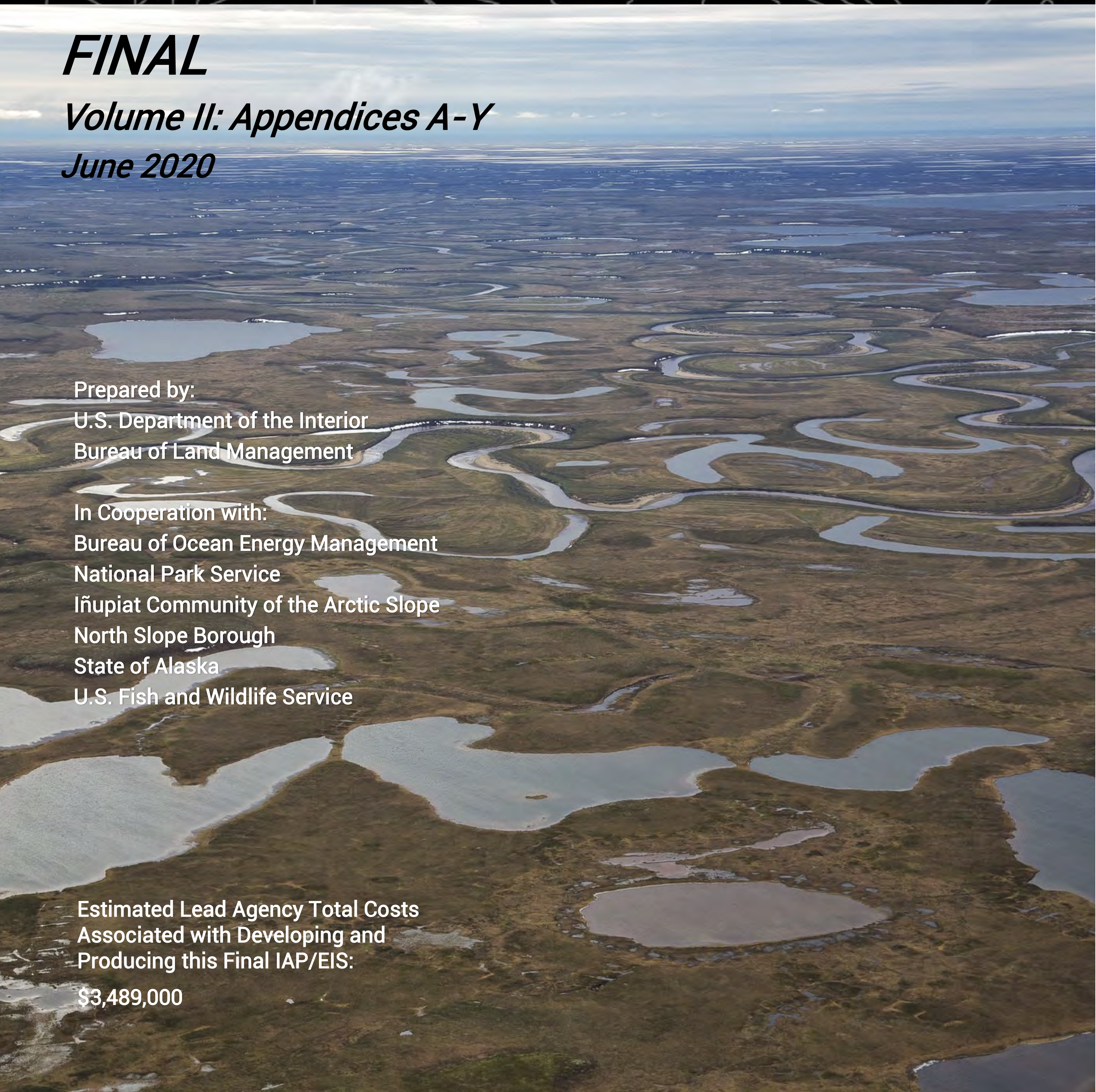
U.S. Department of the Interior
Bureau of Land Management

National Petroleum Reserve in Alaska

Integrated Activity Plan and Environmental Impact Statement



FINAL

Volume II: Appendices A-Y

June 2020

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

In Cooperation with:
Bureau of Ocean Energy Management
National Park Service
Iñupiat Community of the Arctic Slope
North Slope Borough
State of Alaska
U.S. Fish and Wildlife Service

Estimated Lead Agency Total Costs Associated with Developing and Producing this Final IAP/EIS:

$3,489,000

Mission

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

Cover Photo: Northeast National Petroleum Reserve in Alaska. Photo by Bob Wick (BLM).

DOI-BLM-AK-R000-2019-0001-EIS

BLM/AK/PL-20/018+1610+F010

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$3,489,000

APPENDICES

Appendix A
Maps

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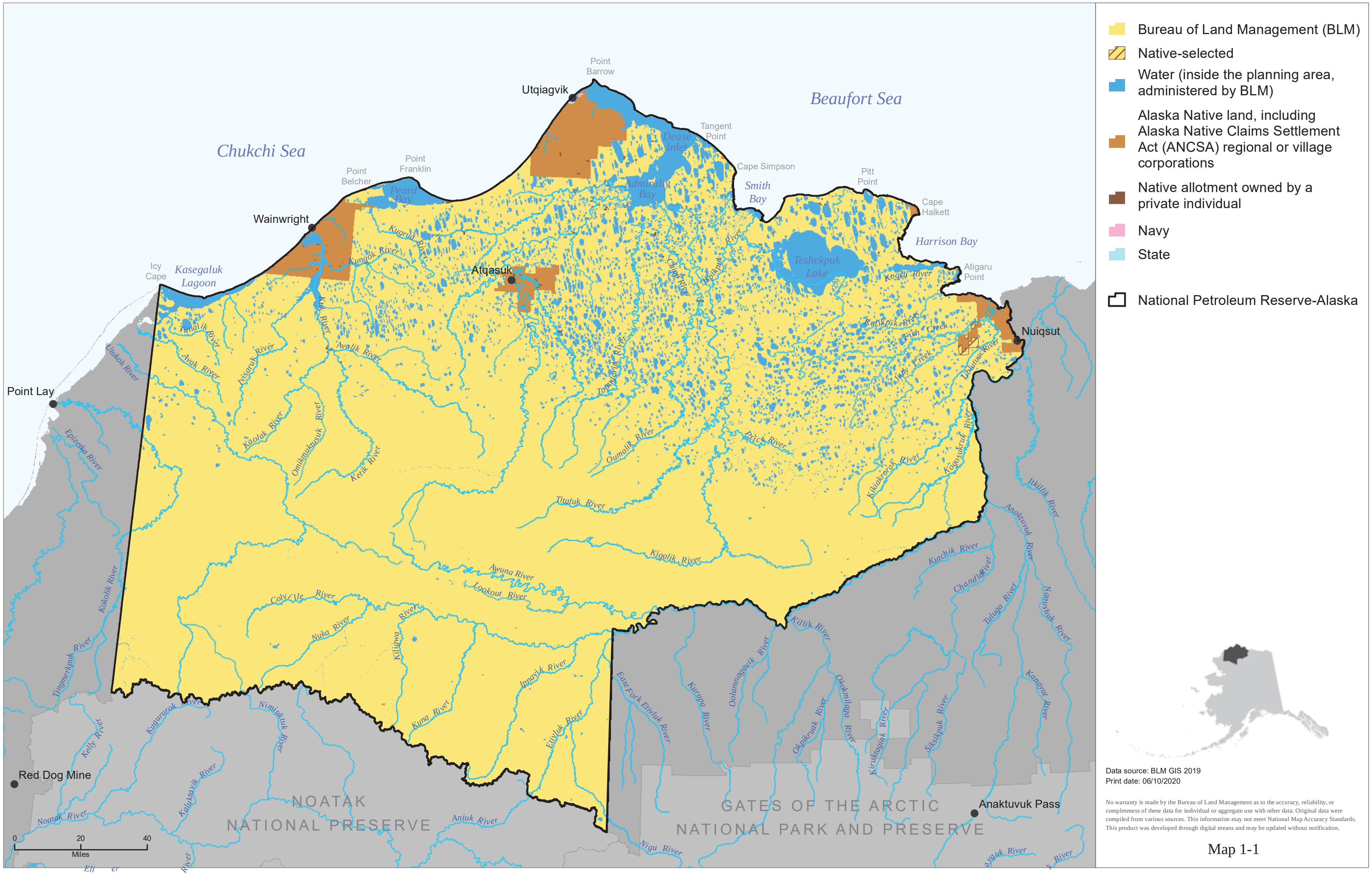
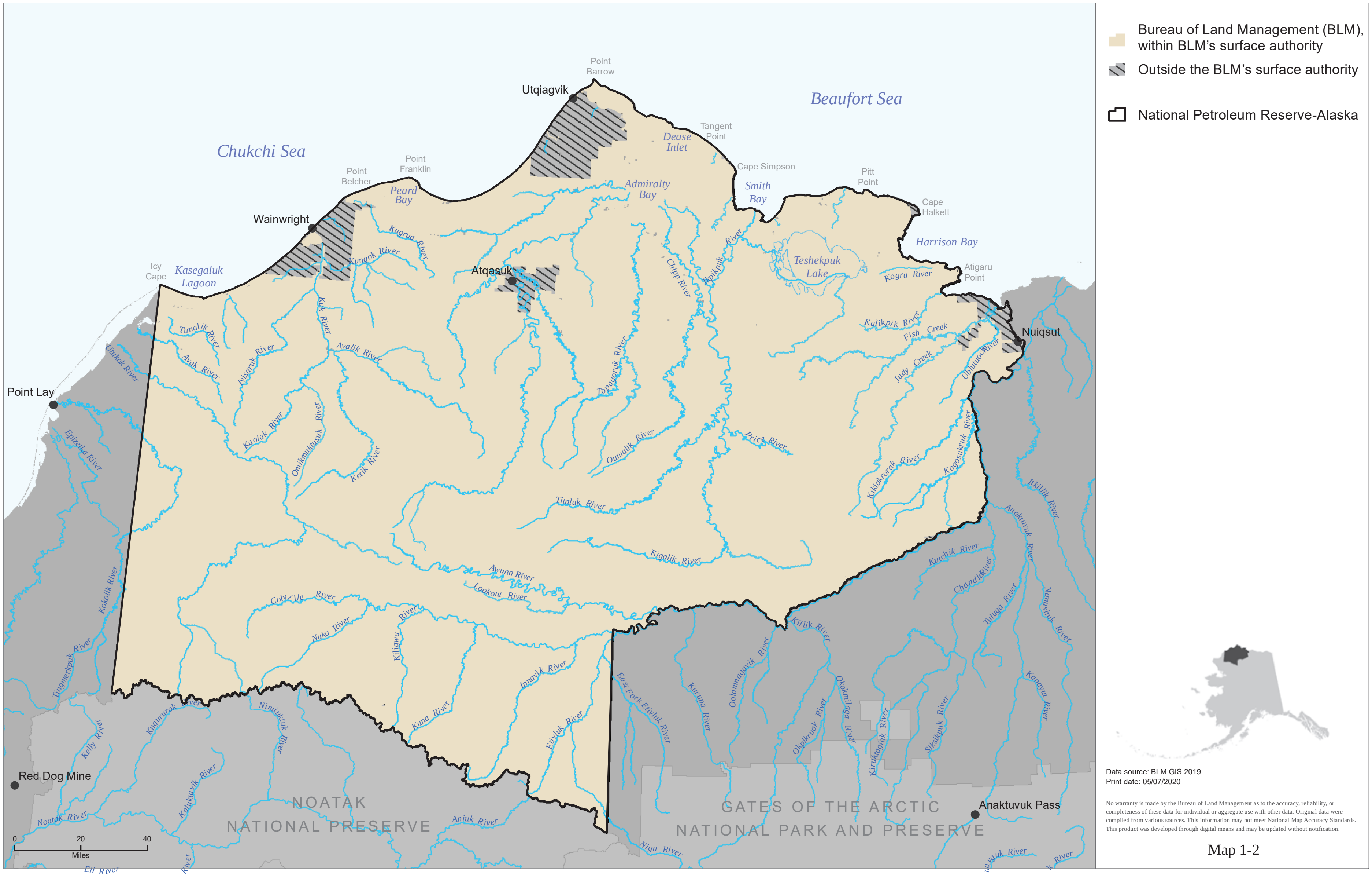
Appendix A. Maps

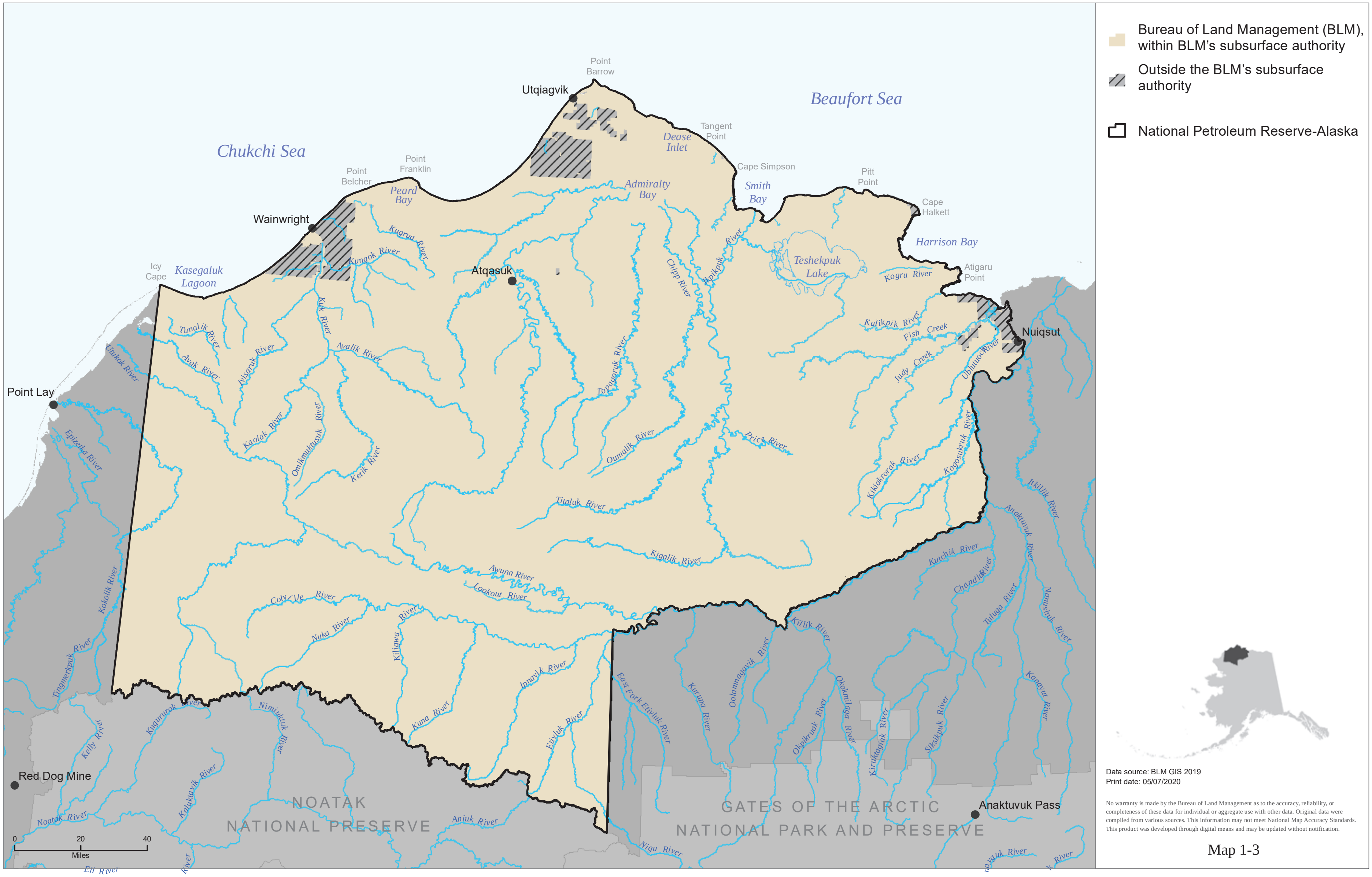

Bureau of Land Management (BLM)
Native-selected
Water (inside the planning area, administered by BLM)
Alaska Native land, including Alaska Native Claims Settlement Act (ANCSA) regional or village corporations
Native allotment owned by a private individual
Navy
State
National Petroleum Reserve-Alaska
Chukchi Sea
Beaufort Sea
Utqiagvik
Point Barrow
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
Teshekpuk Lake
Harrison Bay
Smith Bay
Dease Inlet
Admiralty Bay
Peard Bay
Kasegaluk Lagoon
Icy Cape
Point Belcher
Point Franklin
Tangent Point
Cape Simpson
Pitt Point
Cape Halkett
Atigaru Point
Colville River
Ikpikpuk River
Meade River
Kuk River
Utukok River
Kokolik River
Topagoruk River
Chipp River
Fish Creek
Judy Creek
Kogru River
Titaluk River
Kigalik River
Awuna River
Lookout River
Nuka River
Kiligwa River
Etivluk River
Ipnavik River
Killik River
Chandler River
Anaktuvuk River
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 1-1



Data source: BLM GIS 2019
Print date: 05/07/2020

Map 1-2


Bureau of Land Management (BLM), within BLM's subsurface authority
Outside the BLM's subsurface authority
National Petroleum Reserve-Alaska
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Teshekpuk Lake
Admiralty Bay
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Nuiqsut
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Kuk River
Titaluk River
Kigalik River
Awuna River
Lookout River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 05/07/2020
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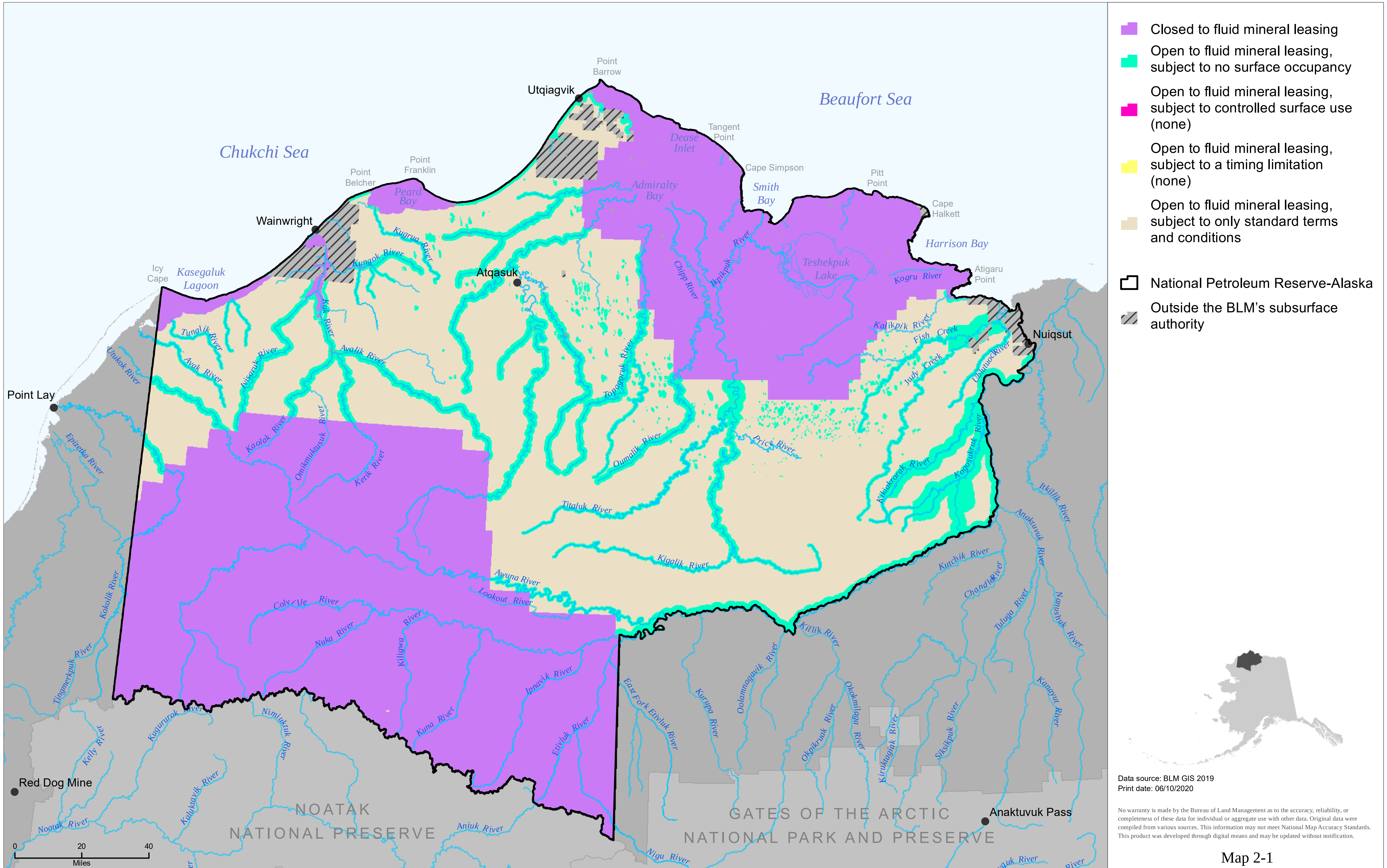
Map 1-3


Closed to fluid mineral leasing
Open to fluid mineral leasing, subject to no surface occupancy
Open to fluid mineral leasing, subject to controlled surface use (none)
Open to fluid mineral leasing, subject to a timing limitation (none)
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Kogru River
Fish Creek
Judy Creek
Titaluk River
Kigalik River
Awuna River
Lookout River
Nuka River
Killik River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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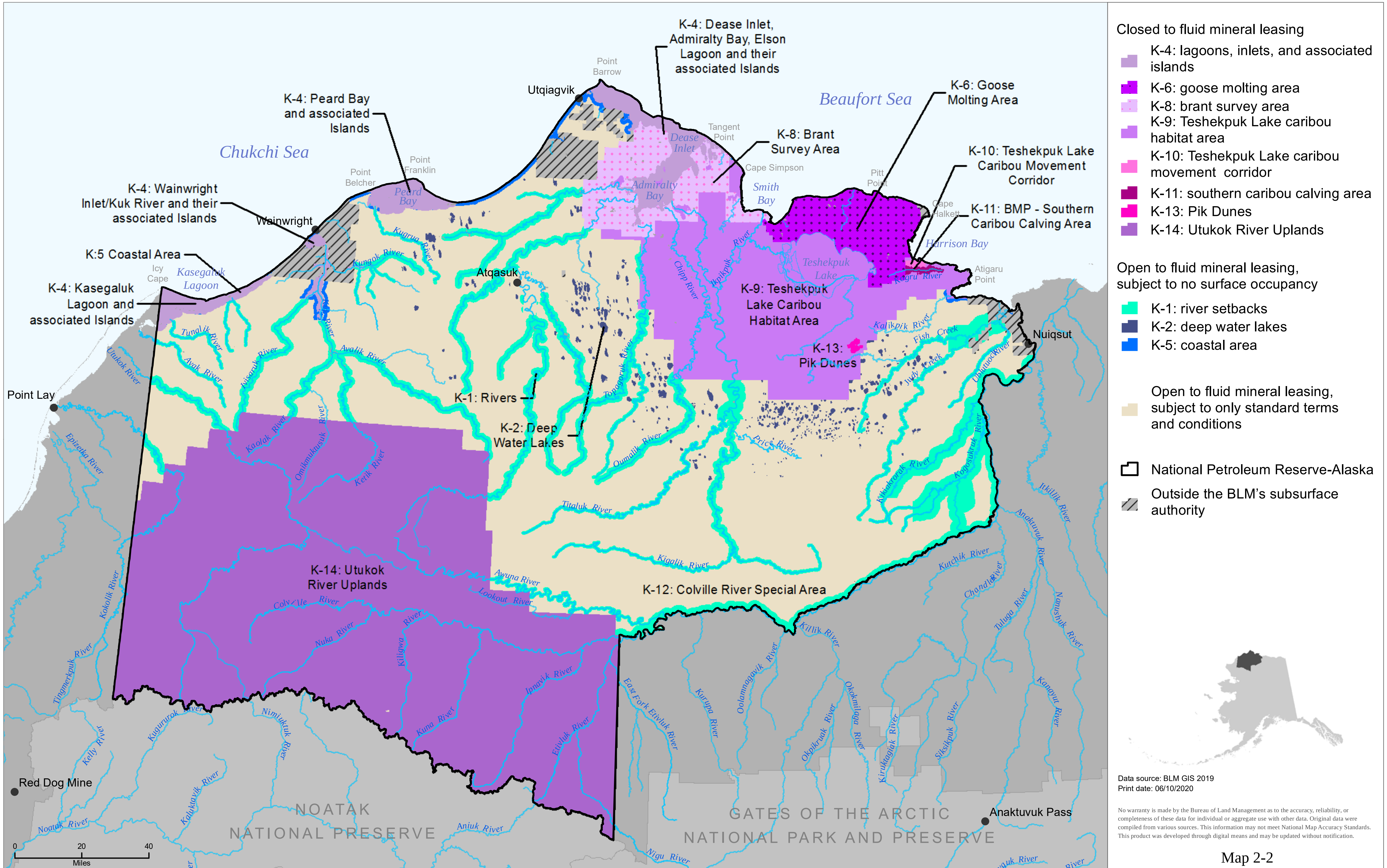
Map 2-1


