from a total of 10 spectacled eider nests due to disturbance associated with on-tundra aircraft landings over the life of the project.

Collisions with vessels

As discussed in the *Environmental Baseline*, migratory birds suffer considerable mortality from collisions with anthropogenic objects. Spectacled and Steller's eiders migrating east during spring and west during summer/fall would be at risk of colliding with vessels in the MTR. Using the best available information, we provide an estimate of collision risk for listed eiders from barge traffic associated with the Willow MDP. We first calculate the *per capita* risk of collision per vessel operating during a single season in the Chukchi and Beaufort seas, using observations of vessel collisions collected by biological observers in a structured monitoring and reporting effort during Royal Dutch Shell's (Shell) 2012 Exploratory Program. Observers on ten vessels operating in the Chukchi Sea for 108 days recorded 131 total bird-vessel encounters, 17 of which were fatal collisions between eiders (13 king and 4 common eiders) and vessels (M. Schroeder, BOEM, unpubl. obs, pers.comm.). Of these 17 collisions, two involved mobile offshore drilling units, while the other 15 involved support vessels, which are reasonably similar to the barges currently planned for use in the Willow MDP. Considering that 10 vessels were involved in 15 fatal eider collisions, we estimate average collision rate per vessel to be 1.5 (i.e., 15 ÷ 10 = 1.5 collisions/vessel) over a 108-day season.

These rates are based on reported collisions for king and common eiders during a single shortened industry season in the Chukchi Sea. Listed eiders were not among the sea duck collisions recorded in 2012; however, spectacled and Steller's eiders moving through the Bering, Chukchi, and Beaufort seas during barging operations for the Willow MDP would also be at risk of colliding with the proposed barges, presumably in proportion to their relative abundance in sea duck populations. Assuming spectacled and Steller's eiders are roughly as vulnerable to collisions as king and common eiders (and we have no basis to assume otherwise), we believe information on *per capita* collision rates of much more abundant king and common eiders can be used to reasonably approximate collision rates for less abundant spectacled and Steller's eiders. To do this, we considered the number of observed collisions for eiders during Shell's 2012 exploratory season in the Chukchi Sea, combined with the estimated number of eiders migrating through the region, which were theoretically exposed to collision risk.

Based on a total of 705,380 eiders (529,271 king and 176,109 common eiders) recorded during migration counts near Utqiaġvik in late summer and fall of 2002 (Quakenbush et al. 2004)[9], we very roughly estimate the *per capita risk* of collision for each vessel operating offshore in the Chukchi Sea to be:

1.5 collisions per vessel per season ÷ 705,380 eiders = 0.0000021 collisions per eider-vessel- season

We then estimate the risk of collision for spectacled and Steller's eiders migrating through the Bering, Chukchi, and Beaufort seas, by multiplying the collision rate per eider (described above), by the estimated abundance of spectacled and Steller's eiders from pre-nesting aerial survey data for the North Slope. The most recent estimate of the number of spectacled eiders breeding on the ACP, in 2019, is 5,108 (SE = 725; from Wilson et al. 2017a; E. Osnas, USFWS, pers. comm.), and the most recent estimate for Steller's eiders on the ACP is 308 (95% CI = 216 – 422; E. Osnas and C. Frost, USFWS, pers. comm).

We can then roughly estimate the risk of collision for spectacled and Steller's eiders migrating through the Bering, Chukchi, and Beaufort seas, by multiplying the individual eider collision rate (described above), by the estimated total number of spectacled eiders on the ACP:

5,108 spectacled eiders × 0.0000021 collisions per vessel per season = 0.011 spectacled eiders per vessel per season

and

308 Steller's eiders × 0.0000021 collisions per vessel per season = 0.0006 Steller's eiders per vessel per season

If these figures represent the number of collisions expected per vessel moving through the Bering, Beaufort, and Chukchi seas, we can then approximate collision exposure from approximately 404 and 86 vessel trips[10] for spectacled and Steller's eiders, respectively, over the life of the project:

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[9] This survey was based on observed counts from a fixed location. It employed a subset of time intervals and extrapolated the data to account for intervals during which no observations were made. Because the majority of king and common eiders nest in Northern Canada, we believe these counts reasonably estimate the number of king and common eiders passing through Arctic Alaska. Listed eiders were not detected during these migration counts, presumably due to the comparative scarcity and identification challenges for spectacled and Steller's eiders.