K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-4: Peard Bay and associated Islands
K-6: Goose Molting Area
K-8: Brant Survey Area
K-10: Teshekpuk Lake Caribou Movement Corridor
K-11: BMP - Southern Caribou Calving Area
K-4: Wainwright Inlet/Kuk River and their associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-9: Teshekpuk Lake Caribou Habitat Area
K-13: Pik Dunes
K-1: Rivers
K-2: Deep Water Lakes
K-14: Utukok River Uplands
K-12: Colville River Special Area
Beaufort Sea
Chukchi Sea
Utqiagvik
Point Barrow
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Closed to fluid mineral leasing
K-4: lagoons, inlets, and associated islands
K-6: goose molting area
K-8: brant survey area
K-9: Teshekpuk Lake caribou habitat area
K-10: Teshekpuk Lake caribou movement corridor
K-11: southern caribou calving area
K-13: Pik Dunes
K-14: Utukok River Uplands
Open to fluid mineral leasing, subject to no surface occupancy
K-1: river setbacks
K-2: deep water lakes
K-5: coastal area
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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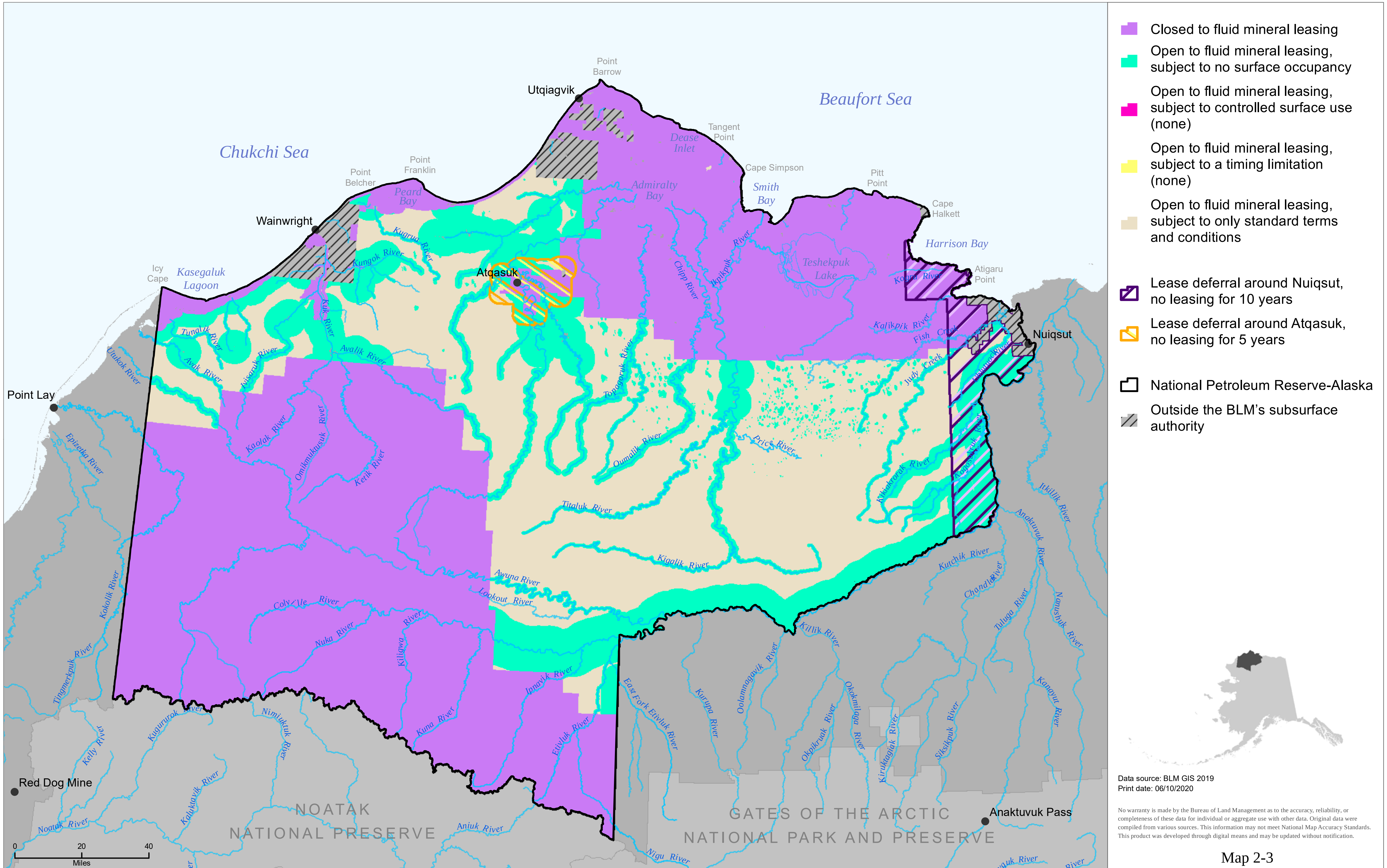
Map 2-2


Closed to fluid mineral leasing
Open to fluid mineral leasing, subject to no surface occupancy
Open to fluid mineral leasing, subject to controlled surface use (none)
Open to fluid mineral leasing, subject to a timing limitation (none)
Open to fluid mineral leasing, subject to only standard terms and conditions
Lease deferral around Nuiqsut, no leasing for 10 years
Lease deferral around Atqasuk, no leasing for 5 years
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Teshekpuk Lake
Admiralty Bay
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Topagoruk River
Meade River
Kuk River
Utukok River
Kokolik River
Ketik River
Nuka River
Kiligwa River
Awuna River
Lookout River
Titaluk River
Kigalik River
Price River
Judy Creek
Fish Creek
Kalikpik River
Chipp River
Ikillik River
Anaktuvuk River
Chandler River
Killik River
Etivluk River
Ipnavik River
Kuna River
Niglu River
Aniuk River
Noatak River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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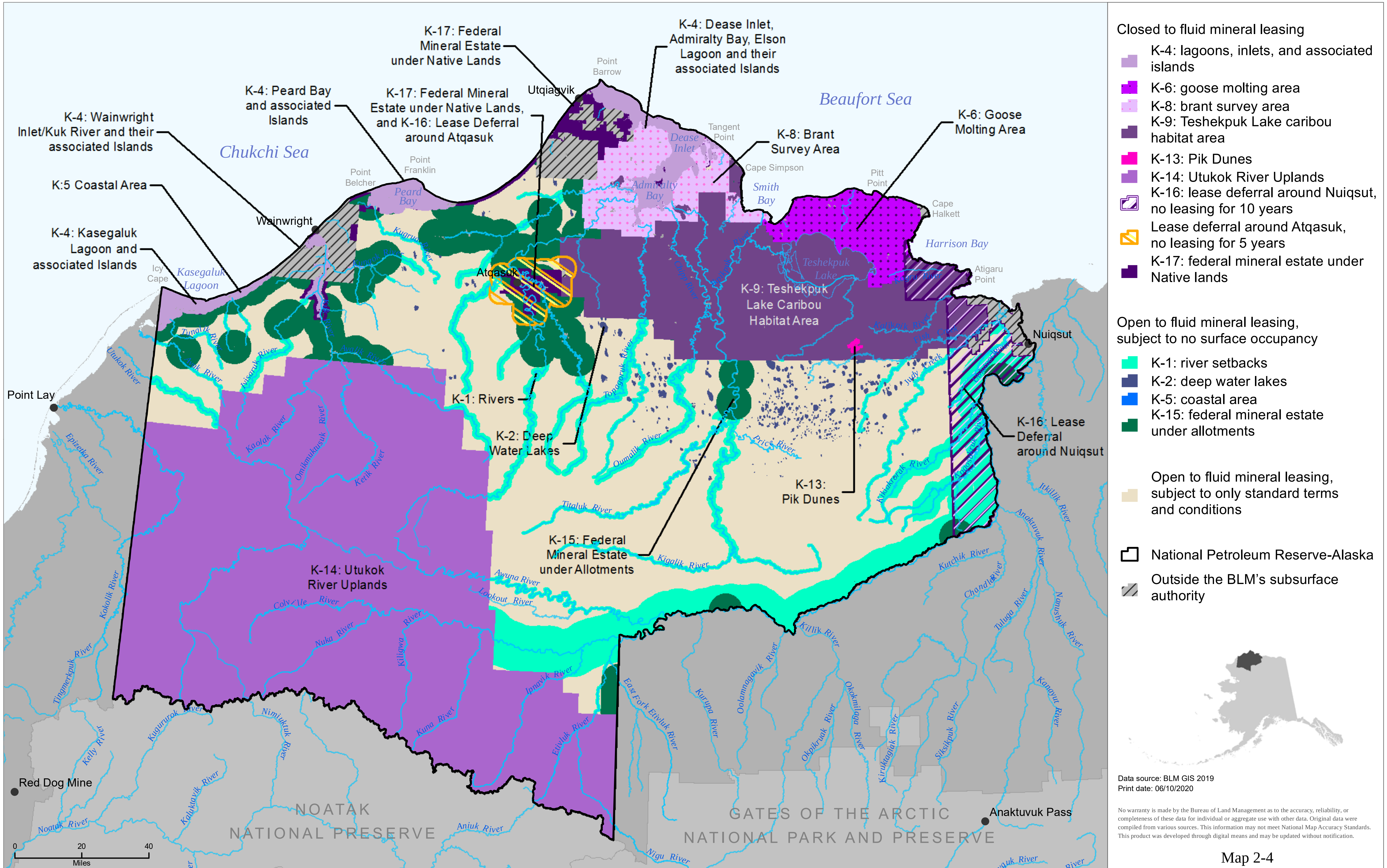
Map 2-3


K-17: Federal Mineral Estate under Native Lands
K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-4: Peard Bay and associated Islands
K-17: Federal Mineral Estate under Native Lands, and K-16: Lease Deferral around Atqasuk
K-4: Wainwright Inlet/Kuk River and their associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-8: Brant Survey Area
K-6: Goose Molting Area
K-9: Teshekpuk Lake Caribou Habitat Area
K-1: Rivers
K-2: Deep Water Lakes
K-13: Pik Dunes
K-16: Lease Deferral around Nuiqsut
K-15: Federal Mineral Estate under Allotments
K-14: Utukok River Uplands
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Utukok River
Kokolik River
Colville River
Nuka River
Kiligwa River
Kuna River
Etivluk River
Ipnavik River
Awuna River
Lookout River
Titaluk River
Kigalik River
Ikpikpuk River
Meade River
Topagoruk River
Oumalik River
Price River
Kuk River
Kaolak River
Omikmuktusuk River
Ketik River
Kugrua River
Killik River
Chandler River
Anaktuvuk River
Itkillik River
Kuchik River
Judy Creek
Fish Creek
Kikiakrorak River
Nigu River
Aniuk River
Noatak River
Kelly River
Kugururok River
Nimiuktuk River
Epizetka River
Tingmerkpuk River
0
20
40
Miles
Closed to fluid mineral leasing
K-4: lagoons, inlets, and associated islands
K-6: goose molting area
K-8: brant survey area
K-9: Teshekpuk Lake caribou habitat area
K-13: Pik Dunes
K-14: Utukok River Uplands
K-16: lease deferral around Nuiqsut, no leasing for 10 years
Lease deferral around Atqasuk, no leasing for 5 years
K-17: federal mineral estate under Native lands
Open to fluid mineral leasing, subject to no surface occupancy
K-1: river setbacks
K-2: deep water lakes
K-5: coastal area
K-15: federal mineral estate under allotments
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
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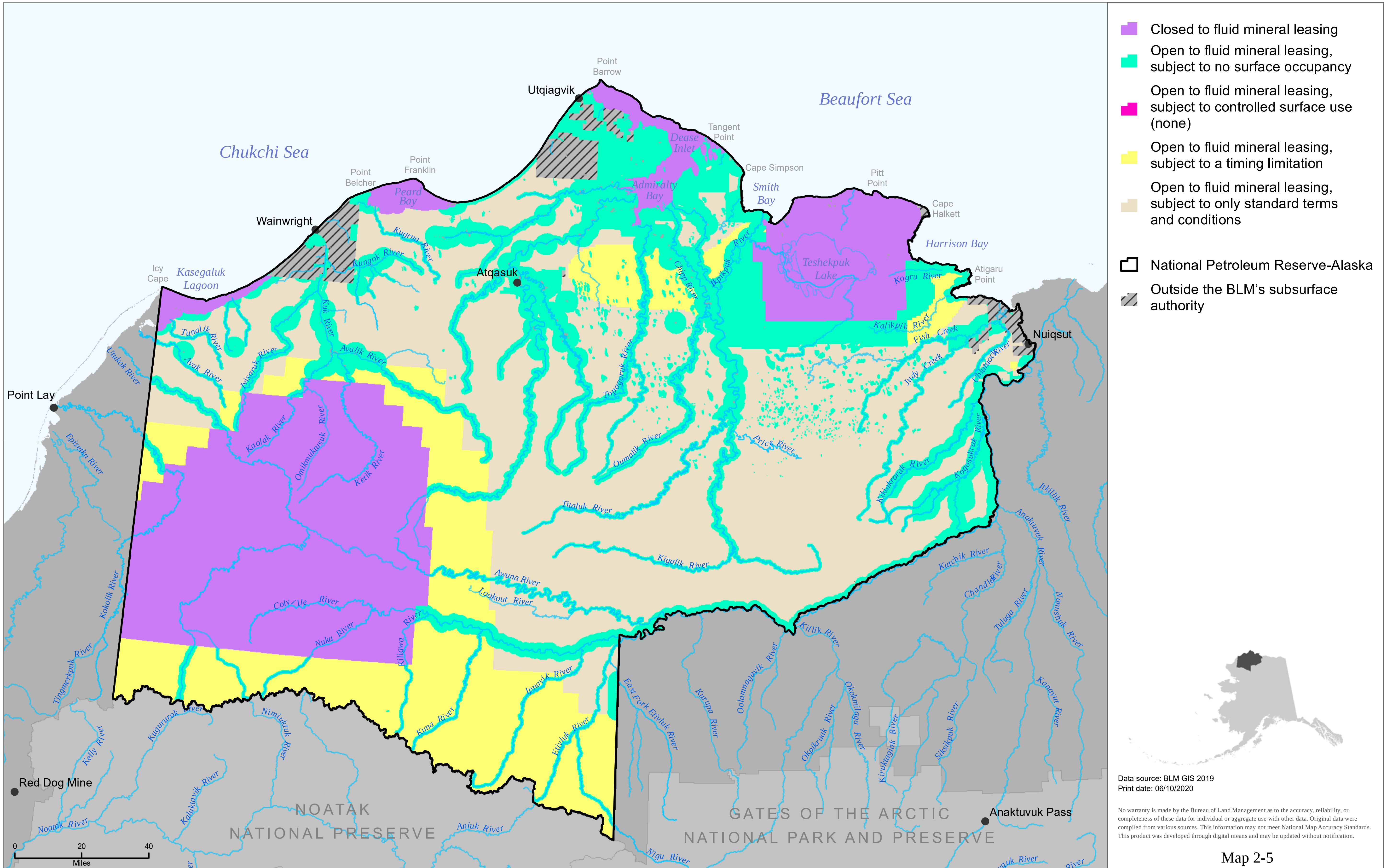
Map 2-4


Closed to fluid mineral leasing
Open to fluid mineral leasing, subject to no surface occupancy
Open to fluid mineral leasing, subject to controlled surface use (none)
Open to fluid mineral leasing, subject to a timing limitation
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
Colville River
Nuka River
Kiligwa River
Awuna River
Lookout River
Kigalik River
Titaluk River
Ikpikpuk River
Price River
Fish Creek
Judy Creek
Kalikpik River
Kogru River
Topagoruk River
Meade River
Kuk River
Avalik River
Kaolak River
Utukok River
Kokolik River
Killik River
Etivluk River
Kuna River
Ipnavik River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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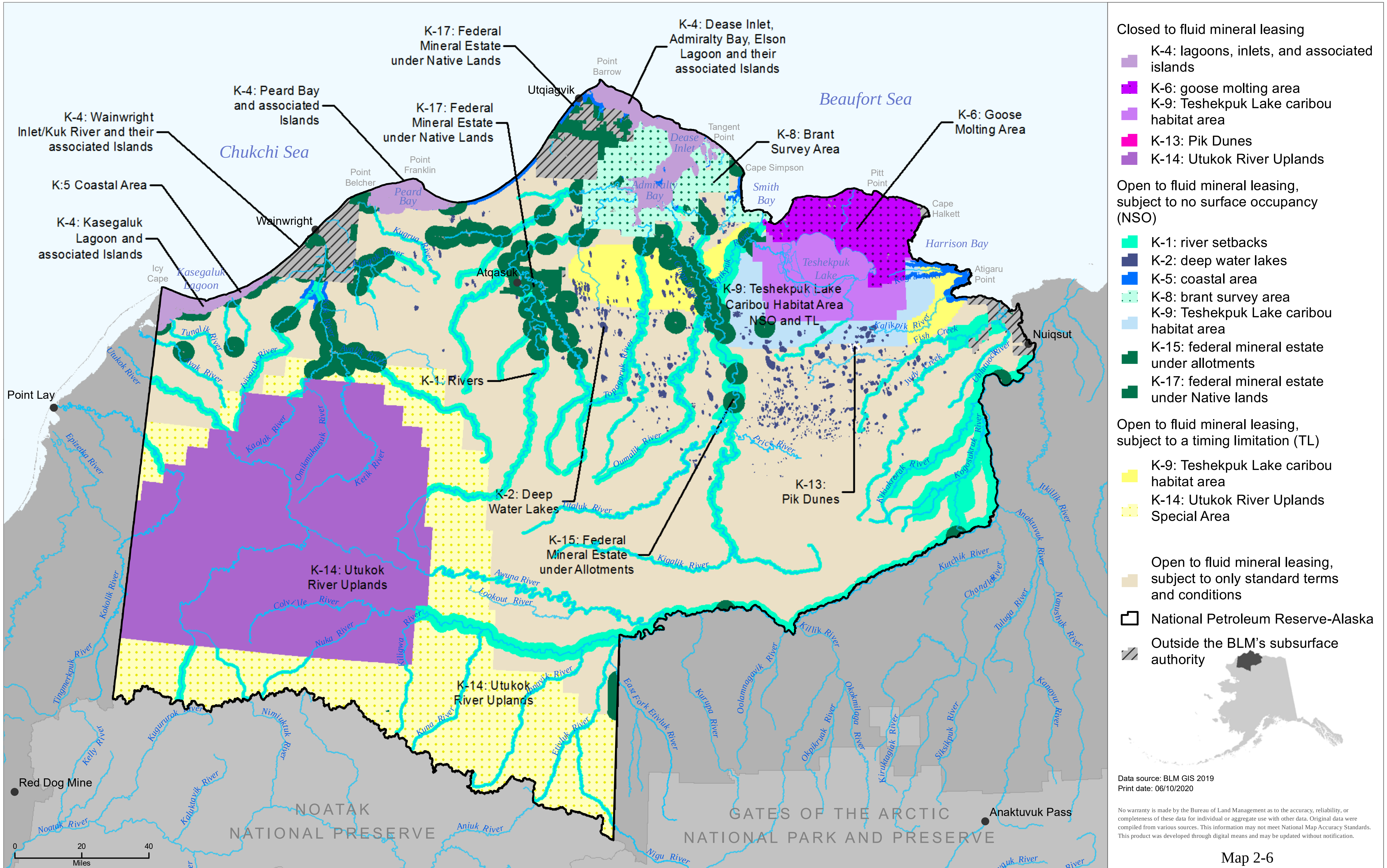
Map 2-5


K-17: Federal Mineral Estate under Native Lands
K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-4: Peard Bay and associated Islands
K-17: Federal Mineral Estate under Native Lands
K-4: Wainwright Inlet/Kuk River and their associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-8: Brant Survey Area
K-6: Goose Molting Area
Beaufort Sea
Chukchi Sea
Utqiagvik
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
K-9: Teshekpuk Lake Caribou Habitat Area NSO and TL
K-1: Rivers
K-2: Deep Water Lakes
K-15: Federal Mineral Estate under Allotments
K-13: Pik Dunes
K-14: Utukok River Uplands
K-14: Utukok River Uplands
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Closed to fluid mineral leasing
K-4: lagoons, inlets, and associated islands
K-6: goose molting area
K-9: Teshekpuk Lake caribou habitat area
K-13: Pik Dunes
K-14: Utukok River Uplands
Open to fluid mineral leasing, subject to no surface occupancy (NSO)
K-1: river setbacks
K-2: deep water lakes
K-5: coastal area
K-8: brant survey area
K-9: Teshekpuk Lake caribou habitat area
K-15: federal mineral estate under allotments
K-17: federal mineral estate under Native lands
Open to fluid mineral leasing, subject to a timing limitation (TL)
K-9: Teshekpuk Lake caribou habitat area
K-14: Utukok River Uplands Special Area
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
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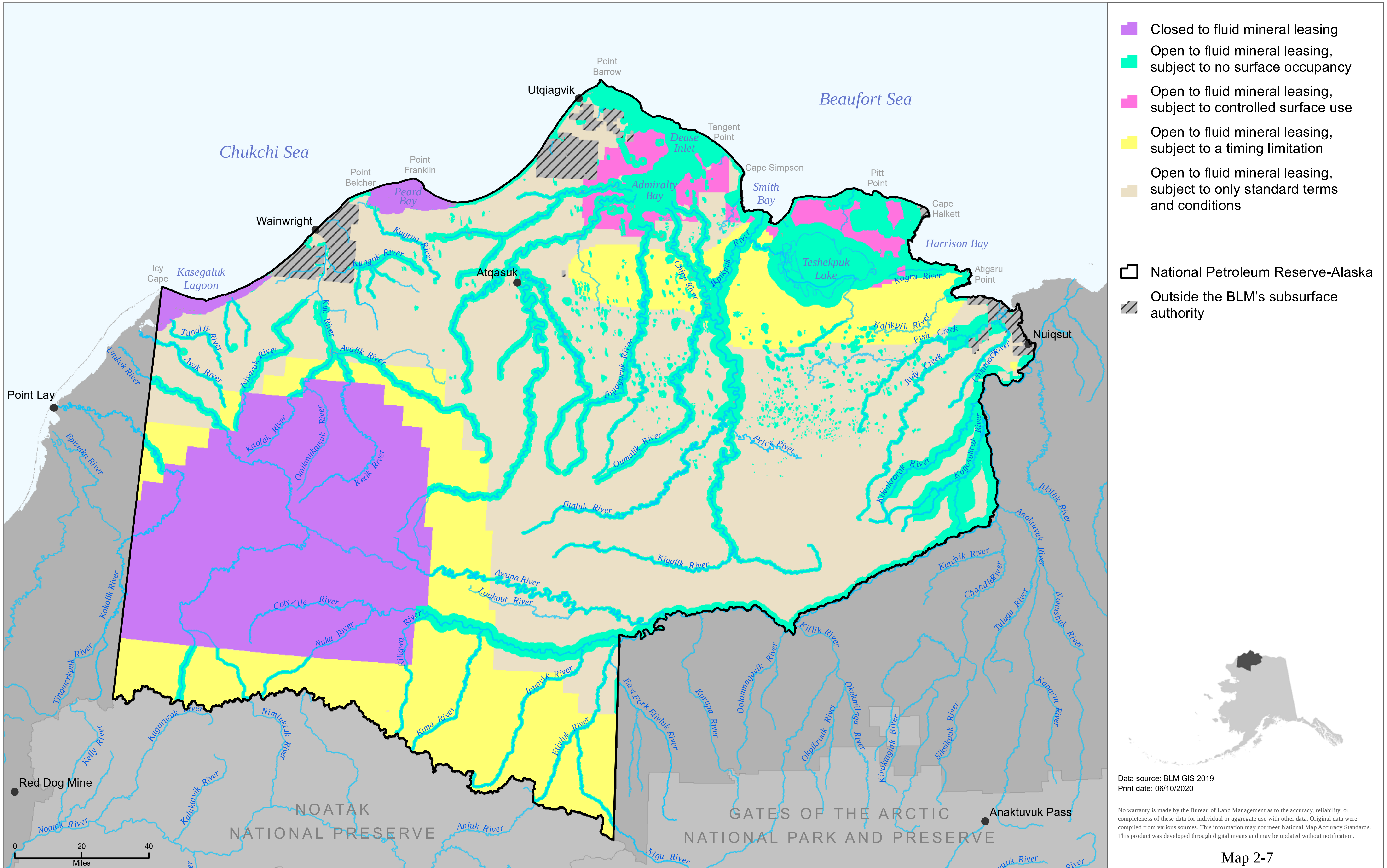
Map 2-6


Closed to fluid mineral leasing
Open to fluid mineral leasing, subject to no surface occupancy
Open to fluid mineral leasing, subject to controlled surface use
Open to fluid mineral leasing, subject to a timing limitation
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Meade River
Chipp River
Topagoruk River
Titaluk River
Kigalik River
Awuna River
Lookout River
Nuka River
Kiligwa River
Etivluk River
Kuna River
Ipnavik River
Utukok River
Kokolik River
Kuk River
Avalik River
Kugrua River
Kungok River
Tunalik River
Avak River
Ivisaruk River
Kaolak River
Omikmuktusuk River
Ketik River
Oumalik River
Price River
Kalikpik River
Kogru River
Fish Creek
Judy Creek
Ublutuoch River
Kikiakrorak River
Kogosukruk River
Killik River
Chandler River
Anaktuvuk River
Itkillik River
Nigu River
Noatak River
Kelly River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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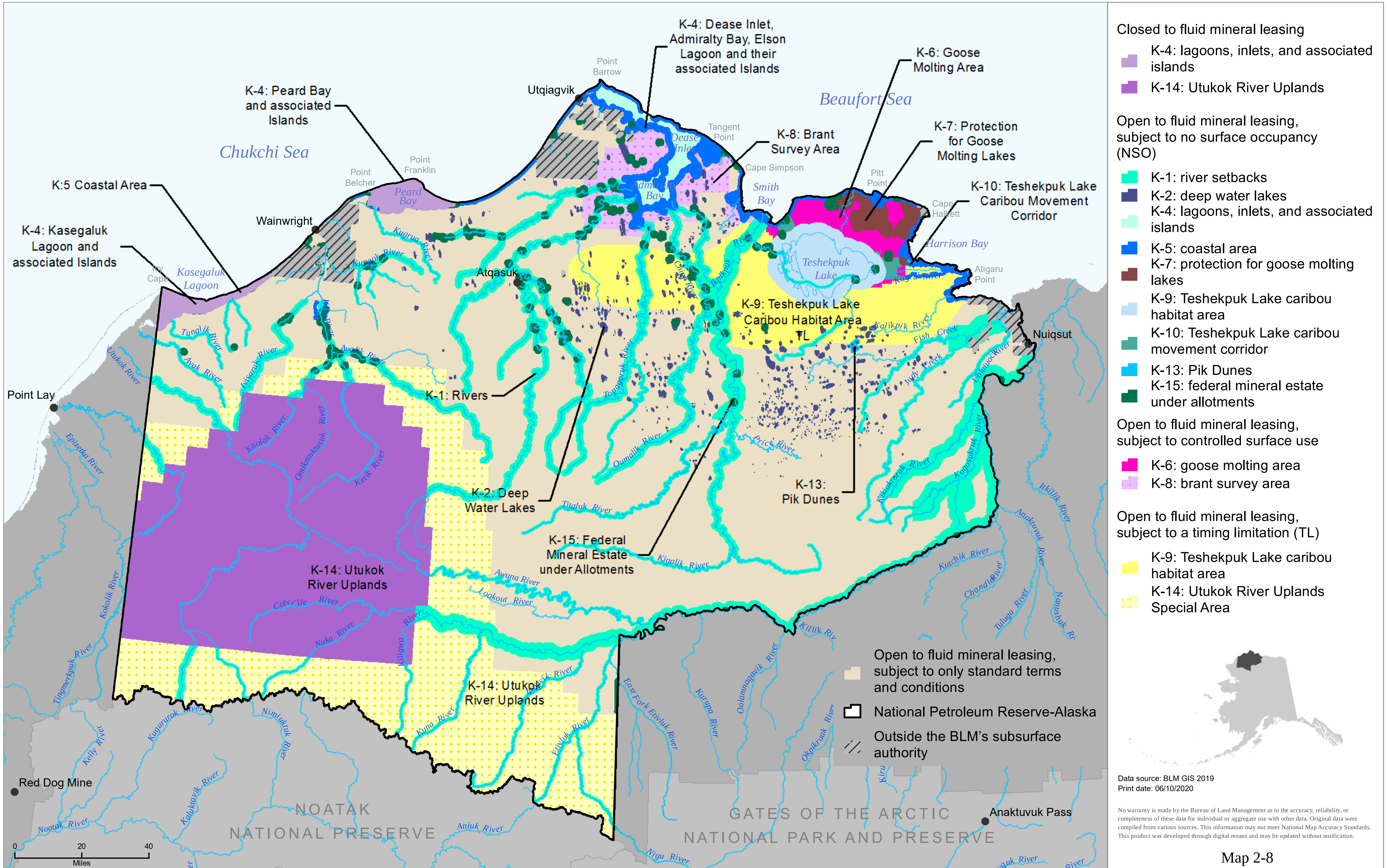
Map 2-7


Closed to fluid mineral leasing
K-4: lagoons, inlets, and associated islands
K-14: Utukok River Uplands
Open to fluid mineral leasing, subject to no surface occupancy (NSO)
K-1: river setbacks
K-2: deep water lakes
K-4: lagoons, inlets, and associated islands
K-5: coastal area
K-7: protection for goose molting lakes
K-9: Teshekpuk Lake caribou habitat area
K-10: Teshekpuk Lake caribou movement corridor
K-13: Pik Dunes
K-15: federal mineral estate under allotments
Open to fluid mineral leasing, subject to controlled surface use
K-6: goose molting area
K-8: brant survey area
Open to fluid mineral leasing, subject to a timing limitation (TL)
K-9: Teshekpuk Lake caribou habitat area
K-14: Utukok River Uplands Special Area
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
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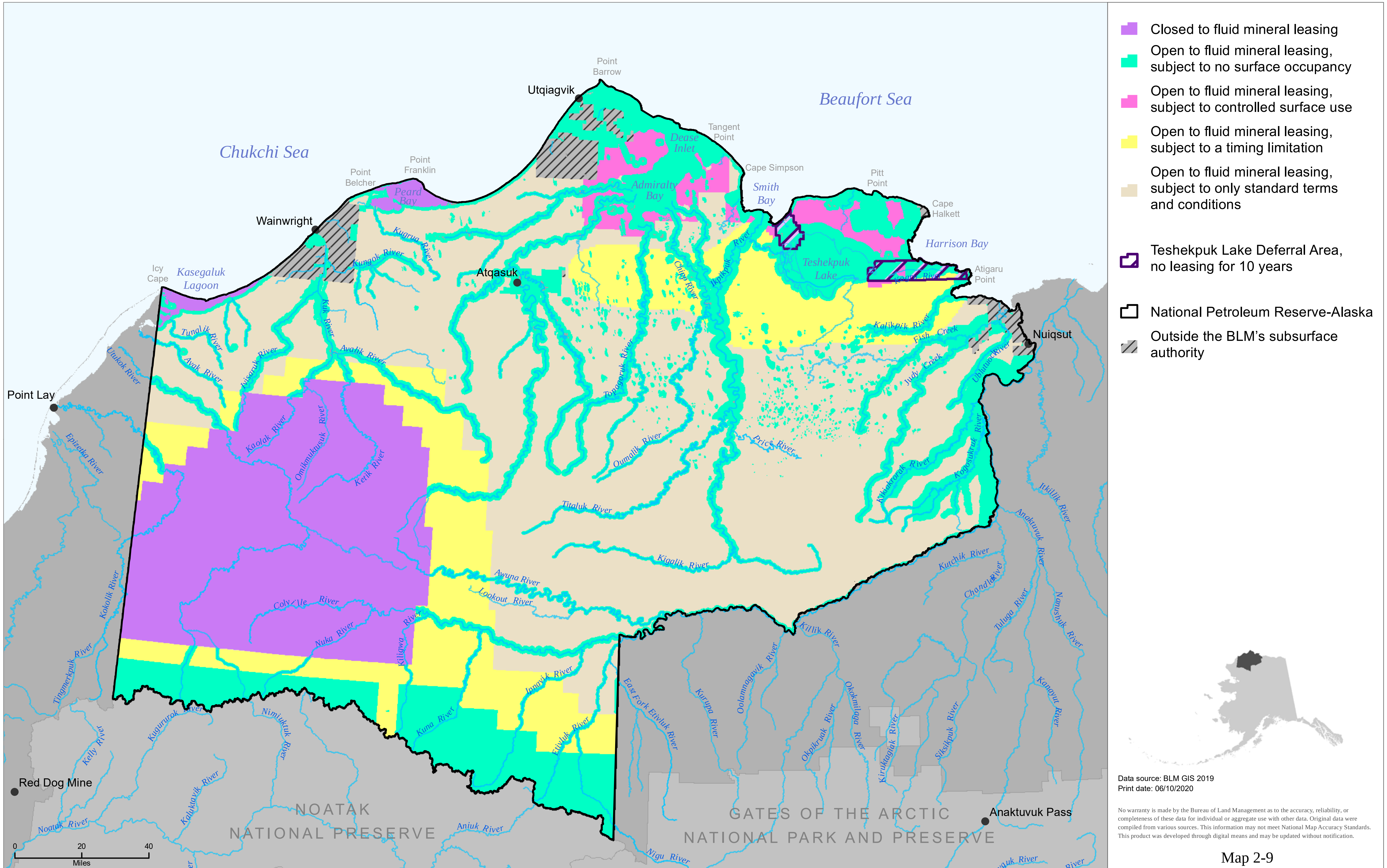
K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-6: Goose Molting Area
K-4: Peard Bay and associated Islands
K-8: Brant Survey Area
K-7: Protection for Goose Molting Lakes
K:5 Coastal Area
K-10: Teshekpuk Lake Caribou Movement Corridor
K-4: Kasegaluk Lagoon and associated Islands
K-9: Teshekpuk Lake Caribou Habitat Area
TL
K-1: Rivers
K-2: Deep Water Lakes
K-13: Pik Dunes
K-15: Federal Mineral Estate under Allotments
K-14: Utukok River Uplands
Beaufort Sea
Chukchi Sea
Harrison Bay
Smith Bay
Teshekpuk Lake
Peard Bay
Dease Inlet
Admiralty Bay
Kasegaluk Lagoon
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Pitt Point
Cape Halkett
Atigaru Point
Point Franklin
Point Belcher
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Map 2-8


Closed to fluid mineral leasing
Open to fluid mineral leasing, subject to no surface occupancy
Open to fluid mineral leasing, subject to controlled surface use
Open to fluid mineral leasing, subject to a timing limitation
Open to fluid mineral leasing, subject to only standard terms and conditions
Teshekpuk Lake Deferral Area, no leasing for 10 years
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0
20
40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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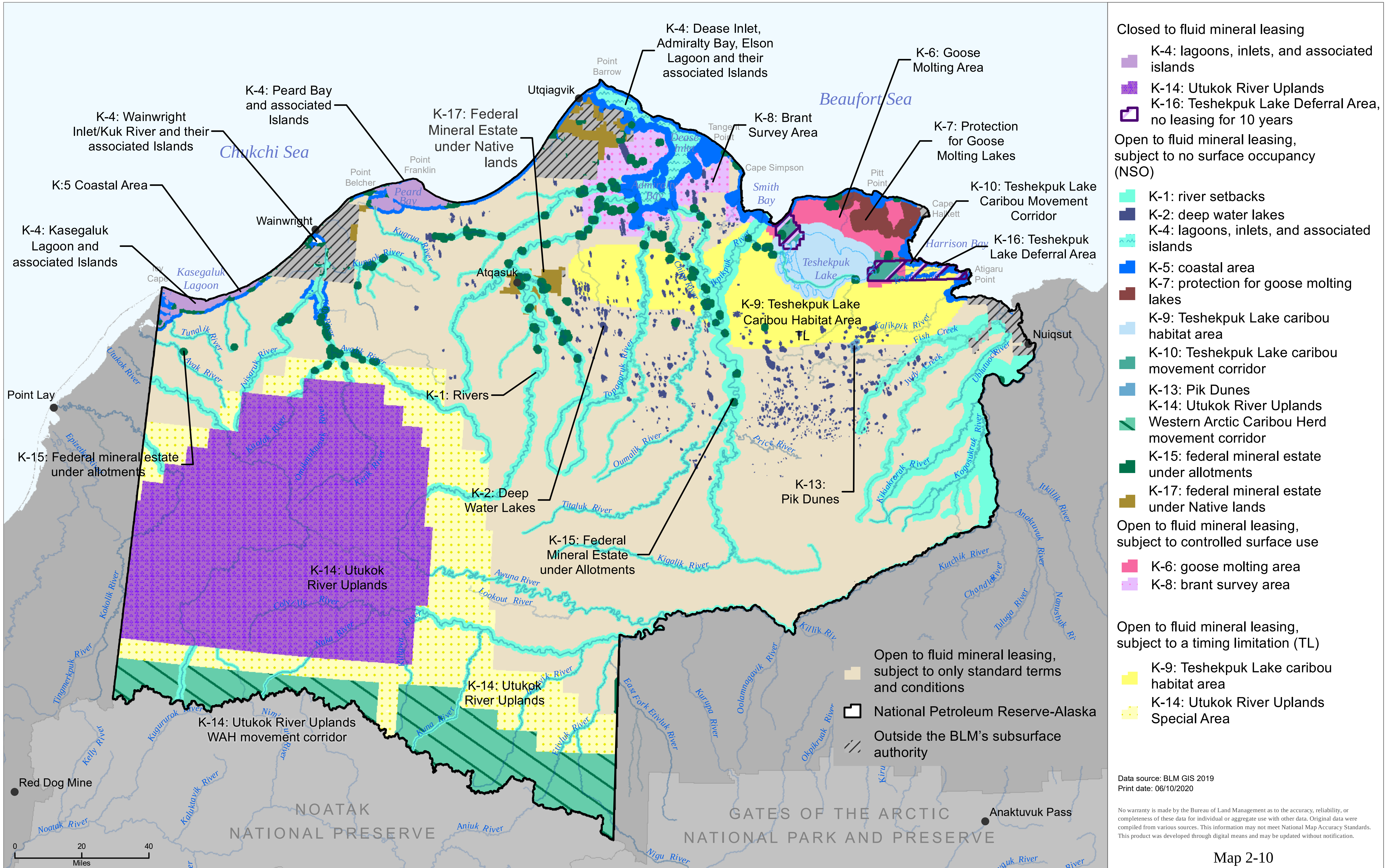
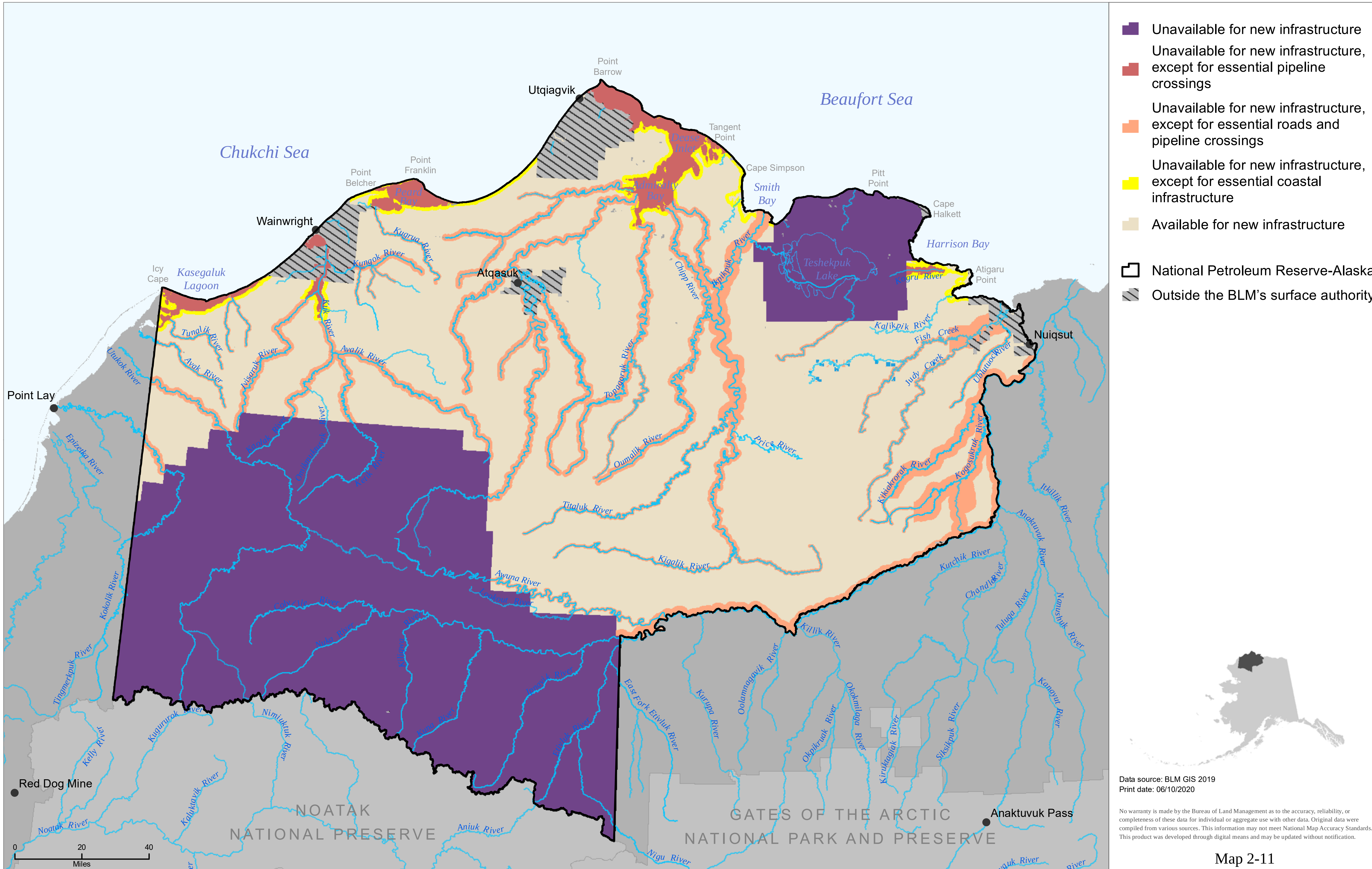
Map 2-9

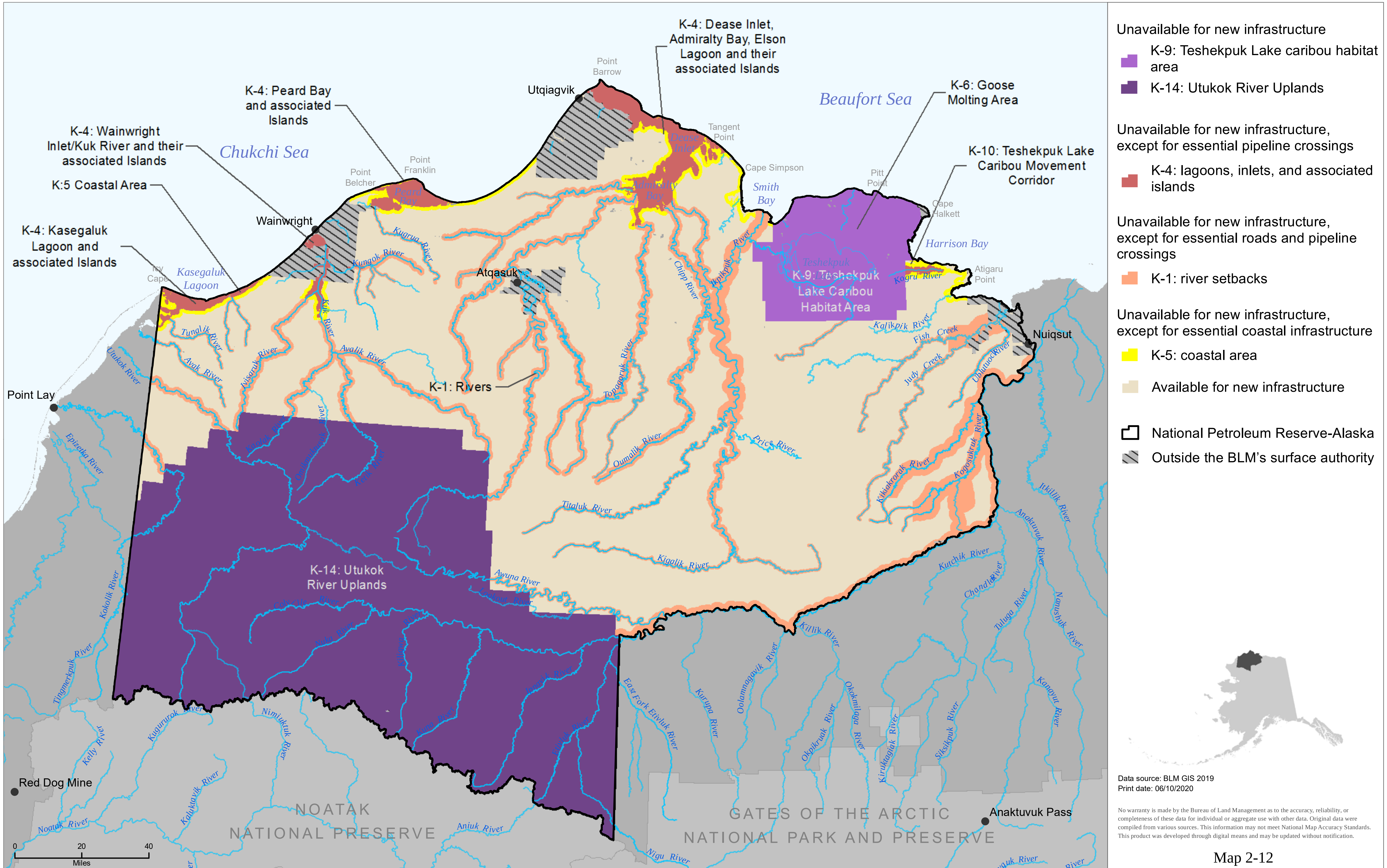

K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-6: Goose Molting Area
K-4: Peard Bay and associated Islands
K-17: Federal Mineral Estate under Native lands
K-4: Wainwright Inlet/Kuk River and their associated Islands
K-8: Brant Survey Area
K-7: Protection for Goose Molting Lakes
K:5 Coastal Area
K-10: Teshekpuk Lake Caribou Movement Corridor
K-4: Kasegaluk Lagoon and associated Islands
K-16: Teshekpuk Lake Deferral Area
K-9: Teshekpuk Lake Caribou Habitat Area TL
K-1: Rivers
K-15: Federal mineral estate under allotments
K-2: Deep Water Lakes
K-13: Pik Dunes
K-15: Federal Mineral Estate under Allotments
K-14: Utukok River Uplands
K-14: Utukok River Uplands
K-14: Utukok River Uplands WAH movement corridor
Beaufort Sea
Chukchi Sea
Utqiagvik
Point Barrow
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Tangent Point
Cape Simpson
Smith Bay
Dease Inlet
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Open to fluid mineral leasing, subject to only standard terms and conditions
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
0 20 40
Miles
Closed to fluid mineral leasing
K-4: lagoons, inlets, and associated islands
K-14: Utukok River Uplands
K-16: Teshekpuk Lake Deferral Area, no leasing for 10 years
Open to fluid mineral leasing, subject to no surface occupancy (NSO)
K-1: river setbacks
K-2: deep water lakes
K-4: lagoons, inlets, and associated islands
K-5: coastal area
K-7: protection for goose molting lakes
K-9: Teshekpuk Lake caribou habitat area
K-10: Teshekpuk Lake caribou movement corridor
K-13: Pik Dunes
K-14: Utukok River Uplands Western Arctic Caribou Herd movement corridor
K-15: federal mineral estate under allotments
K-17: federal mineral estate under Native lands
Open to fluid mineral leasing, subject to controlled surface use
K-6: goose molting area
K-8: brant survey area
Open to fluid mineral leasing, subject to a timing limitation (TL)
K-9: Teshekpuk Lake caribou habitat area
K-14: Utukok River Uplands Special Area
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 2-10

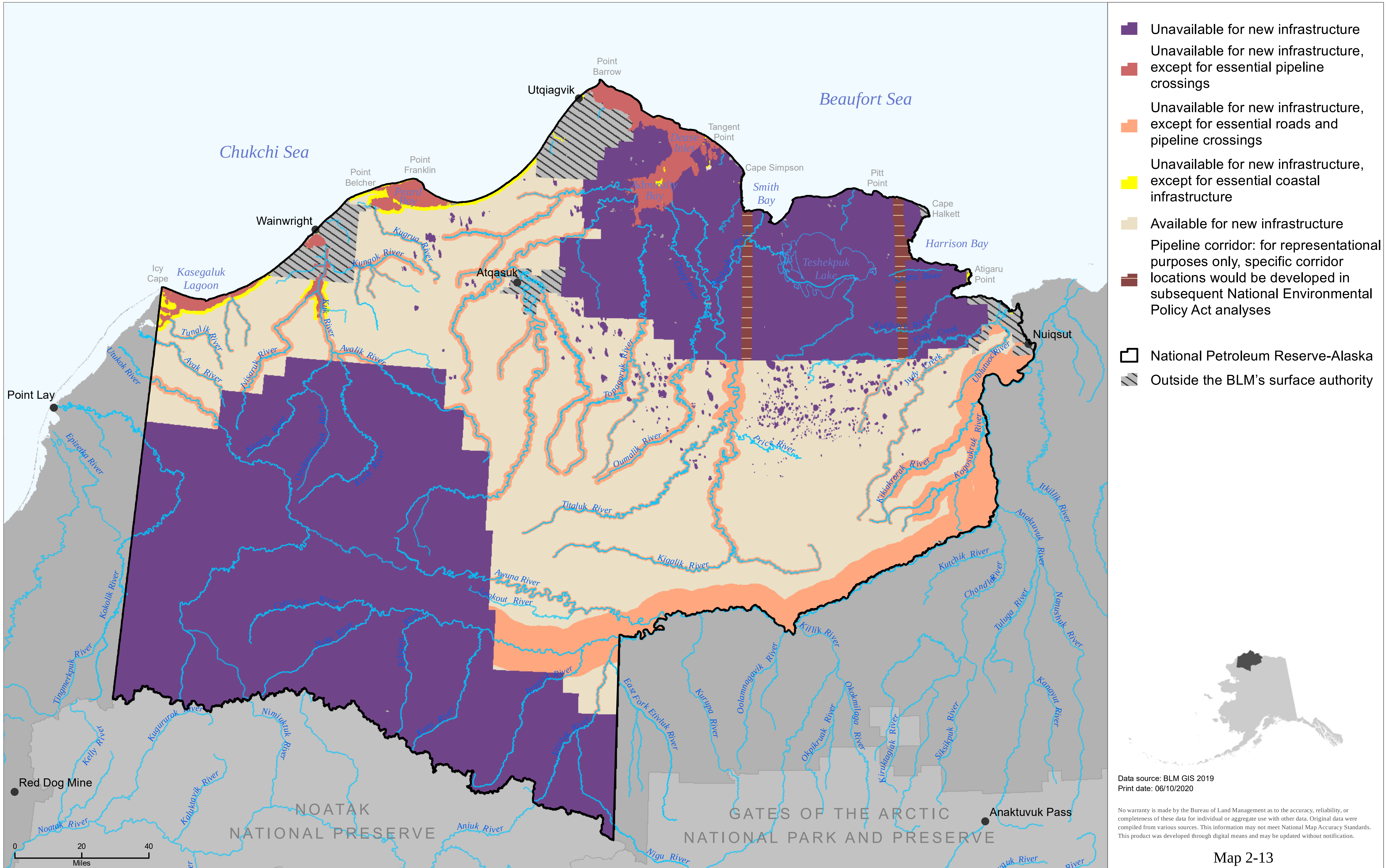


Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-11


Unavailable for new infrastructure
K-9: Teshekpuk Lake caribou habitat area
K-14: Utukok River Uplands
Unavailable for new infrastructure, except for essential pipeline crossings
K-4: lagoons, inlets, and associated islands
Unavailable for new infrastructure, except for essential roads and pipeline crossings
K-1: river setbacks
Unavailable for new infrastructure, except for essential coastal infrastructure
K-5: coastal area
Available for new infrastructure
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-4: Peard Bay and associated Islands
K-4: Wainwright Inlet/Kuk River and their associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-6: Goose Molting Area
K-10: Teshekpuk Lake Caribou Movement Corridor
K-1: Rivers
K-9: Teshekpuk Lake Caribou Habitat Area
K-14: Utukok River Uplands
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Dease Inlet
Admiralty Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kugrua River
Kungok River
Kuk River
Tunalik River
Avak River
Ivisaruk River
Avalik River
Utukok River
Epizetka River
Kokolik River
Tingmerkpuk River
Kelly River
Kugururok River
Nimiuktuk River
Kaluktavik River
Noatak River
Aniuk River
Nigu River
Chipp River
Ikpikpuk River
Topagoruk River
Meade River
Oumalik River
Titaluk River
Kigalik River
Awuna River
Price River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Kogru River
Kikiakrorak River
Kogosukruk River
Itkillik River
Anaktuvuk River
Kuchik River
Chandler River
Tuluga River
Nanushuk River
Kanayut River
Killik River
East Fork Etivluk River
Kuna River
Oolamnagavik River
Okokmilaga River
Okpikruak River
Kiruktagiak River
Siksikpuk River
Teshekpuk Lake
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 2-12