[10] The applicant estimates 33 barges and 53 ocean-going tugs would operate in the MTR within the range of spectacled and Alaska-breeding Steller's eiders during 4 years of construction. Additionally, 318 support vessel trips (e.g., support vessels, screeding barges, etc.) would take place near Oliktok Dock. Because Steller's eiders occur at such low numbers in northeastern NPR-A, we anticipate only spectacled eiders would be exposed to additional collision risk from support vessel operations. Therefore, species-specific collision risk is expected to be:

> 33 barges + 53 ocean-going tugs + 318 Oliktok support vessels = collision exposure from 404 vessel trips for spectacled eiders; and
> 33 barges + 53 ocean-going tugs = collision exposure from 86 vessel trips for Steller's eiders.

0.011 spectacled eiders per vessel season × 404 vessel trips = 4.44 spectacled eiders

and

0.0006 Steller's eiders per vessel per season × 86 vessel trips = 0.05 Steller's eiders

We then make a final adjustment to this estimate. The estimate above was derived from a 108-day season during Shell's 2012 exploration campaign, whereas a typical open-water season, in which marine vessels could potentially operate, is approximately 150 days. Although we expect the proposed barging operations (i.e., vessel trips) would be of shorter duration (likely much shorter) than the length of a typical open-water season, we also acknowledge the timing of barge operations would be difficult to estimate with precision due to a number of factors including seasonal variation in sea ice conditions and marine forecasts. Therefore, lacking greater certainty in barge operation timing, we conservatively extrapolated our estimate to cover a full open-water season. We believe this significantly overestimates the number of days that vessels would be underway and present in waters where listed eiders occur, and therefore represents a substantial overestimation of collision risk to listed eiders.

Therefore, we adjusted the calculations to estimate collisions over approximately 150-days of a typical open-water season as follows:

4.44 spectacled eider collisions ÷ 108 days = 0.041 collisions per day; therefore,

0.041 collisions per day × 150 days = 6.2 spectacled eider collisions

and

0.05 Steller's eider collisions ÷ 108 days = 0.00047 collisions per day; therefore,

0.00047 collisions per day × 150 days = 0.07 Steller's eider collisions

The reliability of these estimates may be limited by several factors. For example, 1) collisions are often episodic, and those resulting from light attraction in inclement weather may be particularly so, such that observations collected on a few structures/vessels in a single year may not be representative of collision rates in general, 2) monitoring for collisions is difficult and an unknown number of collisions may go undetected, even by trained bird observers, and 3) low visibility often coincides with increased collisions (Ronconi et al. 2015), which may increase the number of undetected collisions. We also note that assuming vessels transits would persist for the entire 150-day open-water season likely results in a substantial overestimate of collision risk. However, these estimates are based on the best information available.

APPENDIX B

Below we provide a complete description and results of the polar bear den simulation model used to assess impacts to denning polar bears from disturbance associated with all phases of the proposed project.

Den simulation

To simulate dens on the landscape, we relied on the estimated number of dens in three different regions of northern Alaska provided by Atwood et al. (2020). These included the NPRA, the area between the Colville and Canning rivers (CC), and ANWR. The mean estimated number of dens in each region during a given winter were as follows: 12 dens (95% CI : 3-26) in the NPRA, 26 dens (11-48) in the CC region, and 14 dens (5-30) in ANWR (Atwood et al. 2020). For each iteration of the model (described below), we drew a random sample from a gamma distribution for each of the regions based on the above parameter estimates which allowed uncertainty in the number of dens in each area to be perpetuated through the modeling process. Specifically, we used the method of moments (Hobbs and Hooten 2015) to develop the shape and rate parameters for the gamma distributions as follows: NPRA ($12^2/5.8^2$,$12/5.8^2$), CC ($26^2/9.5^2$,$26/9.5^2$), and ANWR ($14^2/6.3^2$,$14/6.3^2$).