Unavailable for new infrastructure
Unavailable for new infrastructure, except for essential pipeline crossings
Unavailable for new infrastructure, except for essential roads and pipeline crossings
Unavailable for new infrastructure, except for essential coastal infrastructure
Available for new infrastructure
Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Belcher
Point Franklin
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Titaluk River
Kigalik River
Awuna River
Price River
Colville River
Killik River
Noatak River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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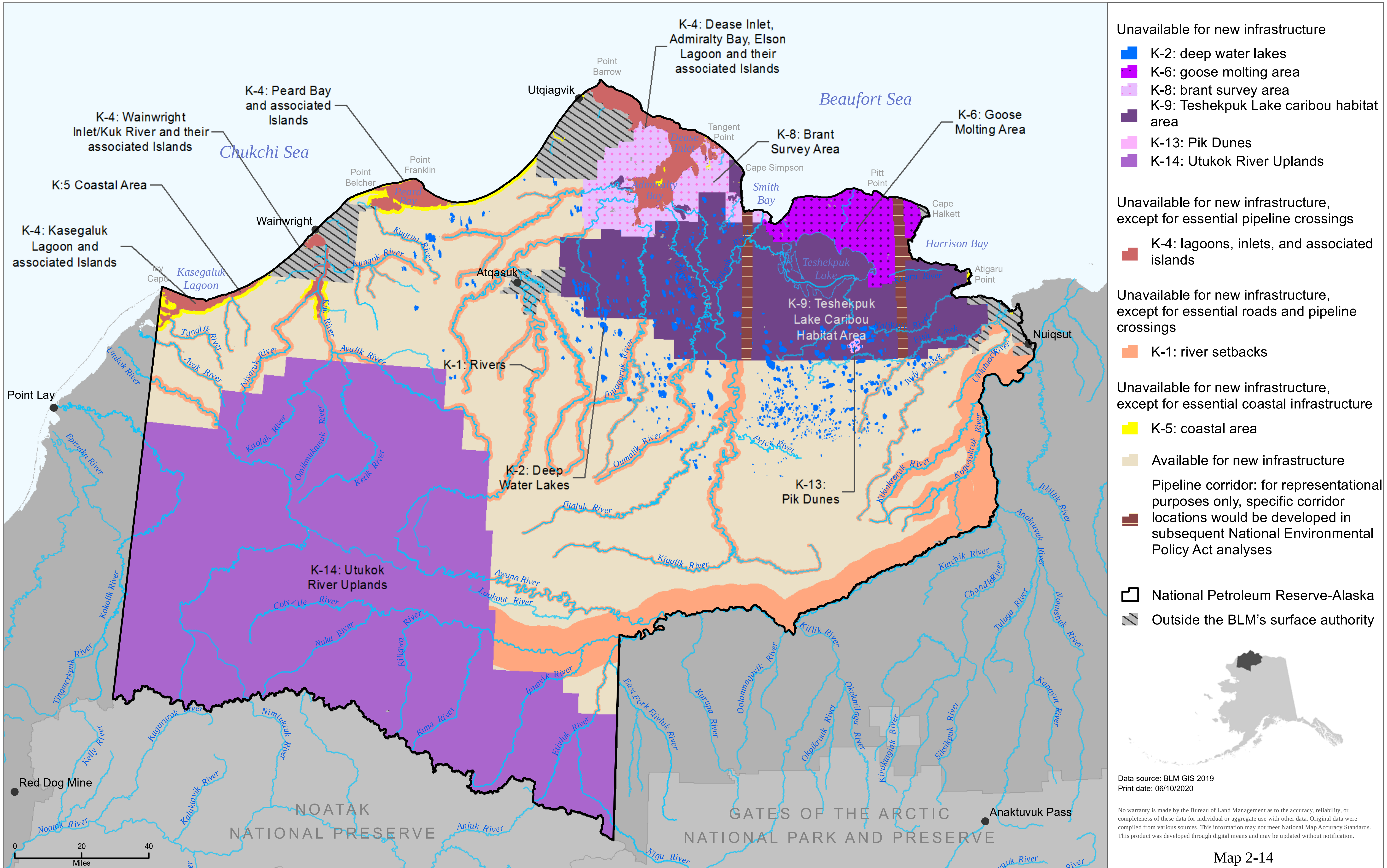
Map 2-13


Unavailable for new infrastructure
K-2: deep water lakes
K-6: goose molting area
K-8: brant survey area
K-9: Teshekpuk Lake caribou habitat area
K-13: Pik Dunes
K-14: Utukok River Uplands
Unavailable for new infrastructure, except for essential pipeline crossings
K-4: lagoons, inlets, and associated islands
Unavailable for new infrastructure, except for essential roads and pipeline crossings
K-1: river setbacks
Unavailable for new infrastructure, except for essential coastal infrastructure
K-5: coastal area
Available for new infrastructure
Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-4: Peard Bay and associated Islands
K-4: Wainwright Inlet/Kuk River and their associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-8: Brant Survey Area
K-6: Goose Molting Area
K-9: Teshekpuk Lake Caribou Habitat Area
K-1: Rivers
K-2: Deep Water Lakes
K-13: Pik Dunes
K-14: Utukok River Uplands
Beaufort Sea
Chukchi Sea
Utqiagvik
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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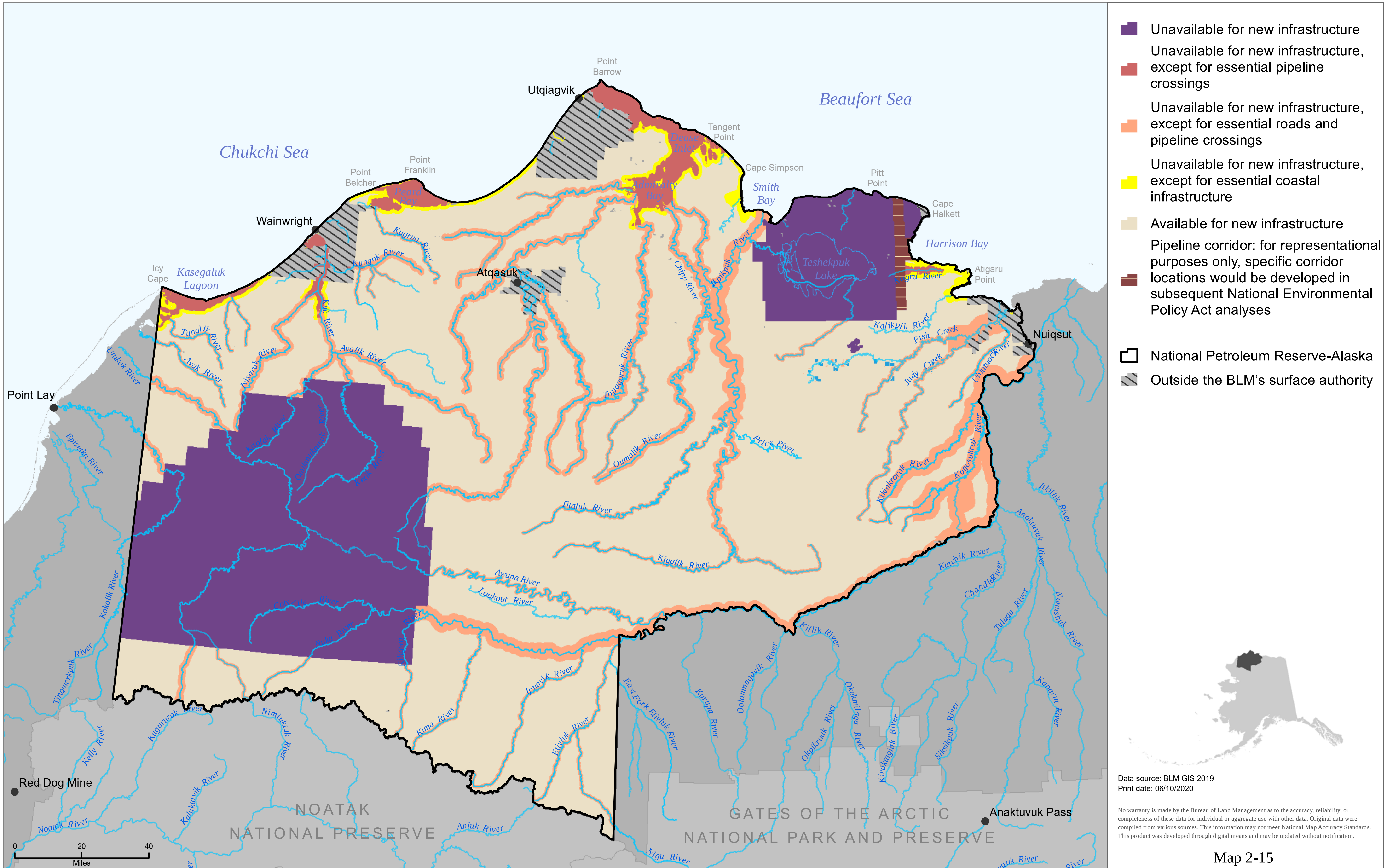
Map 2-14


Unavailable for new infrastructure
Unavailable for new infrastructure, except for essential pipeline crossings
Unavailable for new infrastructure, except for essential roads and pipeline crossings
Unavailable for new infrastructure, except for essential coastal infrastructure
Available for new infrastructure
Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Teshekpuk Lake
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Admiralty Bay
Dease Inlet
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kuk River
Kugrua River
Kungok River
Chipp River
Ikpikpuk River
Topagoruk River
Oumalik River
Price River
Titaluk River
Kigalik River
Awuna River
Lookout River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Kikiakrorak River
Kogosukruk River
Colville River
Killik River
Kuna River
Ipnavik River
Etivluk River
Utukok River
Avalik River
Ivisaruk River
Tunalik River
Avak River
Kokolik River
Epizetka River
Kukpowruk River
Nigu River
Aniuk River
Noatak River
Chandler River
Anaktuvuk River
Kurupa River
Oolamnagavik River
Okokmilaga River
Okpikruak River
Kuchik River
Itkillik River
Nanushuk River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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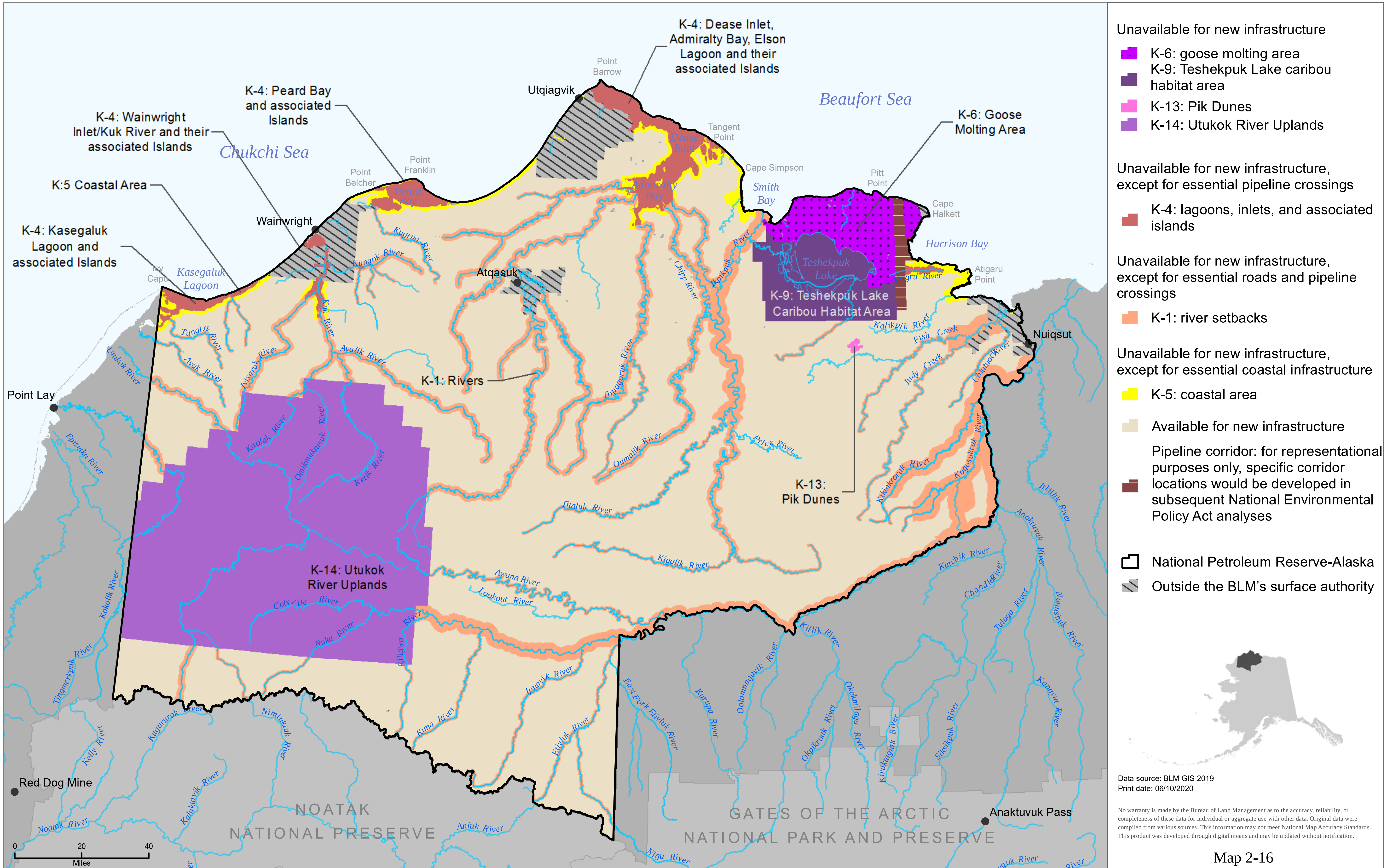
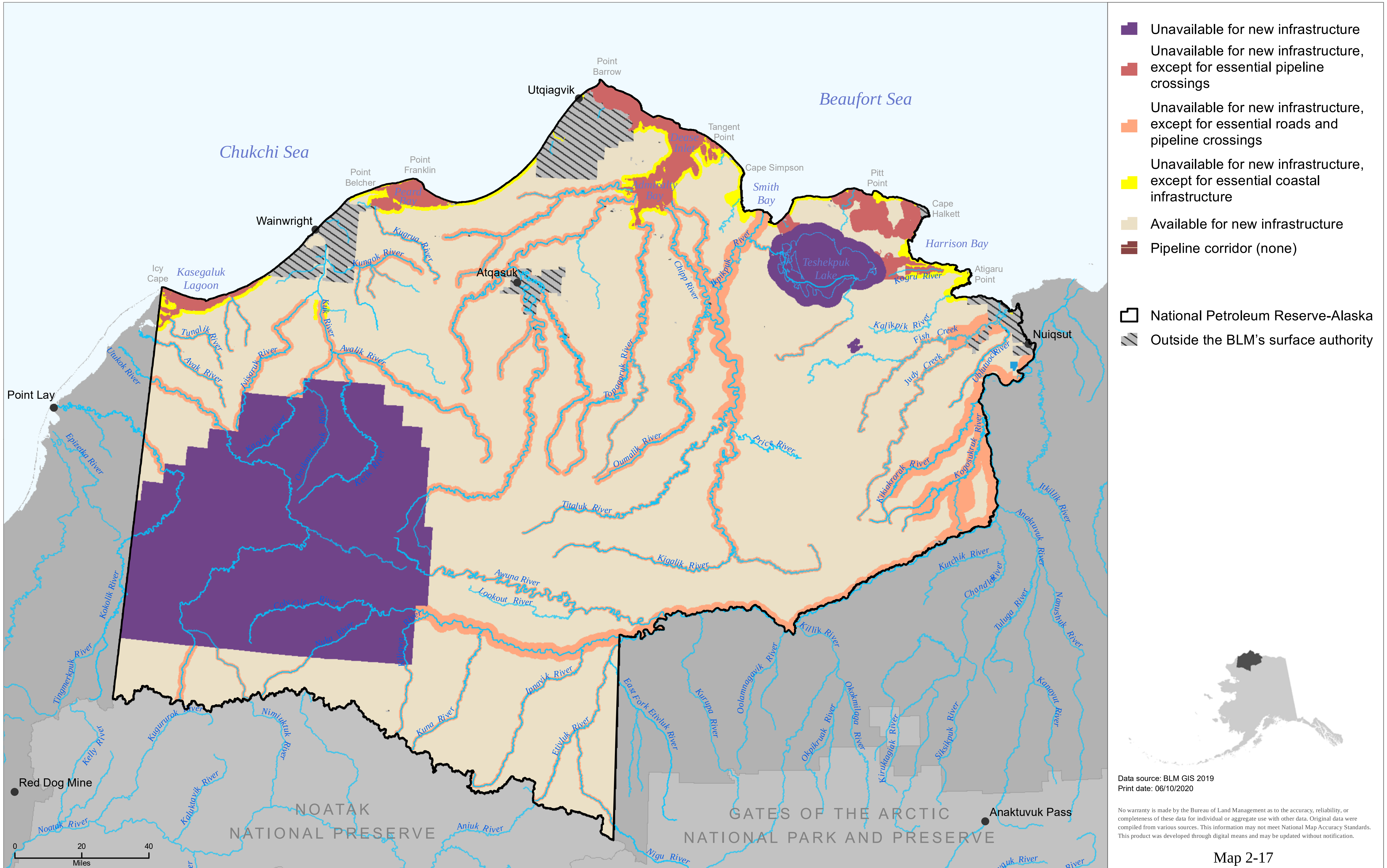
Map 2-15


K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-4: Peard Bay and associated Islands
K-4: Wainwright Inlet/Kuk River and their associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-6: Goose Molting Area
K-9: Teshekpuk Lake Caribou Habitat Area
K-1: Rivers
K-13: Pik Dunes
K-14: Utukok River Uplands
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Wainwright
Atqasuk
Kasegaluk Lagoon
Icy Cape
Point Lay
Red Dog Mine
Anaktuvuk Pass
Teshekpuk Lake
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Unavailable for new infrastructure
K-6: goose molting area
K-9: Teshekpuk Lake caribou habitat area
K-13: Pik Dunes
K-14: Utukok River Uplands
Unavailable for new infrastructure, except for essential pipeline crossings
K-4: lagoons, inlets, and associated islands
Unavailable for new infrastructure, except for essential roads and pipeline crossings
K-1: river setbacks
Unavailable for new infrastructure, except for essential coastal infrastructure
K-5: coastal area
Available for new infrastructure
Pipeline corridor: for representational purposes only, specific corridor locations would be developed in subsequent National Environmental Policy Act analyses
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
Map 2-16


Unavailable for new infrastructure
Unavailable for new infrastructure, except for essential pipeline crossings
Unavailable for new infrastructure, except for essential roads and pipeline crossings
Unavailable for new infrastructure, except for essential coastal infrastructure
Available for new infrastructure
Pipeline corridor (none)
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Teshekpuk Lake
Nuiqsut
Point Belcher
Point Franklin
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Chipp River
Topagoruk River
Meade River
Titaluk River
Kigalik River
Awuna River
Lookout River
Price River
Kalikpik River
Fish Creek
Judy Creek
Kikiakrorak River
Kogosukruk River
Kuk River
Avalik River
Kungok River
Kugrua River
Utukok River
Kokolik River
Kaolak River
Ketik River
Ipnavik River
Kuna River
Etivluk River
Killik River
Chandler River
Itkillik River
Noatak River
Kelly River
Aniuk River
Nigu River
0
20
40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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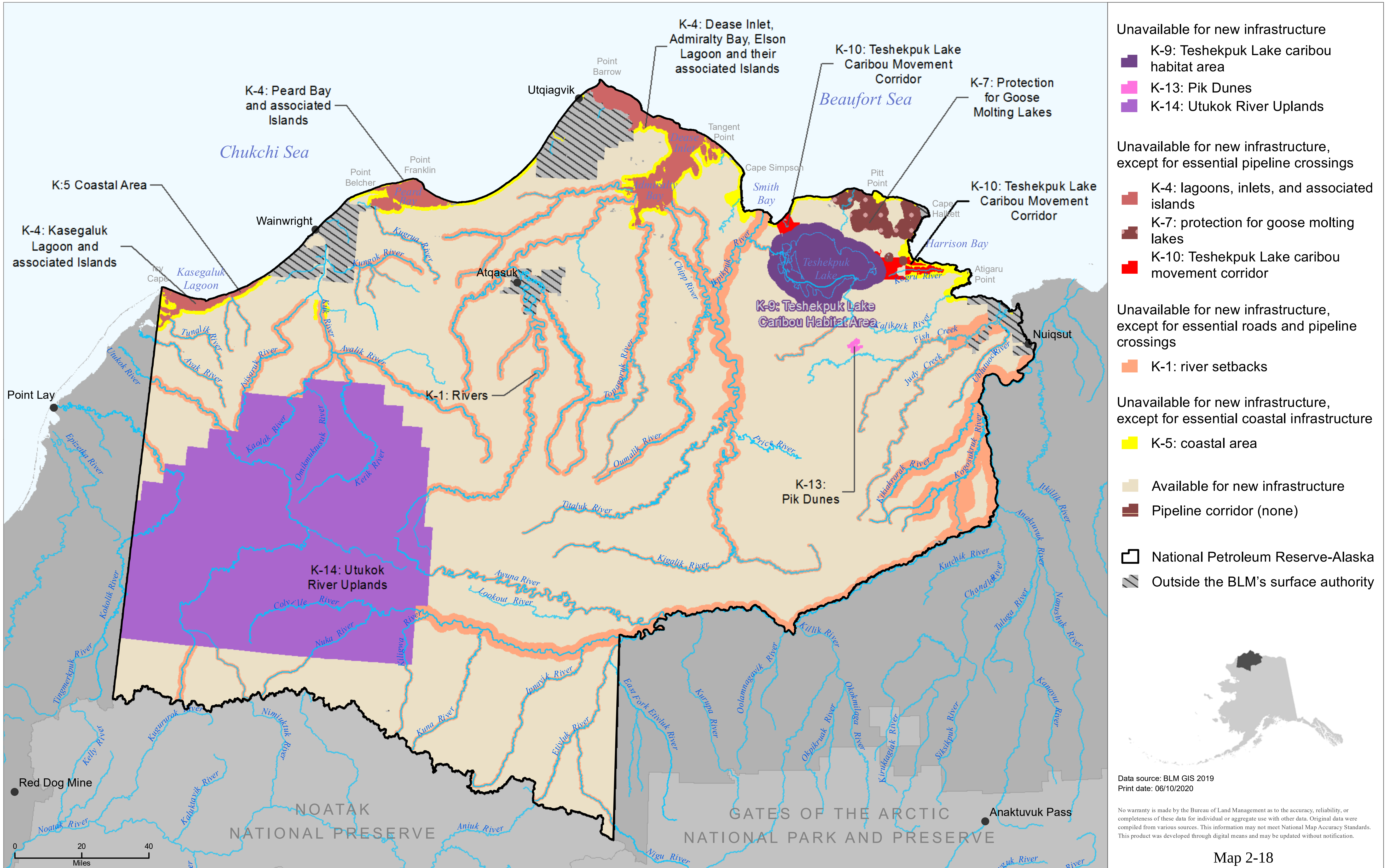
Map 2-17


K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-10: Teshekpuk Lake Caribou Movement Corridor
K-7: Protection for Goose Molting Lakes
K-10: Teshekpuk Lake Caribou Movement Corridor
K-4: Peard Bay and associated Islands
K:5 Coastal Area
K-4: Kasegaluk Lagoon and associated Islands
K-1: Rivers
K-9: Teshekpuk Lake Caribou Habitat Area
K-13: Pik Dunes
K-14: Utukok River Uplands
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Dease Inlet
Admiralty Bay
Wainwright
Atqasuk
Kasegaluk Lagoon
Icy Cape
Point Lay
Teshekpuk Lake
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Unavailable for new infrastructure
K-9: Teshekpuk Lake caribou habitat area
K-13: Pik Dunes
K-14: Utukok River Uplands
Unavailable for new infrastructure, except for essential pipeline crossings
K-4: lagoons, inlets, and associated islands
K-7: protection for goose molting lakes
K-10: Teshekpuk Lake caribou movement corridor
Unavailable for new infrastructure, except for essential roads and pipeline crossings
K-1: river setbacks
Unavailable for new infrastructure, except for essential coastal infrastructure
K-5: coastal area
Available for new infrastructure
Pipeline corridor (none)
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
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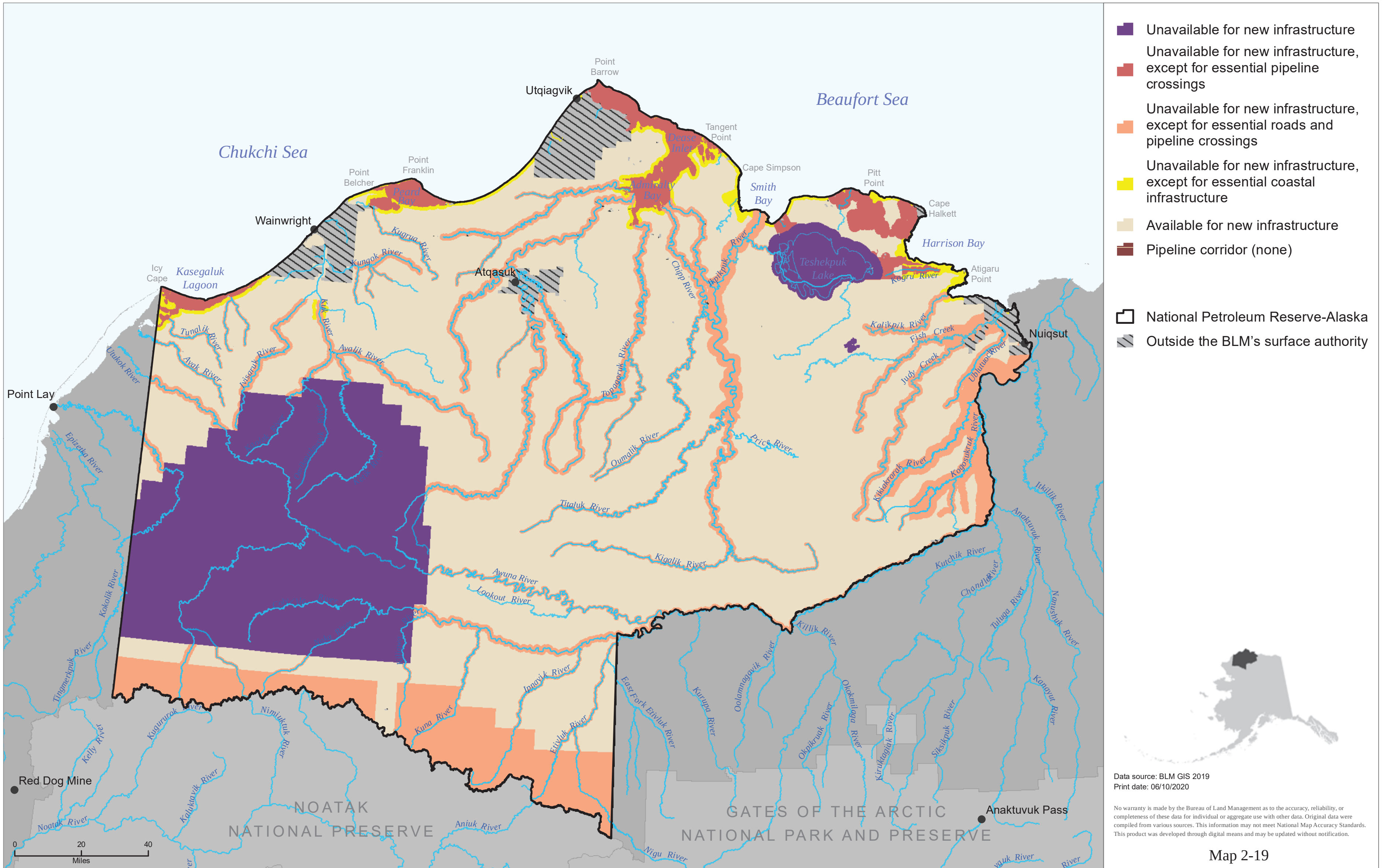
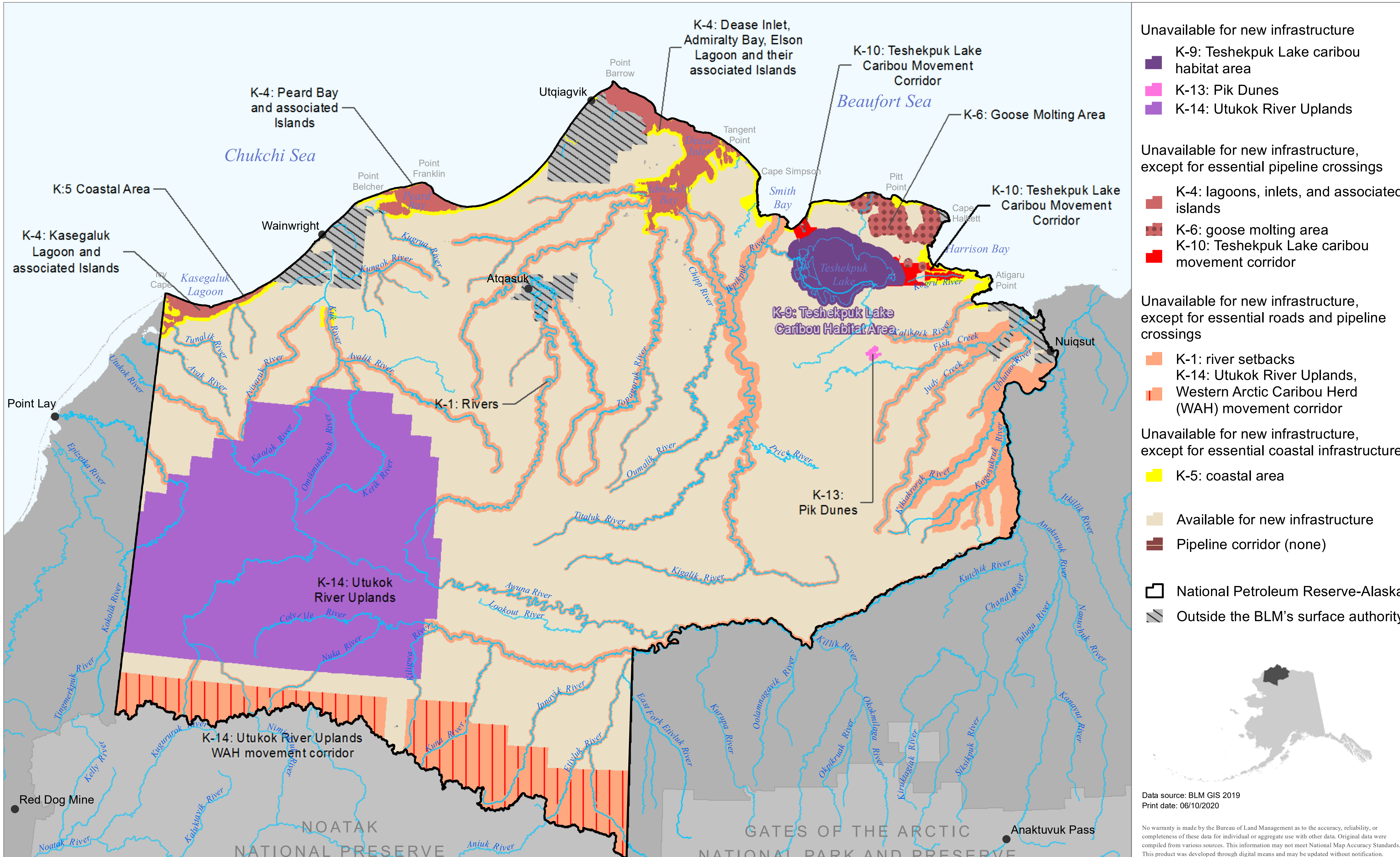
Map 2-18



Data source: BLM GIS 2019
Print date: 06/10/2020

Map 2-19


K-4: Dease Inlet, Admiralty Bay, Elson Lagoon and their associated Islands
K-10: Teshekpuk Lake Caribou Movement Corridor
K-4: Peard Bay and associated Islands
Beaufort Sea
K-6: Goose Molting Area
Chukchi Sea
K:5 Coastal Area
K-10: Teshekpuk Lake Caribou Movement Corridor
K-4: Kasegaluk Lagoon and associated Islands
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Point Franklin
Point Belcher
Wainwright
Atqasuk
Kasegaluk Lagoon
Teshekpuk Lake
Atigaru Point
K-9: Teshekpuk Lake Caribou Habitat Area
Nuiqsut
Point Lay
K-1: Rivers
K-13: Pik Dunes
K-14: Utukok River Uplands
K-14: Utukok River Uplands WAH movement corridor
Red Dog Mine
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
0 20 40
Miles
Unavailable for new infrastructure
K-9: Teshekpuk Lake caribou habitat area
K-13: Pik Dunes
K-14: Utukok River Uplands
Unavailable for new infrastructure, except for essential pipeline crossings
K-4: lagoons, inlets, and associated islands
K-6: goose molting area
K-10: Teshekpuk Lake caribou movement corridor
Unavailable for new infrastructure, except for essential roads and pipeline crossings
K-1: river setbacks
K-14: Utukok River Uplands, Western Arctic Caribou Herd (WAH) movement corridor
Unavailable for new infrastructure, except for essential coastal infrastructure
K-5: coastal area
Available for new infrastructure
Pipeline corridor (none)
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
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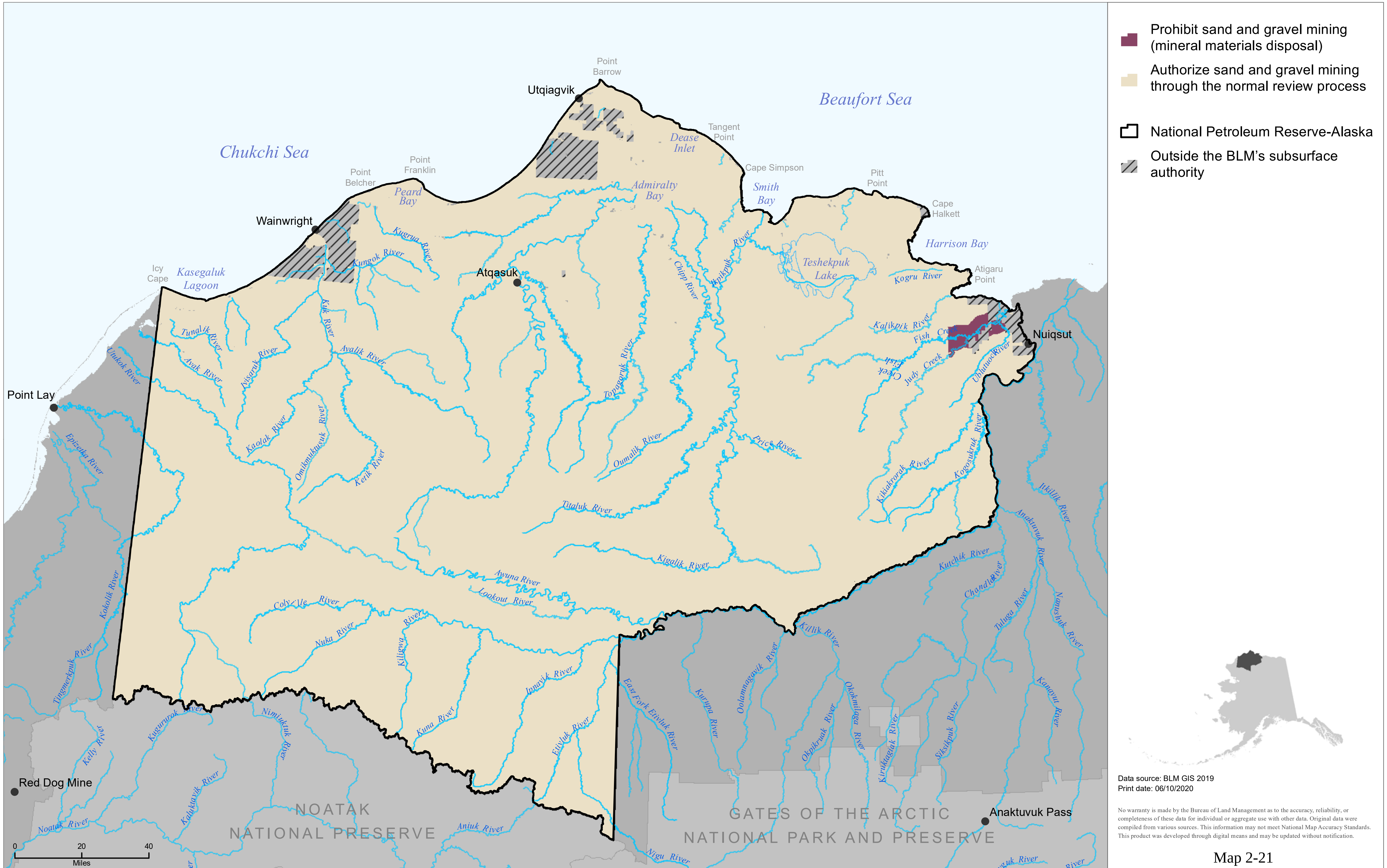
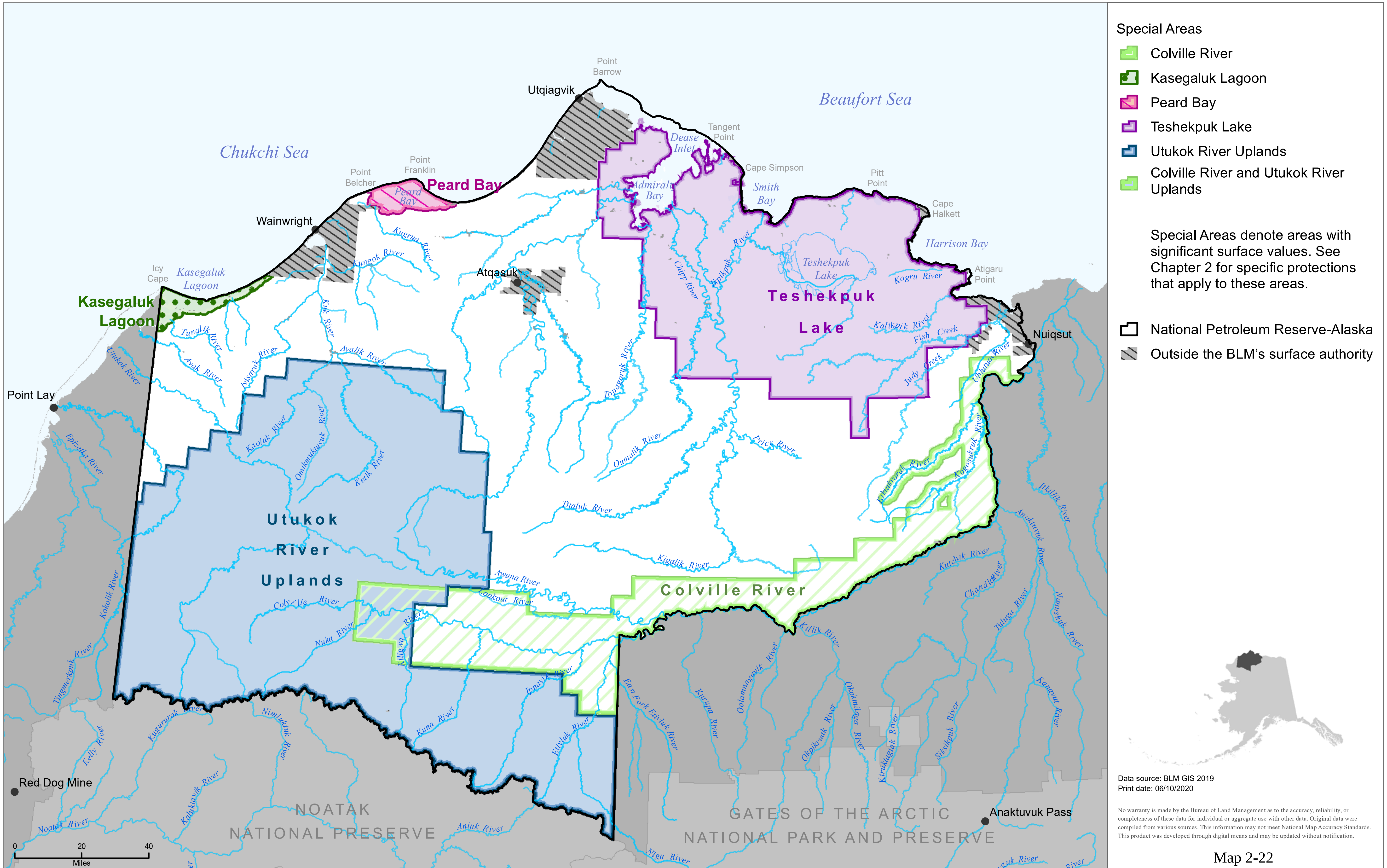
Map 2-20

Alternatives B, C, D, and E: Sand and Gravel Mining



Map 2-21


Special Areas
Colville River
Kasegaluk Lagoon
Peard Bay
Teshekpuk Lake
Utukok River Uplands
Colville River and Utukok River Uplands
Special Areas denote areas with significant surface values. See Chapter 2 for specific protections that apply to these areas.
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Peard Bay
Kasegaluk Lagoon
Teshekpuk Lake
Utukok River Uplands
Colville River
Wainwright
Atqasuk
Nuiqsut
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0
20
40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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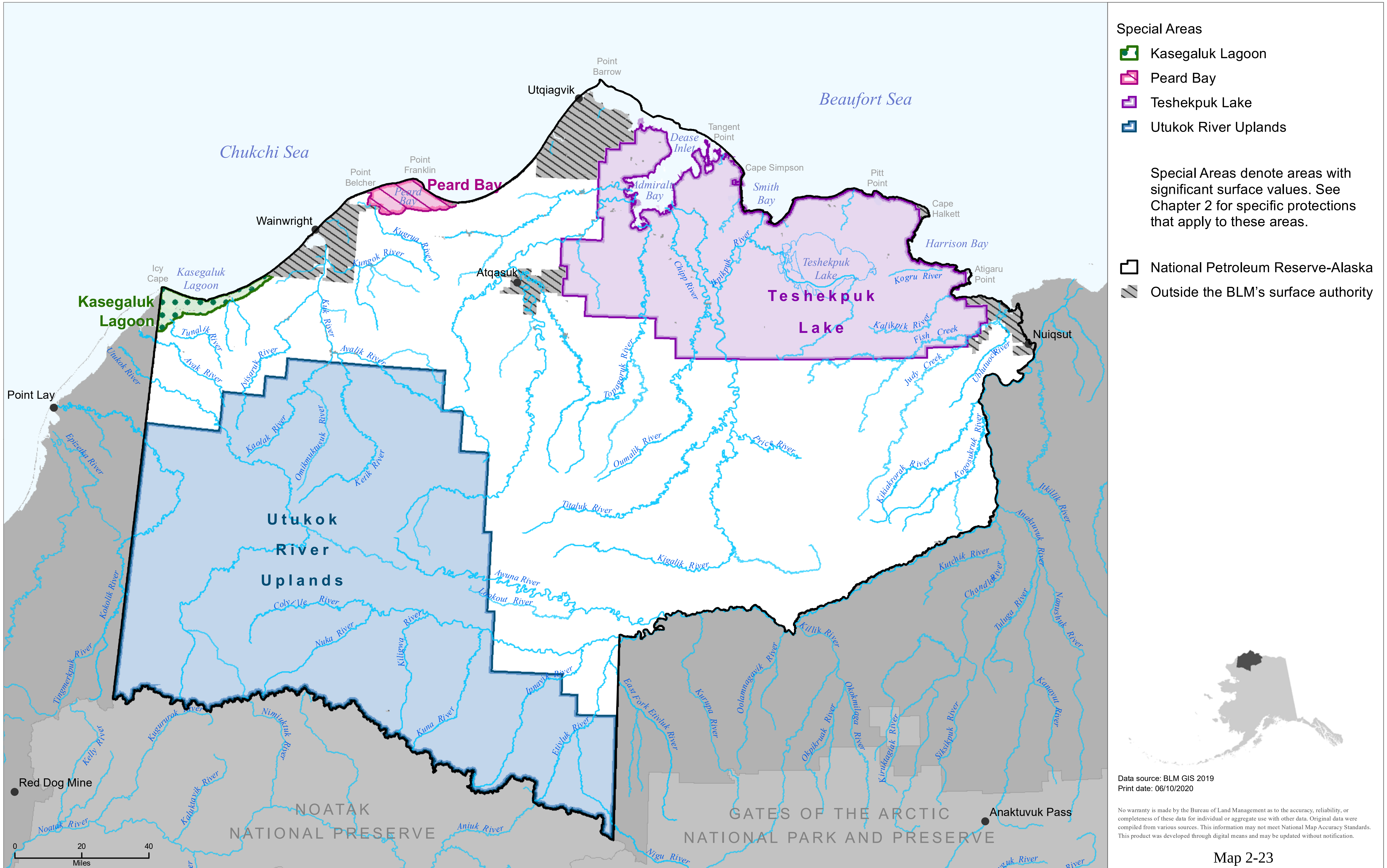
Map 2-22


Special Areas
Kasegaluk Lagoon
Peard Bay
Teshekpuk Lake
Utukok River Uplands
Special Areas denote areas with significant surface values. See Chapter 2 for specific protections that apply to these areas.
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Peard Bay
Point Franklin
Point Belcher
Wainwright
Icy Cape
Kasegaluk Lagoon
Point Lay
Atqasuk
Dease Inlet
Tangent Point
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Teshekpuk Lake
Utukok River Uplands
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
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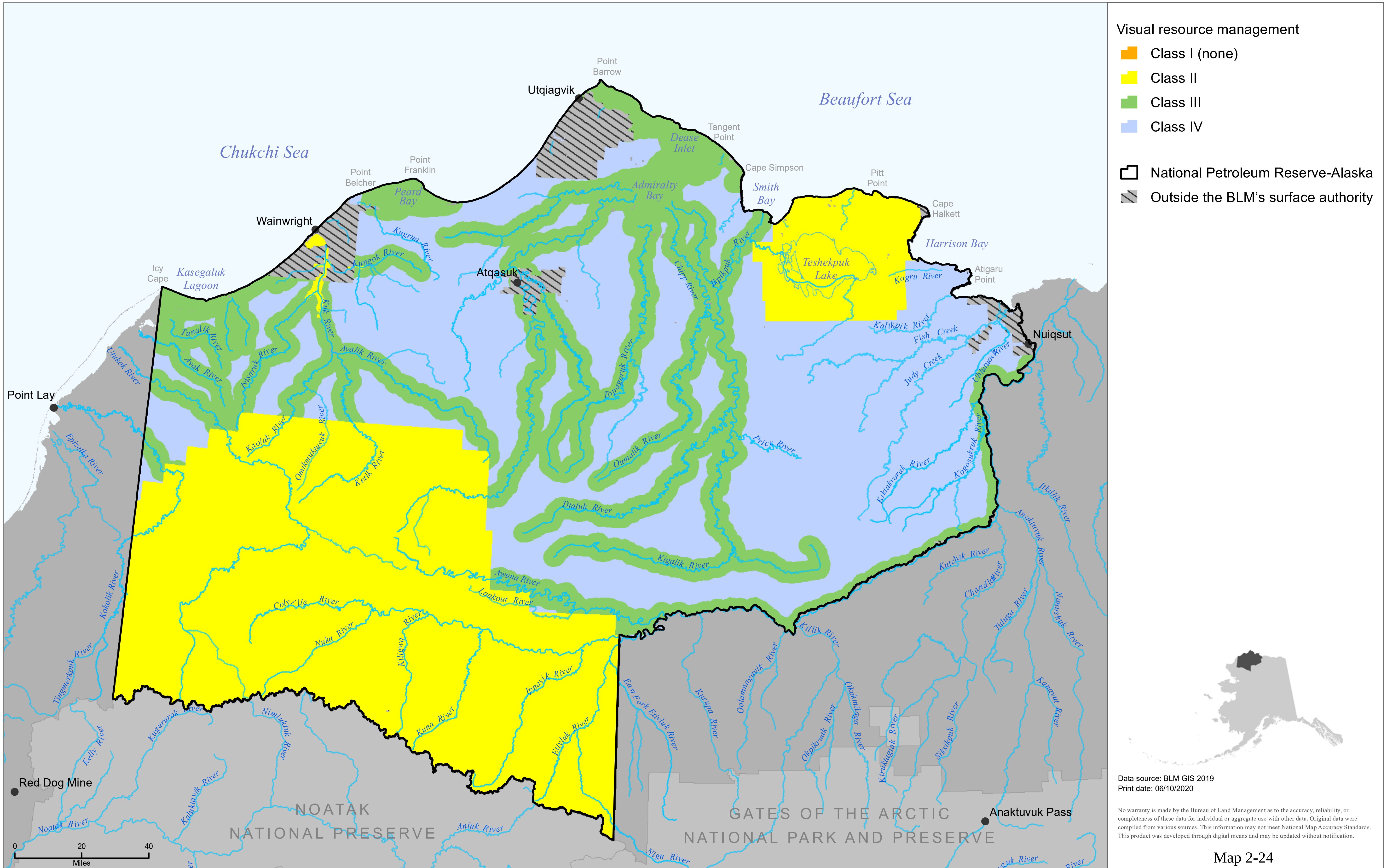
Map 2-23