Because not all areas in northern Alaska are equally-used for denning and some areas do not contain the requisite topographic attributes required for sufficient snow accumulation for den excavation, we did not simply randomly place dens on the landscape. Instead, we followed a similar approach to that used by Wilson and Durner (2020). For each iteration of the model, we randomly distributed dens across areas identified as denning habitat (Durner et al. 2006a, 2013), with the probability of a den occurring at a given location being proportional to the density of dens predicted by a kernel density map. The kernel density map was developed by using known den locations in northern Alaska identified either by GPS-collared bears or through systematic surveys for denning bears (Durner et al. 2020). To approximate the distribution of dens we used a scaled adaptive kernel density estimator applied to n observed den locations, which took the form $\mathrm{f}(\mathbf{s}) \propto \frac{\theta z(\mathbf{s})}{n}\sum_i^n \mathrm{k}\left(\frac{\mathbf{s}}{\mathrm{h}(\mathbf{s})}\right)$, where the adaptive bandwidth $\mathrm{h}(\boldsymbol{s}) = \left(\beta_0 + \beta_1 I(\boldsymbol{s}_i \in \mathcal{M}) I(\boldsymbol{s} \in \mathcal{M})\right)\beta_2 z(\boldsymbol{s})$ for the location of the ith den and each location $\mathbf{s}$ in the study area. An east-west gradient $z(\boldsymbol{s})$ scaled the density and bandwidth to account for lower sampling effort in western areas, and the indicator functions allowed the bandwidth to vary abruptly between the mainland $\mathcal{M}$ and barrier islands. The parameters θ, β_0, β_1, β_2 were chosen so that the density estimate approximated the observed density of dens and our understanding of likely den locations in areas with low sampling effort.

For each simulated den, we assigned dates of key denning events; den entrance, birth of cubs, when cubs reached 60 days of age, den emergence, and departure from the den site after emergence. These represent the chronology of each den under undisturbed conditions. We selected the entrance date for each den from a normal distribution parameterized by entrance dates of radio-collared bears in the SB subpopulation that denned on land included in Rode et al. (2018) and published in Atwood et al. (2020) (n = 52, mean = 11 November, SD = 18 days); we truncated this distribution to ensure that all simulated dates occurred within the range of observed values (i.e., 12 Sep to 22 Dec) +/- one week. We selected a date of birth for each litter from a uniform distribution with a range of 1 December to 15 January; the period of time when most cubs are believed to be born (Messier et al. 1994, Van de Velde et al. 2003). We selected the emergence date as a random draw from an asymmetric Laplace distribution with parameters μ=81.0, σ=4.79, and p=0.79 estimated from the empirical emergence dates in Rode et al. (2018) and published in Atwood et al. (2020) (n=52) of radio-collared bears in the SB subpopulation that denned on land using the mleALD function from package 'ald' (Galarzar and Lachos 2018) in program R (R Core Development Team). We constrained simulated emergence dates to occur within the range of observed emergence dates (9 Jan to 9 Apr) +/- one week and to not occur prior to cubs reaching an age of 60 days. Finally, we assigned the number of days each family group spent at the den site post-emergence based on values reported in three behavioral studies, Smith et al. (2007, 2013) and Robinson (2014), which monitored dens near the target area immediately after emergence (n = 25 dens). Specifically, we used the mean (8.3) and SD (5.6) of the dens monitored in these studies to parameterize a gamma distribution using the method of moments (Hobbs and Hooten 2015) with a shape parameter equal to $8.3^2/5.6^2$ and a rate parameter equal to $8.3/5.6^2$; we selected a post-emergence, pre-departure time for each den from this distribution. Additionally, we assigned each den a litter size by drawing the number of cubs from a multinomial distribution with probabilities derived from litter sizes (n = 25 litters) reported in Smith et al. (2007, 2010, 2013) and Robinson (2014). Because there is some probability that a female naturally emerges with 0 cubs, we also wanted to ensure this scenario was captured. It is difficult to parameterize the probability of litter size equal to 0 because it is rarely observed. We therefore assumed that dens in the USGS dataset (Atwood et al., 2020) that had denning durations less than the shortest den duration where a female was later observed with cubs (i.e., 79 days). There were only 3 bears in the USGS data (Atwood et al., 2020) that met this criteria, leading to an assumed probability of a litter size of 0 at emergence being 0.07. We therefore assigned the probability of 0, 1, 2 or 3 cubs as 0.07, 0.15, 0.71, and 0.07, respectively.