Visual resource management
Class I (none)
Class II
Class III
Class IV
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Admiralty Bay
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Kigalik River
Titaluk River
Price River
Fish Creek
Judy Creek
Kogru River
Kalikpik River
Ikpikpuk River
Topagoruk River
Meade River
Kuk River
Avalik River
Utukok River
Kokolik River
Kaolak River
Nuka River
Killik River
Etivluk River
Awuna River
Lookout River
Data source: BLM GIS 2019
Print date: 06/10/2020
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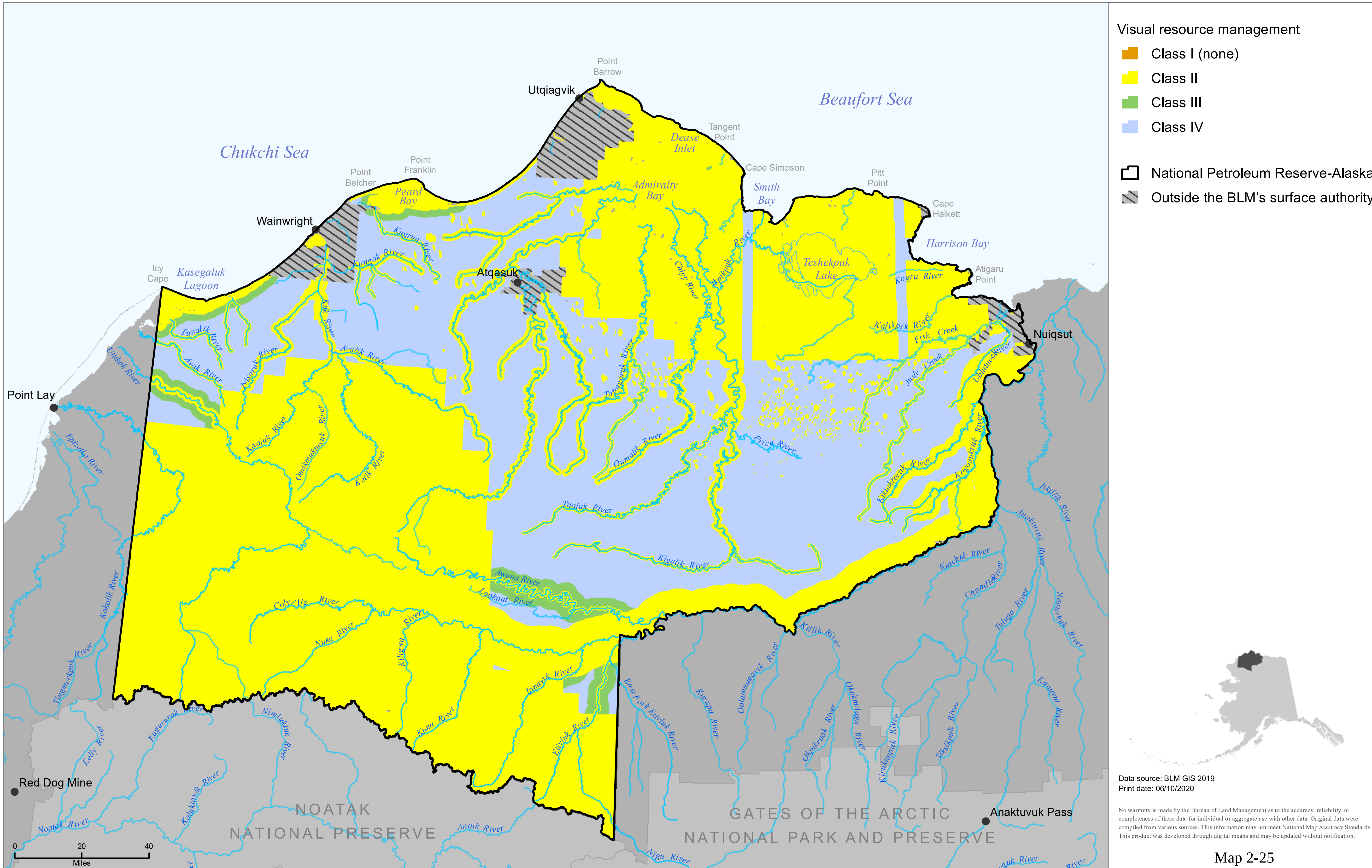
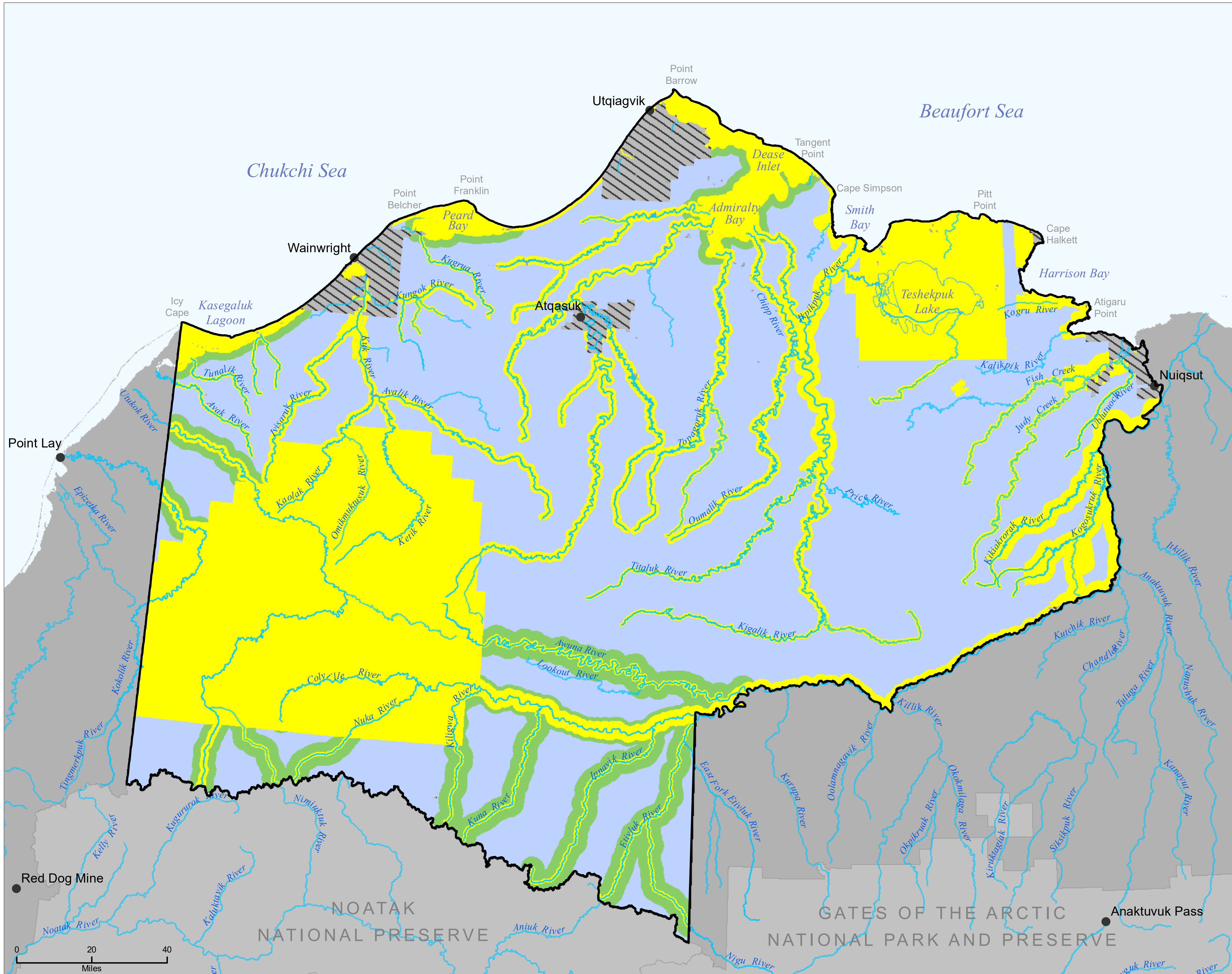
0
20
40
Miles

Map 2-24


Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Admiralty Bay
Teshekpuk Lake
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Kigalik River
Titaluk River
Price River
Meade River
Chipp River
Topagoruk River
Oumalik River
Awuna River
Lookout River
Nuka River
Kiligwa River
Ipnavik River
Kuna River
Etivluk River
Utukok River
Kaolak River
Ketik River
Kuk River
Avalik River
Kugrua River
Kungok River
Tunalik River
Avak River
Nigisaktuvik River
Omikmuktusuk River
Kogru River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Kikiakrorak River
Kogosukruk River
Itkillik River
Anaktuvuk River
Chandler River
Killik River
Kurupa River
Oolamnagavik River
Okokmilaga River
Kokolik River
Noatak River
Aniuk River
Nigu River
0
20
40
Miles
Visual resource management
Class I (none)
Class II
Class III
Class IV
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 2-25



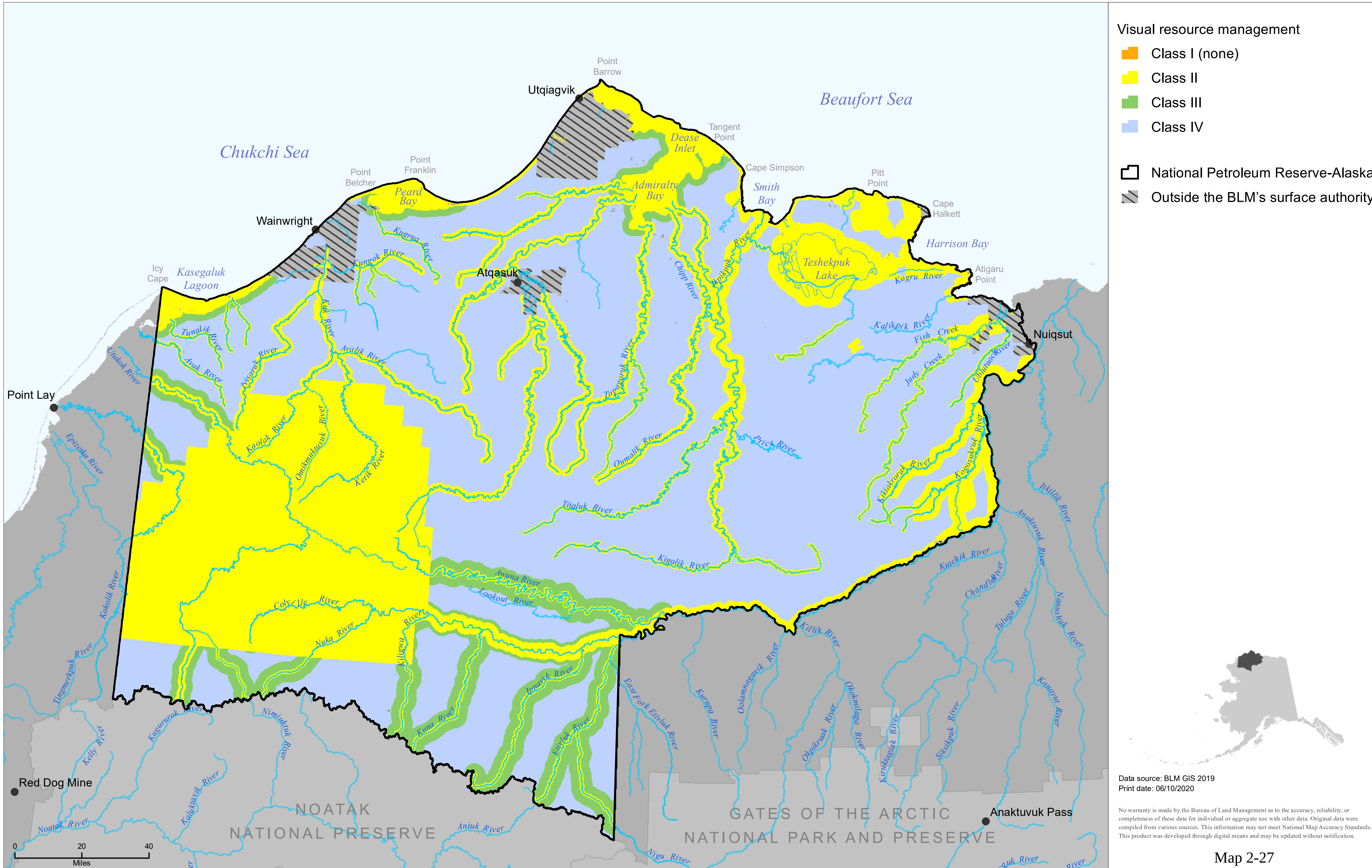
Visual resource management
- Class I (none)
- Class II
- Class III
- Class IV

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

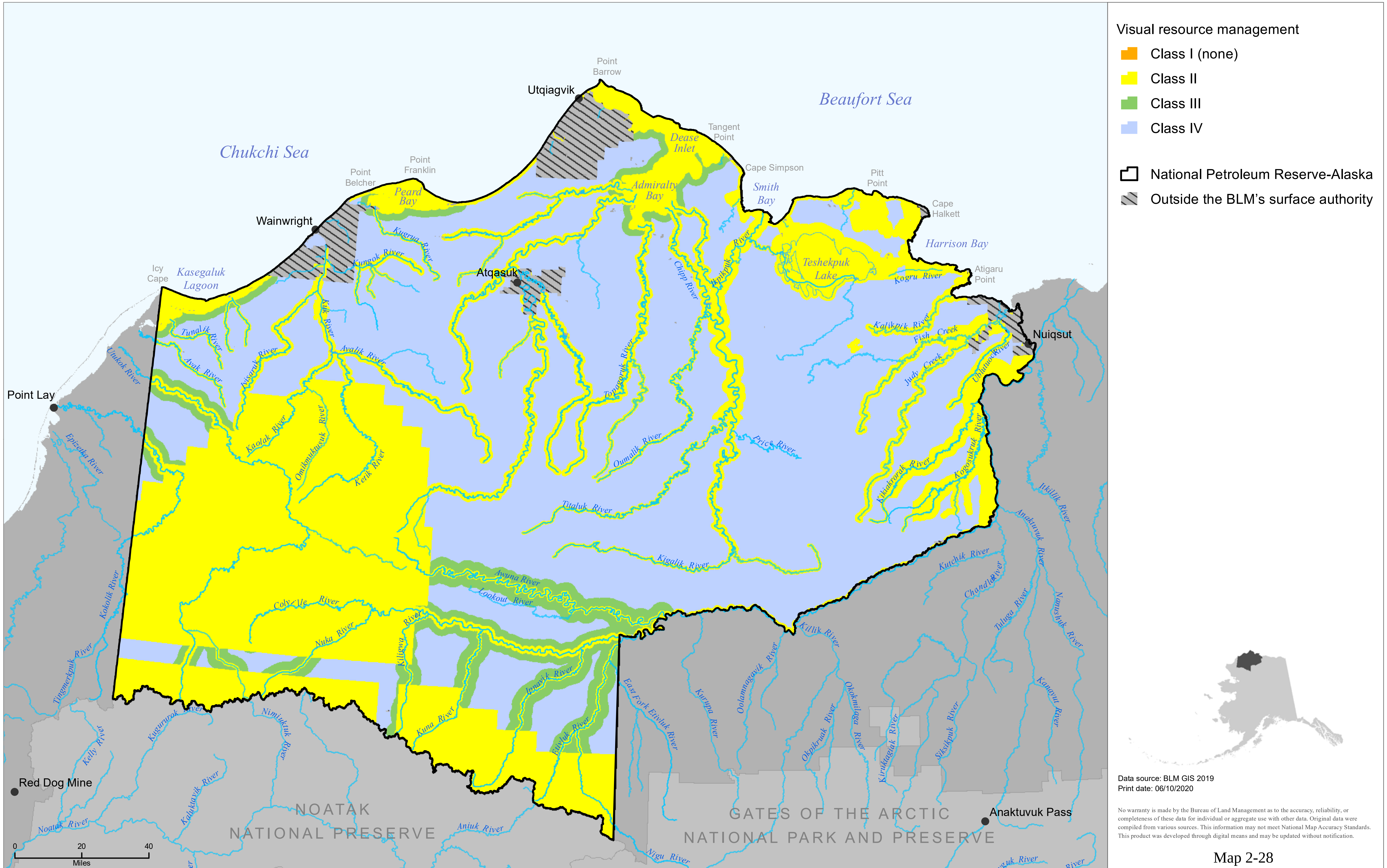
Data source: BLM GIS 2019
Print date: 06/10/2020

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 2-26


Visual resource management
Class I (none)
Class II
Class III
Class IV
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Miles
0
20
40
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

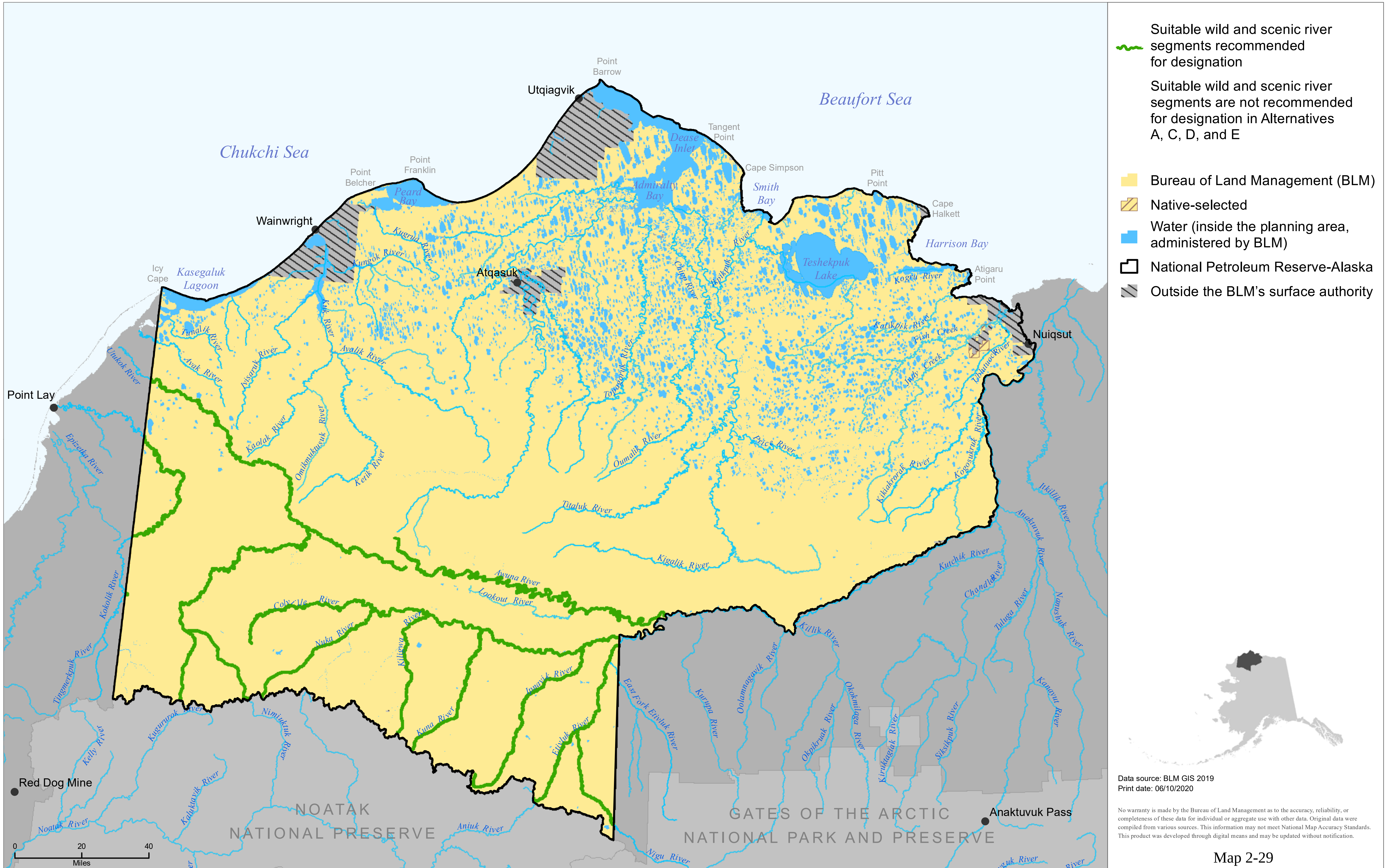
Map 2-27



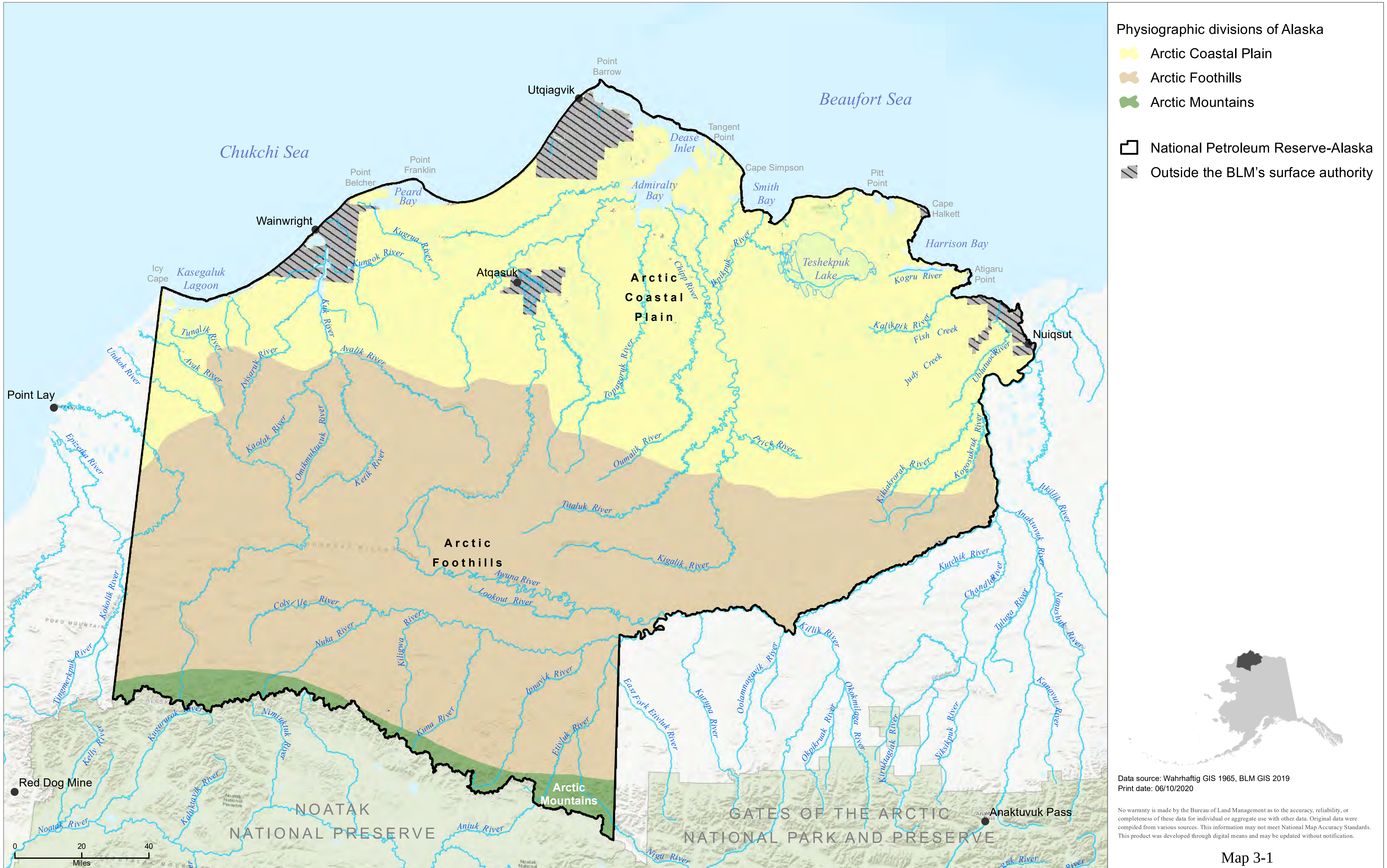
Data source: BLM GIS 2019
Print date: 06/10/2020

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

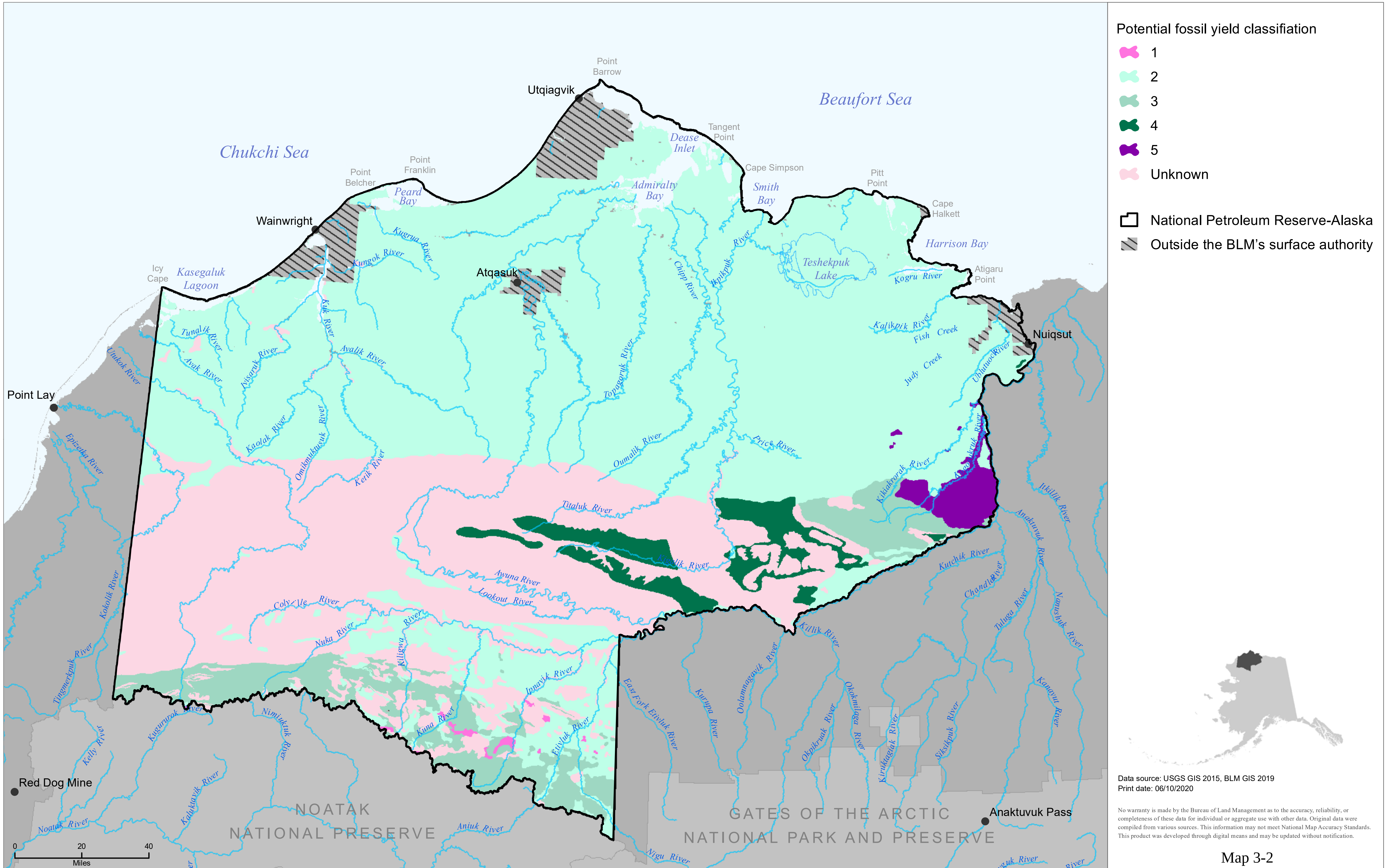
Map 2-28


Suitable wild and scenic river segments recommended for designation
Suitable wild and scenic river segments are not recommended for designation in Alternatives A, C, D, and E
Bureau of Land Management (BLM)
Native-selected
Water (inside the planning area, administered by BLM)
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Nuka River
Awuna River
Lookout River
Kiligwa River
Kuna River
Ipnavik River
Etivluk River
Titaluk River
Kigalik River
Ikpikpuk River
Chipp River
Topagoruk River
Meade River
Oumalik River
Price River
Kikiakrorak River
Kogosukruk River
Judy Creek
Fish Creek
Kalikpik River
Kogru River
Ublutuoch River
Kuk River
Avalik River
Kugrua River
Kungok River
Ketik River
Omikmuktusuk River
Kaolak River
Nigisaktuvik River
Avak River
Utukok River
Epizetka River
Kokolik River
Kukpowruk River
Nimiuktuk River
Kugururok River
Kelly River
Kaluktavik River
Noatak River
Aniuk River
Nigu River
East Fork Etivluk River
Killik River
Kurupa River
Oolamnagavik River
Okokmilaga River
Okpikruak River
Kiruktagiak River
Siksikpuk River
Chandler River
Kuchik River
Tuluga River
Anaktuvuk River
Nanushuk River
Itkillik River
Kanayut River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

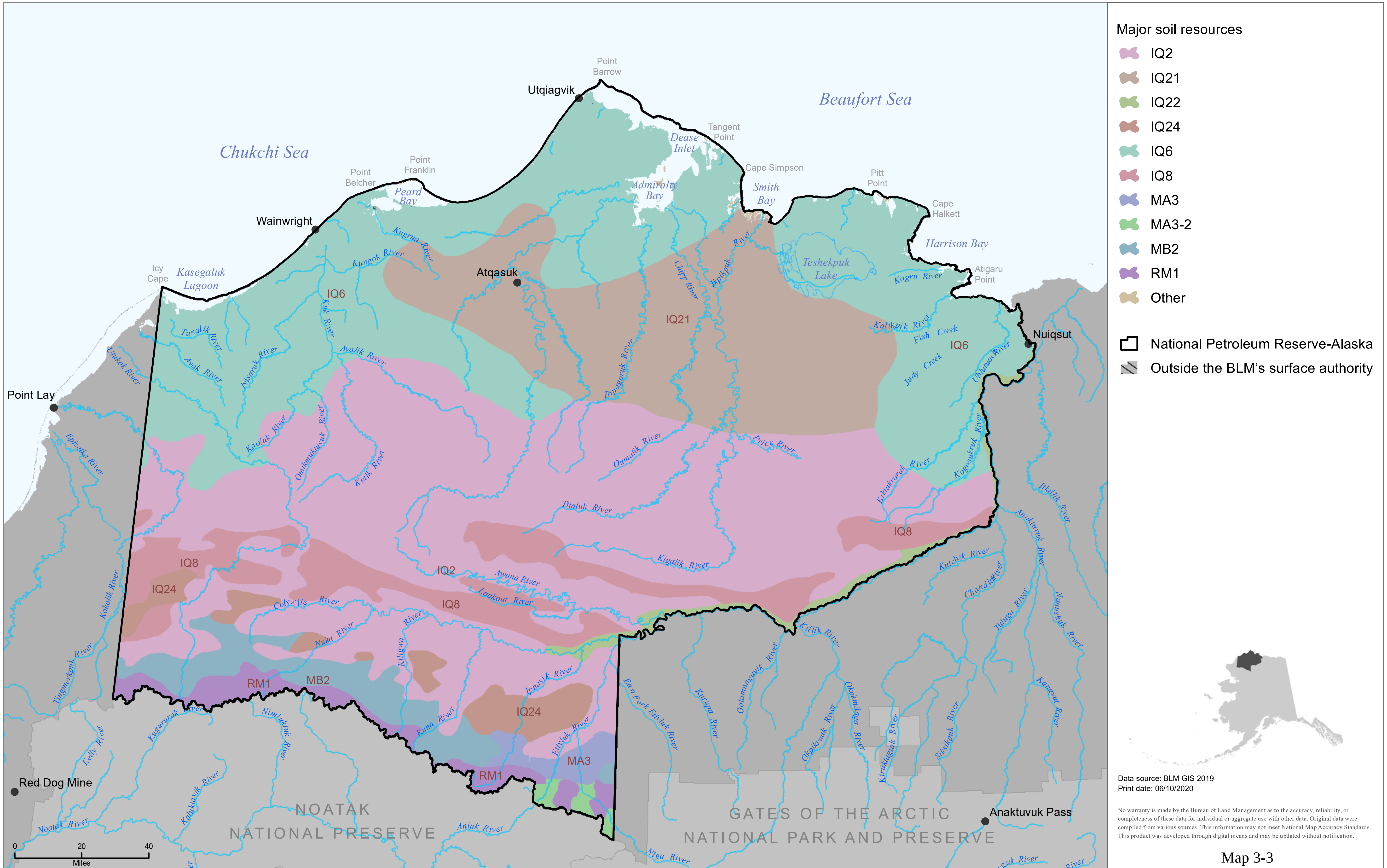
Map 2-29

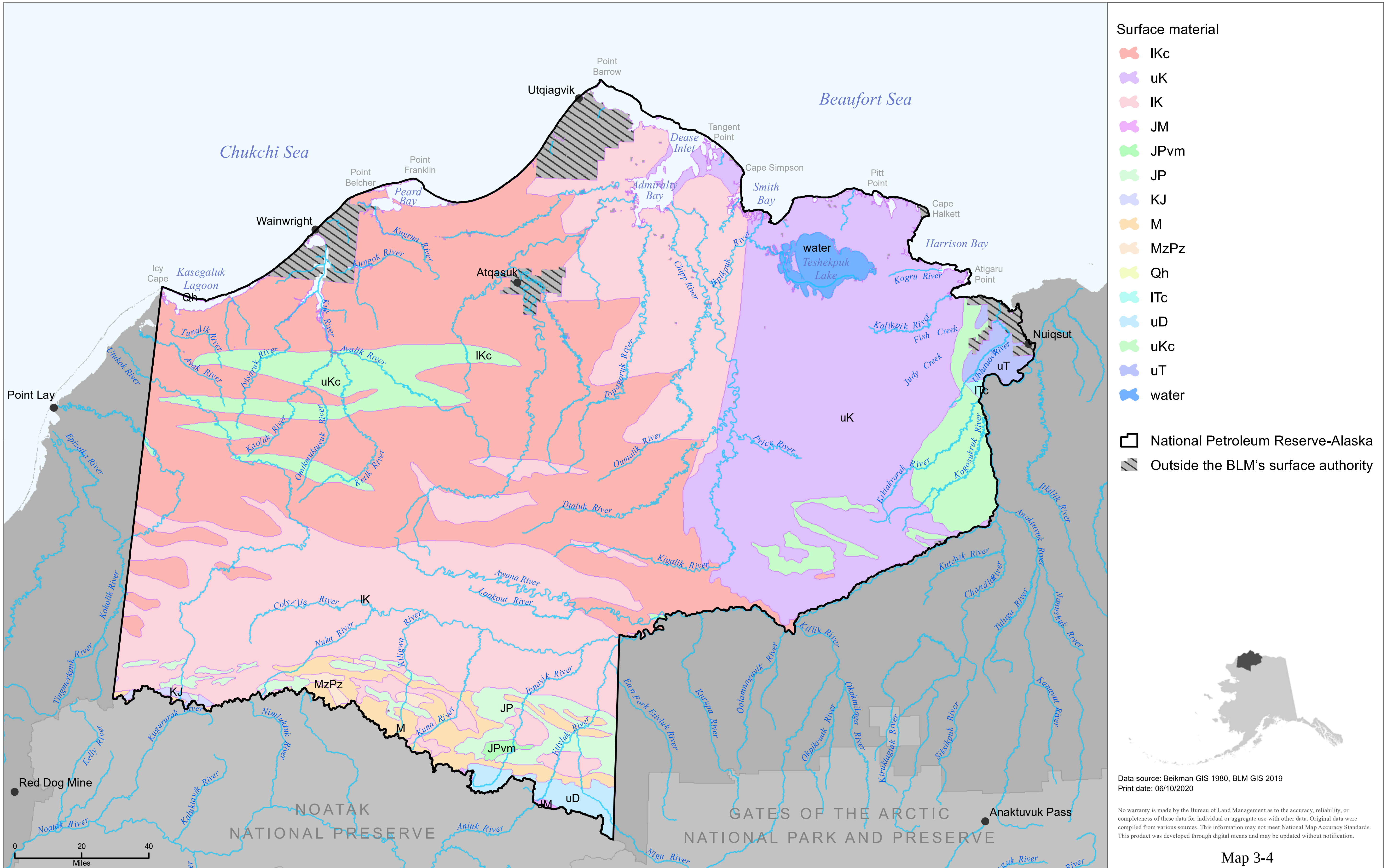

Physiographic divisions of Alaska
Arctic Coastal Plain
Arctic Foothills
Arctic Mountains
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Admiralty Bay
Point Franklin
Point Belcher
Peard Bay
Pitt Point
Cape Halkett
Harrison Bay
Wainwright
Icy Cape
Kasegaluk Lagoon
Atqasuk
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Lay
Arctic Coastal Plain
Arctic Foothills
Arctic Mountains
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0
20
40
Miles
Data source: Wahrhaftig GIS 1965, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

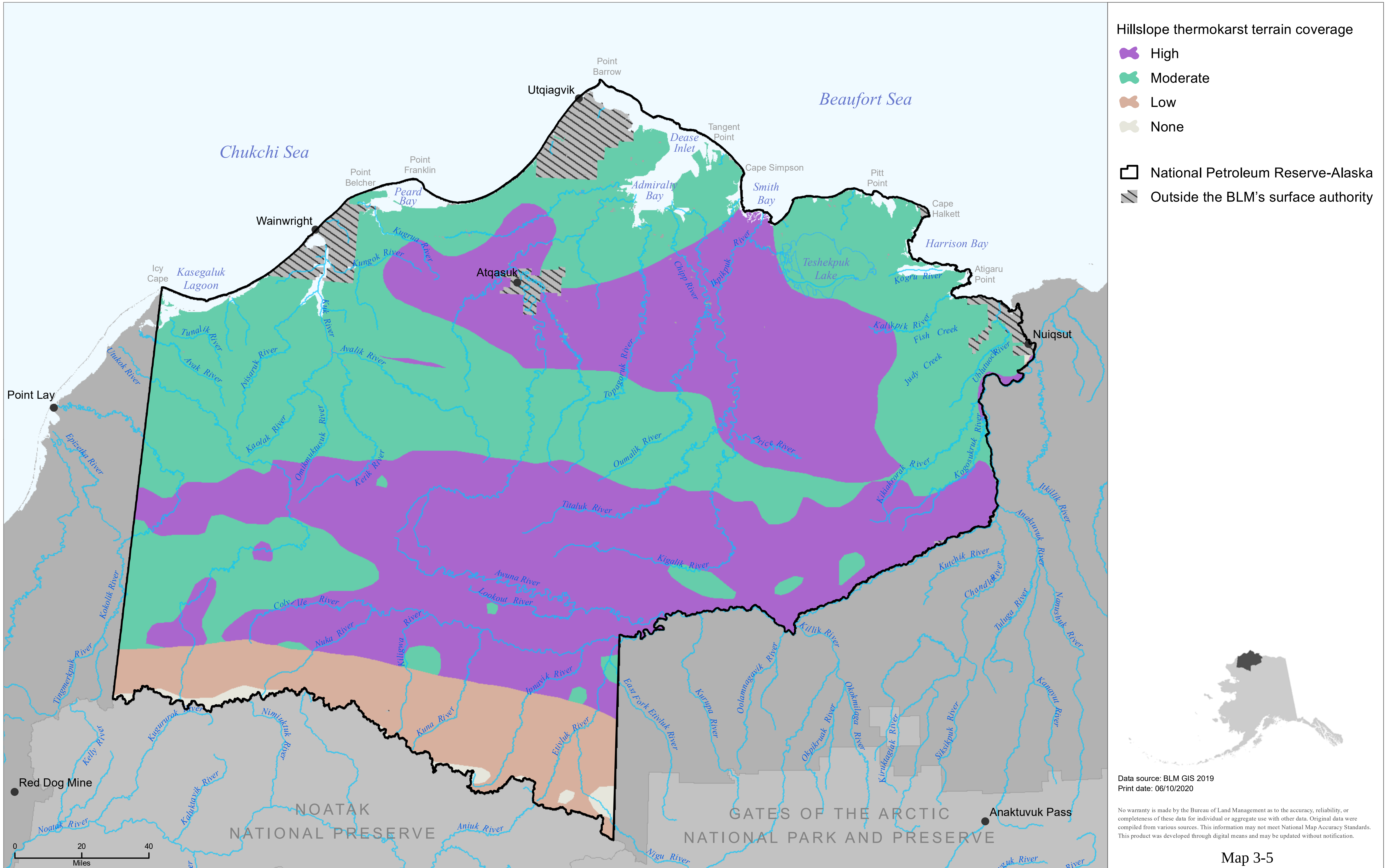
Map 3-1


Potential fossil yield classifiation
1
2
3
4
5
Unknown
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kugrua River
Kungok River
Kuk River
Avalik River
Tunalik River
Avak River
Nigisaktuvik River
Kaolak River
Omalik River
Ketik River
Utukok River
Epizetka River
Kokolik River
Chipp River
Ikpikpuk River
Topagoruk River
Oumalik River
Price River
Titaluk River
Kogru River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Kikiakrorak River
Colville River
Awuna River
Lookout River
Nuka River
Kiligwa River
Ipnavik River
Kuna River
Etivluk River
East Fork Etivluk River
Killik River
Itkillik River
Anaktuvuk River
Chandler River
Kurupa River
Oolamnagavik River
Okokmilaga River
Okpikruak River
Siksikpuk River
Nanushuk River
Kanayut River
Kuchik River
Tuluga River
Nimiuktuk River
Kugururok River
Kelly River
Kaluktavik River
Noatak River
Aniuk River
Nigu River
0
20
40
Miles
Data source: USGS GIS 2015, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

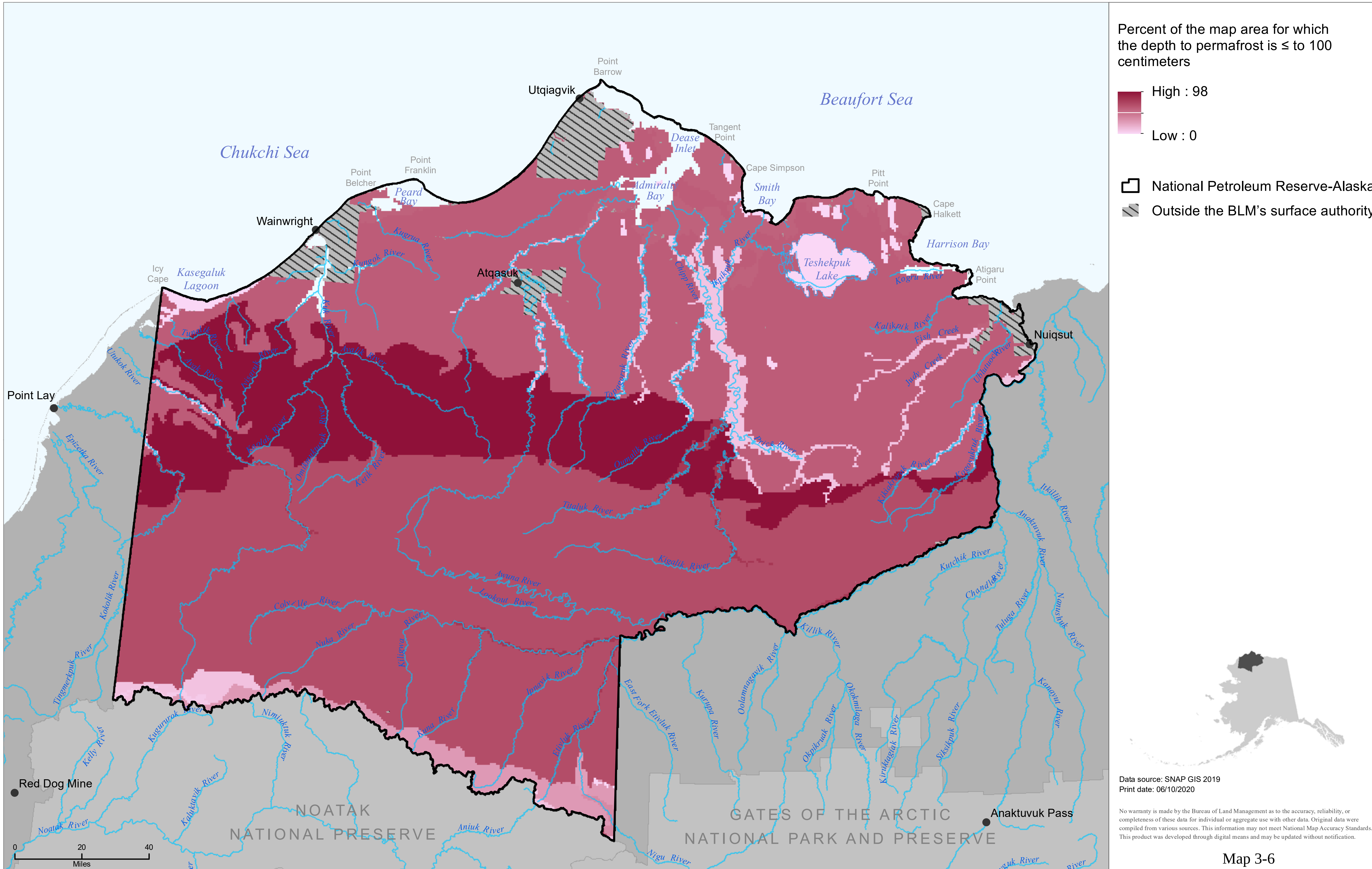
Map 3-2


Major soil resources
IQ2
IQ21
IQ22
IQ24
IQ6
IQ8
MA3
MA3-2
MB2
RM1
Other
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Teshekpuk Lake
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kuk River
Kugrua River
Kungok River
Chipp River
Ikpikpuk River
Topagoruk River
Kogru River
Kalikpik River
Fish Creek
Judy Creek
Colville River
Avalik River
Tunalik River
Avak River
Utukok River
Kaolak River
Ketik River
Meade River
Oumalik River
Price River
Titaluk River
Kigalik River
Awuna River
Lookout River
Colville River
Nuka River
Killik River
Etivluk River
Ipnavik River
Kuna River
Kiligwa River
Kokolik River
Epizetka River
Kukpowruk River
Noatak River
Aniuk River
Nigu River
Itkillik River
Anaktuvuk River
Chandler River
Kurupa River
Okokmilaga River
Nanushuk River
0 20 40
Miles
IQ6
IQ21
IQ2
IQ8
IQ24
RM1
MB2
MA3
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
Map 3-3


Surface material
IKc
uK
IK
JM
JPvm
JP
KJ
M
MzPz
Qh
ITc
uD
uKc
uT
water
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Teshekpuk Lake
Admiralty Bay
Peard Bay
Point Franklin
Point Belcher
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Meade River
Kuk River
Kigalik River
Killik River
Nuka River
Awuna River
Titaluk River
Price River
Fish Creek
Judy Creek
Kogru River
Kalikpik River
Miles
0
20
40
Data source: Beikman GIS 1980, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
Map 3-4


Hillslope thermokarst terrain coverage
High
Moderate
Low
None
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Miles
0
20
40
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