Infrastructure and human activities
The model developed by Wilson and Durner (2020) provides a template for estimating the level of potential impact to denning polar bears of proposed activities while also considering the natural denning ecology of polar bears in the region. The approach developed by Wilson and Durner (2020) also allows for the incorporation of uncertainty in both the metric associated with denning bears and in the timing and spatial patterns of proposed activities when precise information on those activities is unavailable. Based on information provided in the application, we overlaid proposed infrastructure (e.g., ice roads, pads, roads, and the mine site) with simulated dens to determine which simulated dens were potentially exposed to disturbance. We assumed any dens within 1 mile (1.6 km) from infrastructure was exposed to disturbance.

Aerial infrared surveys
We assumed that all proposed development would have a single aerial infrared (AIR) survey flown each winter of the 30 year project period. We applied the same approach as Wilson and Durner (2020) to simulate if a den was detected during an AIR survey, including the assumption that dens with snow depths > 100 cm would be unavailable for detection by AIR (Amstrup et al. 2004b, Robinson et al. 2014). For those dens that were detected during a simulated AIR survey, we assumed effective mitigation measures would be put in place to avoid further disturbance to the den until after bears emerged from and departed the den. We did allow, however, for surveyed dens to potentially be disturbed by AIR survey flights.

Model implementation
For each iteration of the model, we first determined which dens were exposed to the proposed infrastructure (including seasonal ice roads and pads). We assumed that any den within 1 mile of infrastructure or human activities was exposed (MacGillivray et al. 2003, Larson et al. 2020), excluding those detected during an AIR survey. We then identified the stage in the denning cycle when the exposure occurred based on the date range of the activities the den was exposed to: den establishment (i.e., initial entrance into den until cubs are born), early denning (i.e., birth of cubs until they are 60 days old), late denning (i.e., date cubs are 60 days old until den emergence) and post-emergence (i.e., the date of den emergence until permanent departure from the den site). We then determined whether the exposure elicited a response by the denning bear based on probabilities derived from the reviewed case studies. Specifically, for discrete and repeated exposures during each period, we divided the number of cases that documented responses associated with either a Level B, Level A, or lethal take (i.e., cub abandonment) of bears by the total number of cases with that combination of period and exposure type (Table B1). Level B take was applicable to both adults and cubs, if present, whereas Level A and lethal take were only applicable to cubs. For the sake of this analysis, we only focused on lethal and serious Level A takes of cubs during the early denning, late denning, and post-emergence periods.

For dens exposed to any form of continuous activity, we applied used a multinomial distribution with the probabilities of different levels of take for that period (Table B1). If the probabilities summed to <1, the remainder was assigned to a no-response class. If a disturbance was estimated to occur with the multinomial distribution, we randomly assigned the date of disturbance from the set of dates activity occurred during the specific denning period considered. For example, if a den was continuously exposed to activity during the post emergence denning period which lasted 10 days from 1-10 April and the draw from the multinomial distribution resulted in the a Lethal take, we would then randomly choose a date between 1-10 April when disturbance occurred. After a Level A or lethal take was simulated to occur, a den was not allowed to be disturbed again during the subsequent denning periods because the outcome of that denning event was already determined. We took a similar approach for dens exposed to discrete activity, whereby every day that a discrete exposure occurred, a random draw from a multinomial distribution was obtained for the probabilities associated with the denning period (Table X). If the multinomial draw indicated a disturbance occurred, the date of disturbance was recorded. For this analysis, we assumed all activity was continuous throughout the denning period, except for AIR flights, which we assumed occurred at a discrete time.

The level of take associated with a disturbance varied according to the severity and timing of the exposure (Table B1). Exposures that resulted in abandonment of cubs (during late denning or post-emergence) or emergence from dens prior to cubs reaching 60 days of age were considered lethal takes of cubs. If a disturbance resulted in den emergence prior to the date assigned to the den in the absence of disturbance, the level of take was considered serious Level-A. If a post-emergence exposure resulted in bears leaving the den site prior to the non-exposure departure date, the outcome was classified as a non-serious Level A take for each cub. Adult females received Level-B takes for any disturbance. Cubs could similarly be applied a Level-B take during the late denning and post-emergence time periods if only a behavioral response was simulated to have occurred.

We developed the code to run this model in program R (R Core Development Team 2020) and ran 1,000 iterations of the model (i.e., Monte Carlo simulation) to derive the estimated number of dens disturbed and associated levels of take. For each of the 30 years of the application, we determined the number of cubs that would have lethal of serious injury Level A take. The activity present during each year of the simulations was based on information contained in the application, so it varied during the first 10 years of the project period.

Model results

The model estimated a mean take of 2.2 cubs and a median take of 0 cubs (95% CI: 0.0 – 30.0) (lethal or serious injury) over the 30 year period of activity. During the first 9 years of activity, the model estimated a mean level of take of ~0.15 cubs each year and a median of 0, with the maximum annual mean during that period being 0.17 and the median always being 0 (95% CI: 0.0 – 2.0). After the first 9 years of activity, the model estimated an annual mean level of take of 0.075 and a median of 0 (95% CI: 0.0 – 2.0) cubs per year.

Table B1. Probability that a discrete or repeated exposure elicited a response by denning polar bears that would result in Level B, Level A, or lethal take. Level B take was applicable to both adults and cubs, if present; Level A and lethal take were applicable to cubs only and were not possible during the den establishment period, which ended with the birth of cubs. Probabilities were calculated from the analysis of 56 case studies of polar bear responses to human activity. During the early denning period, there was no Level A take for cubs, only lethal or Level B take.

Exposure type	Period	Level B	Level A	Lethal
Discrete	den establishment	0.667	NA	NA
	early denning	NA	NA	0.000
	late denning	0.091	0.909	0.000
	post-emergence	0.000	0.600	0.400
Repeated	den establishment	0.000	NA	NA
	early denning	0.000	NA	0.222
	late denning	0.650	0.200	0.050
	post-emergence	0.250	0.625	0.125

The model was also used to assess the probability that take would occur. For the 30-year life of the project we estimate that:

- The probability of 0 takes occurring is 0.841 (i.e., there is an 84% probability that 0 takes occur);
- The probability of greater or equal to 1 take occurring is 0.159 (i.e., there is a 15.9% probability that one or more take would occur); and
- The probability of greater or equal to 2 takes occurring is 0.158 (i.e., there is a 15.8% probability that two or more takes would occur).

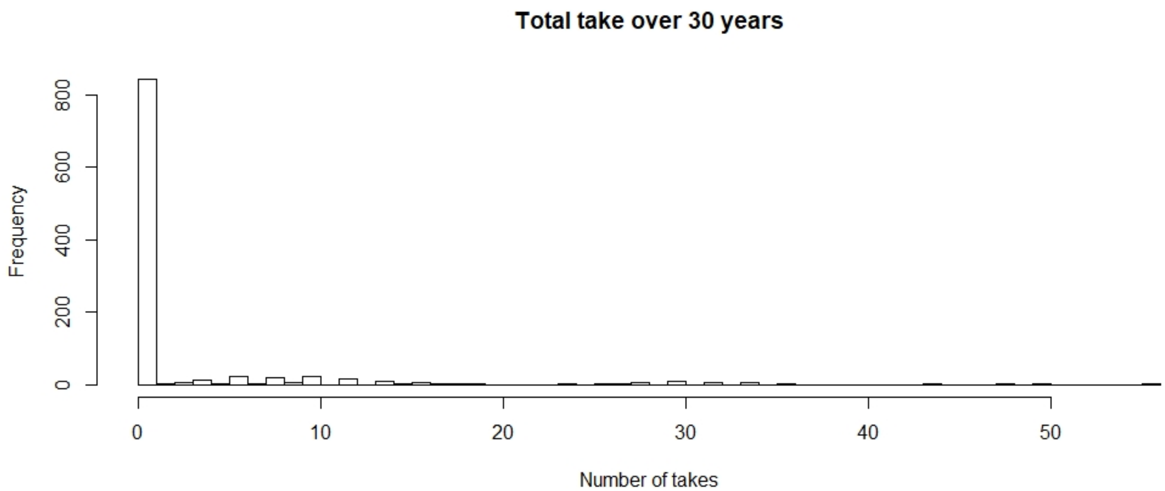

Figure B1. A histogram of the number of serious injury or lethal takes (i.e., x-axis) estimated in each of 1,000 iterations of the den disturbance model over a 30-year period. Frequency (i.e., y-axis) refers to how many of the 1,000 iterations of the model resulted in the number of takes identified on the x-axis. For example, >800 iterations of the model resulted in an estimate of 0 serious injury or lethal takes of denning polar bears.