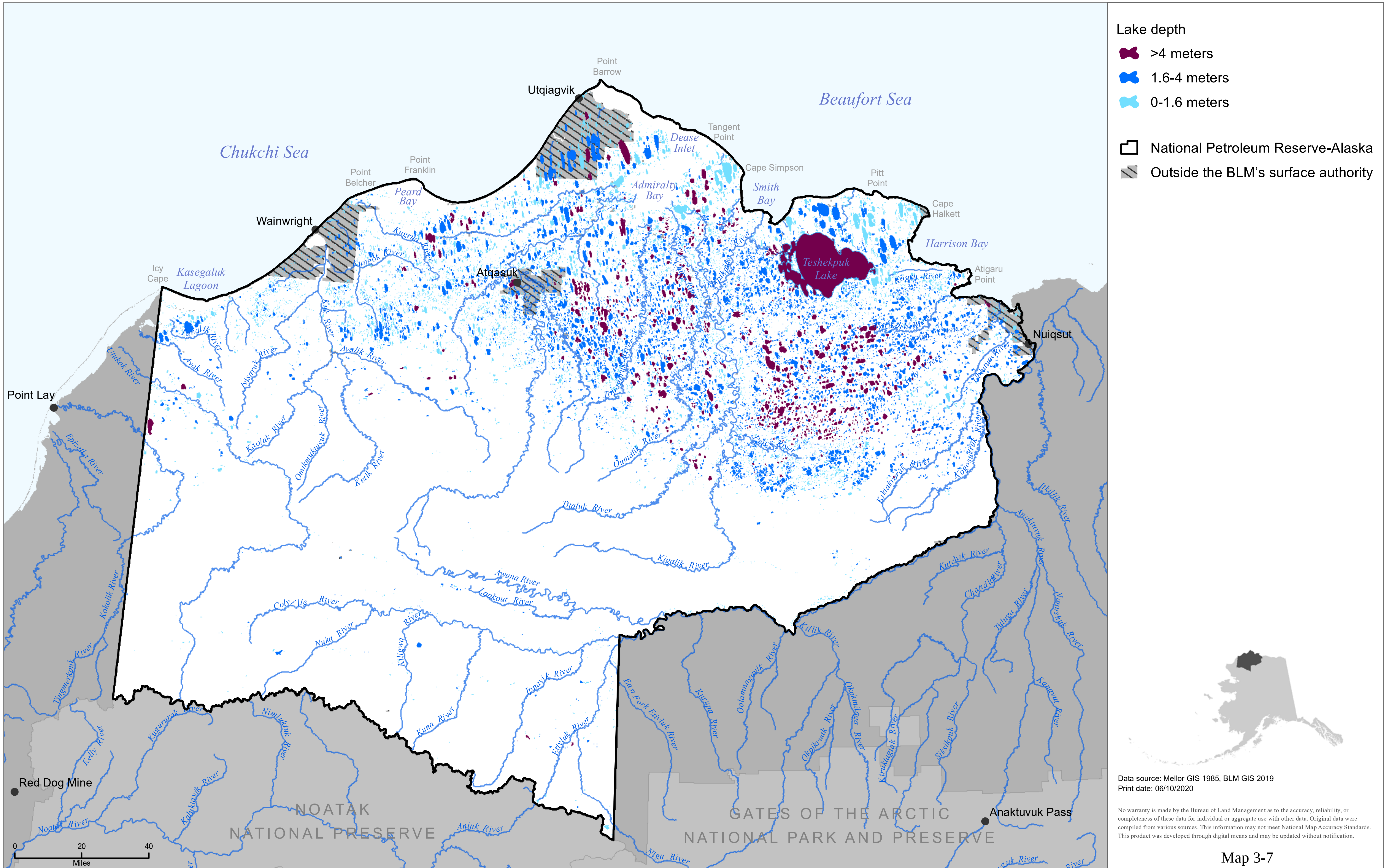
Map 3-5



Data source: SNAP GIS 2019
Print date: 06/10/2020

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-6


Lake depth
>4 meters
1.6-4 meters
0-1.6 meters
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Titaluk River
Kigalik River
Colville River
Nuka River
Kuna River
Ipnavik River
Etivluk River
Killik River
Red Dog Mine
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
0 20 40
Miles
Data source: Mellor GIS 1985, BLM GIS 2019
Print date: 06/10/2020
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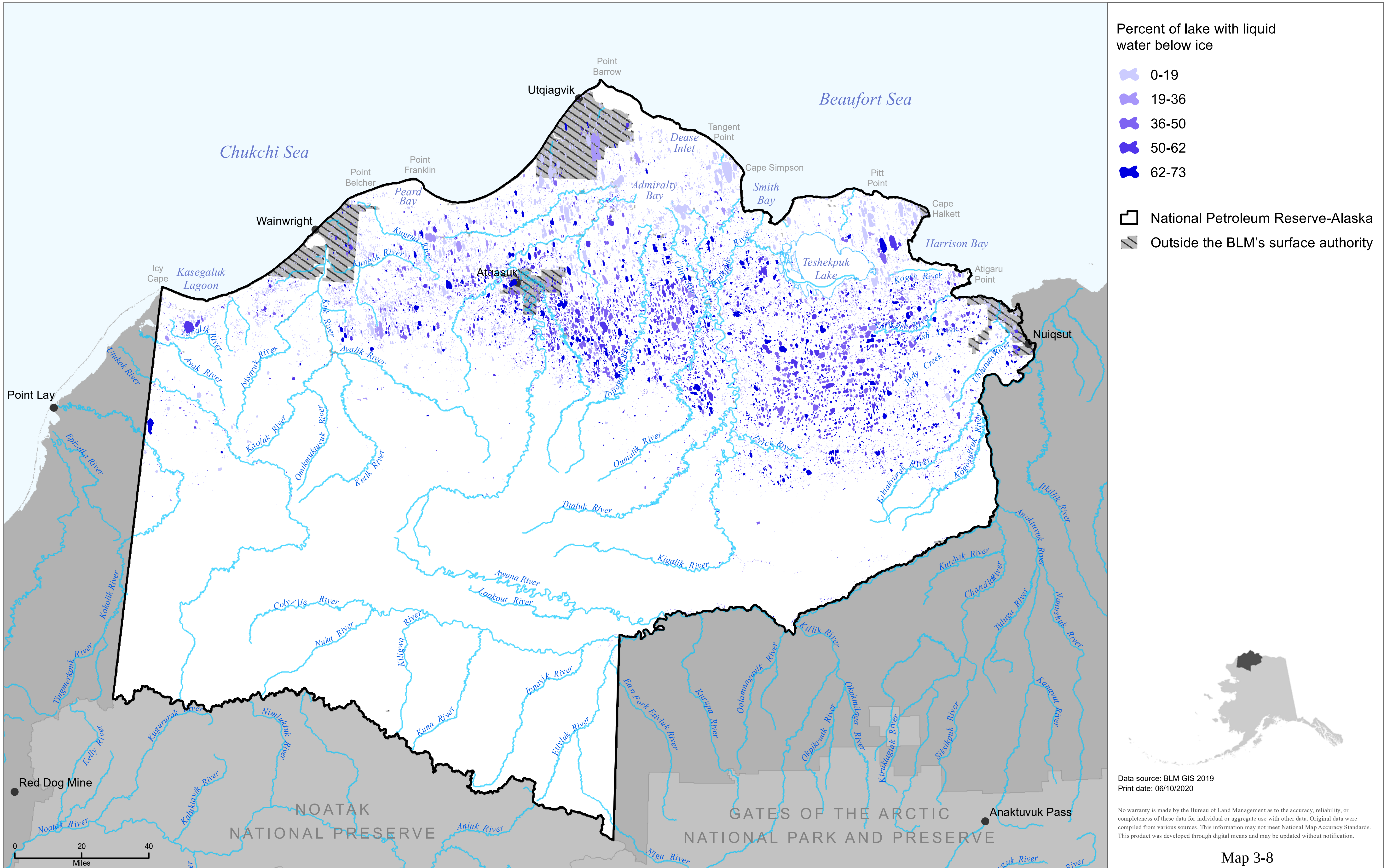
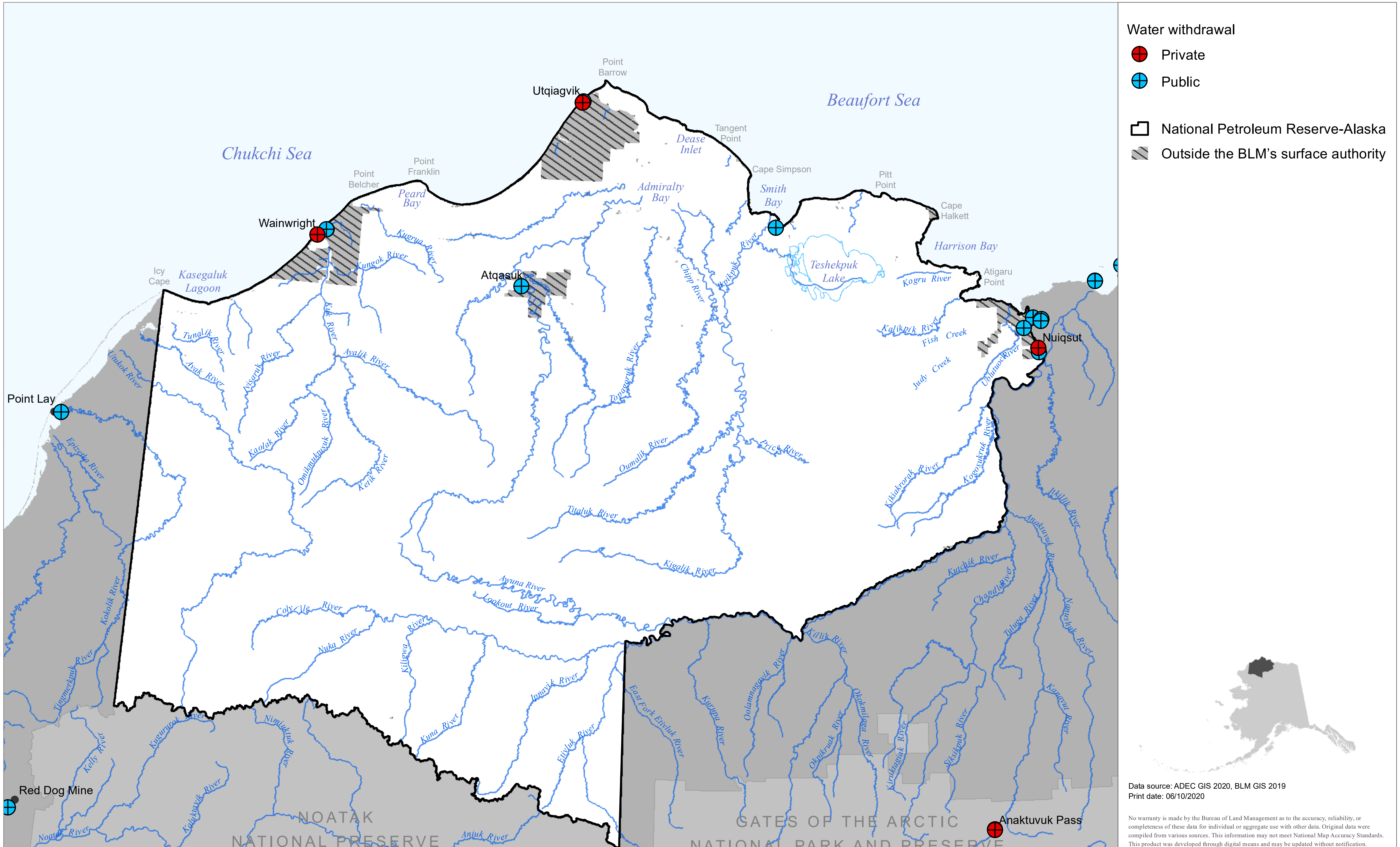
Map 3-7



Data source: BLM GIS 2019
Print date: 06/10/2020

Map 3-8


Water withdrawal
Private
Public
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0
20
40
Miles
Data source: ADEC GIS 2020, BLM GIS 2019
Print date: 06/10/2020
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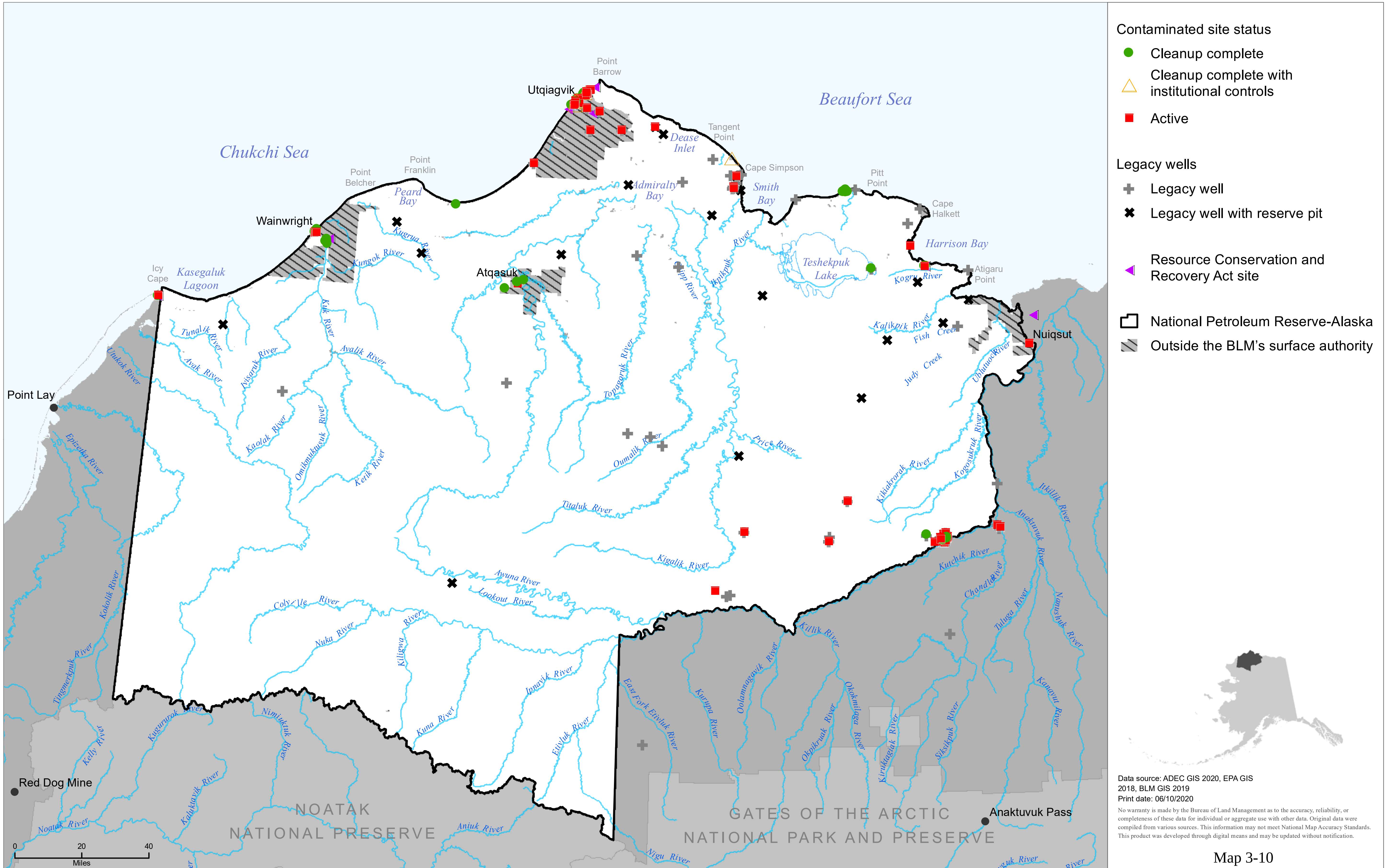
Map 3-9


Contaminated site status
Cleanup complete
Cleanup complete with institutional controls
Active
Legacy wells
Legacy well
Legacy well with reserve pit
Resource Conservation and Recovery Act site
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Topagoruk River
Meade River
Kuk River
Utukok River
Kokolik River
Titaluk River
Kigalik River
Price River
Fish Creek
Judy Creek
Kalikpik River
Ublutuoch River
Oumalik River
Avalik River
Kungok River
Kugrua River
Tunalik River
Avak River
Nigisaktuvik River
Kaolak River
Ketik River
Awuna River
Lookout River
Nuka River
Kiligwa River
Kuna River
Ipnavik River
Etivluk River
Kogru River
Killik River
Chandler River
Anaktuvuk River
Itkillik River
Kuchik River
Kikiakrorak River
Data source: ADEC GIS 2020, EPA GIS 2018, BLM GIS 2019
Print date: 06/10/2020
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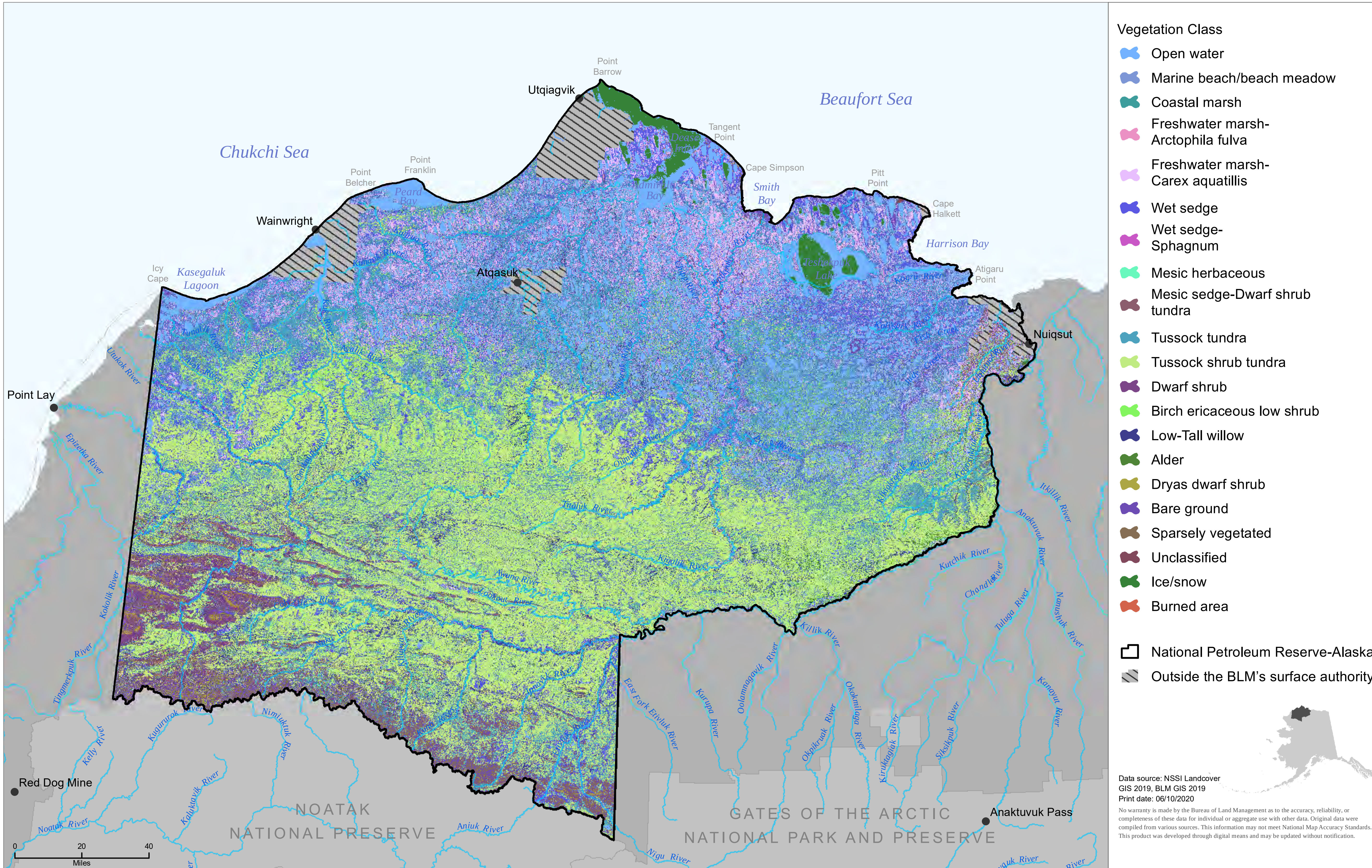
0 20 40
Miles

Map 3-10


Vegetation Class
Open water
Marine beach/beach meadow
Coastal marsh
Freshwater marsh-Arctophila fulva
Freshwater marsh-Carex aquatillis
Wet sedge
Wet sedge-Sphagnum
Mesic herbaceous
Mesic sedge-Dwarf shrub tundra
Tussock tundra
Tussock shrub tundra
Dwarf shrub
Birch ericaceous low shrub
Low-Tall willow
Alder
Dryas dwarf shrub
Bare ground
Sparsely vegetated
Unclassified
Ice/snow
Burned area
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: NSSI Landcover GIS 2019, BLM GIS 2019
Print date: 06/10/2020
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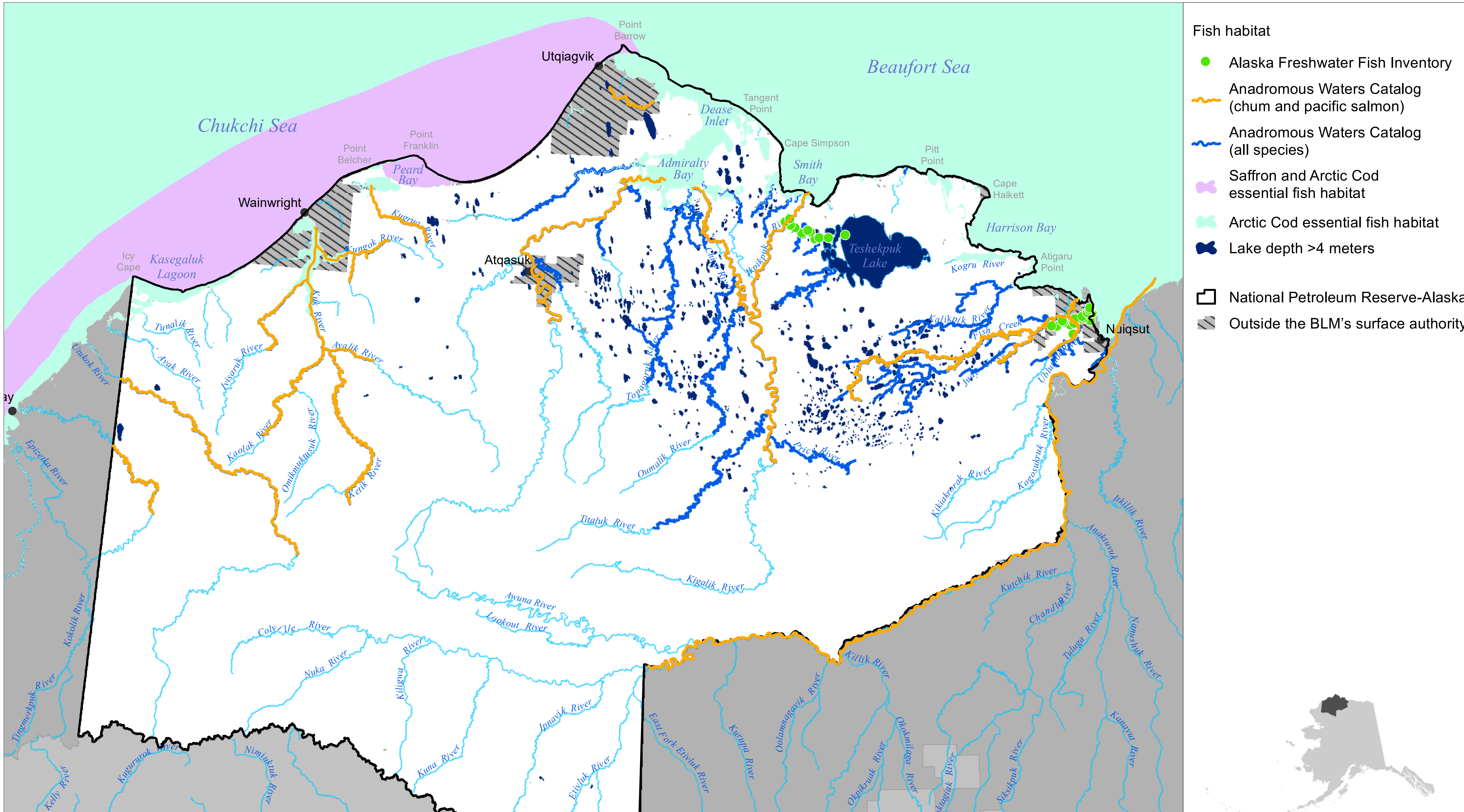
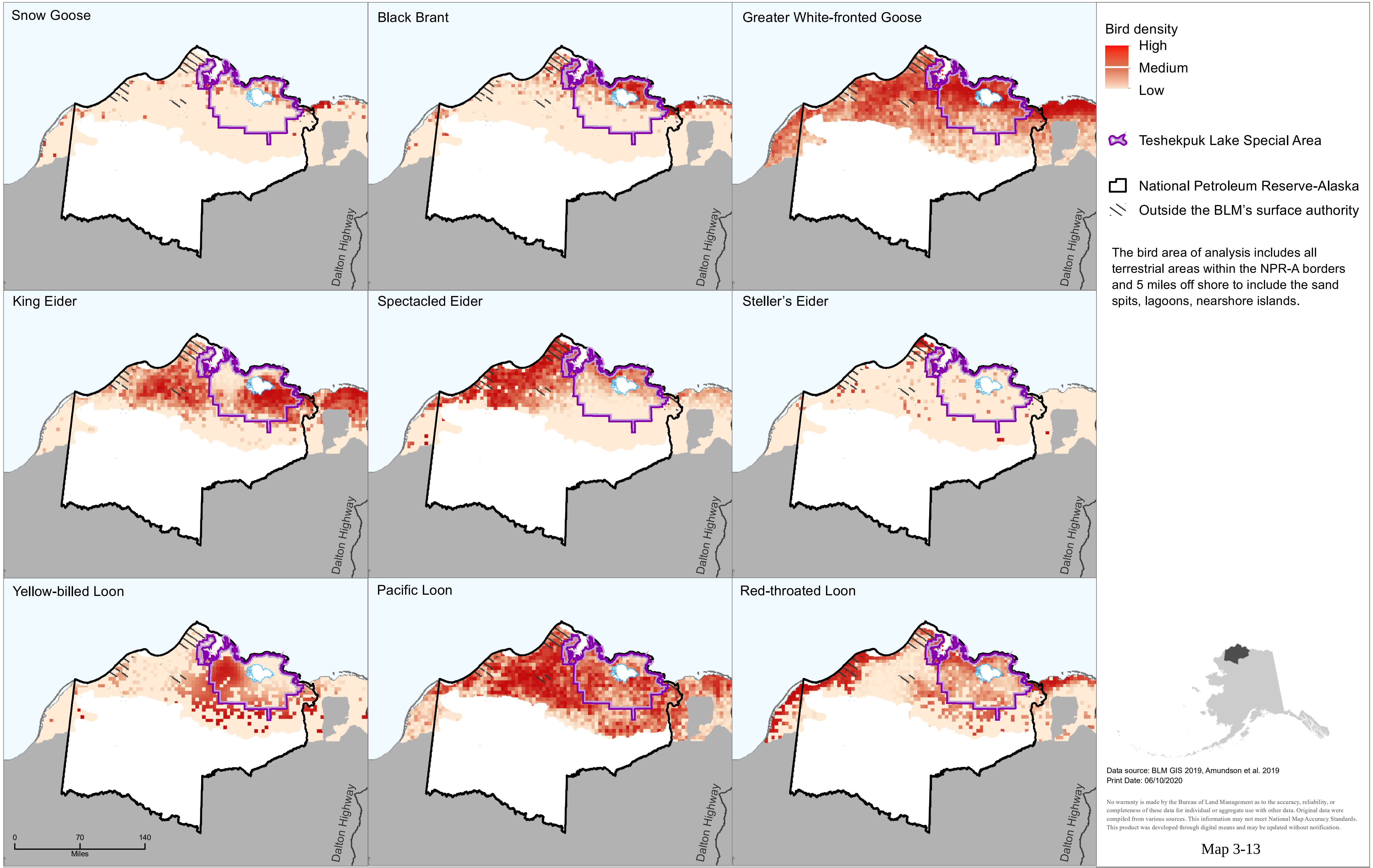
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Utukok River
Kokolik River
Kuna River
Ikpikpuk River
Colville River
Killik River
Chandler River
Anaktuvuk River
Itkillik River
Noatak River
Aniuk River
Nigu River
Kelly River
Kukpowruk River
0 20 40
Miles



Data source: BLM GIS 2019, ADFG GIS 2019
Print date: 06/10/2020

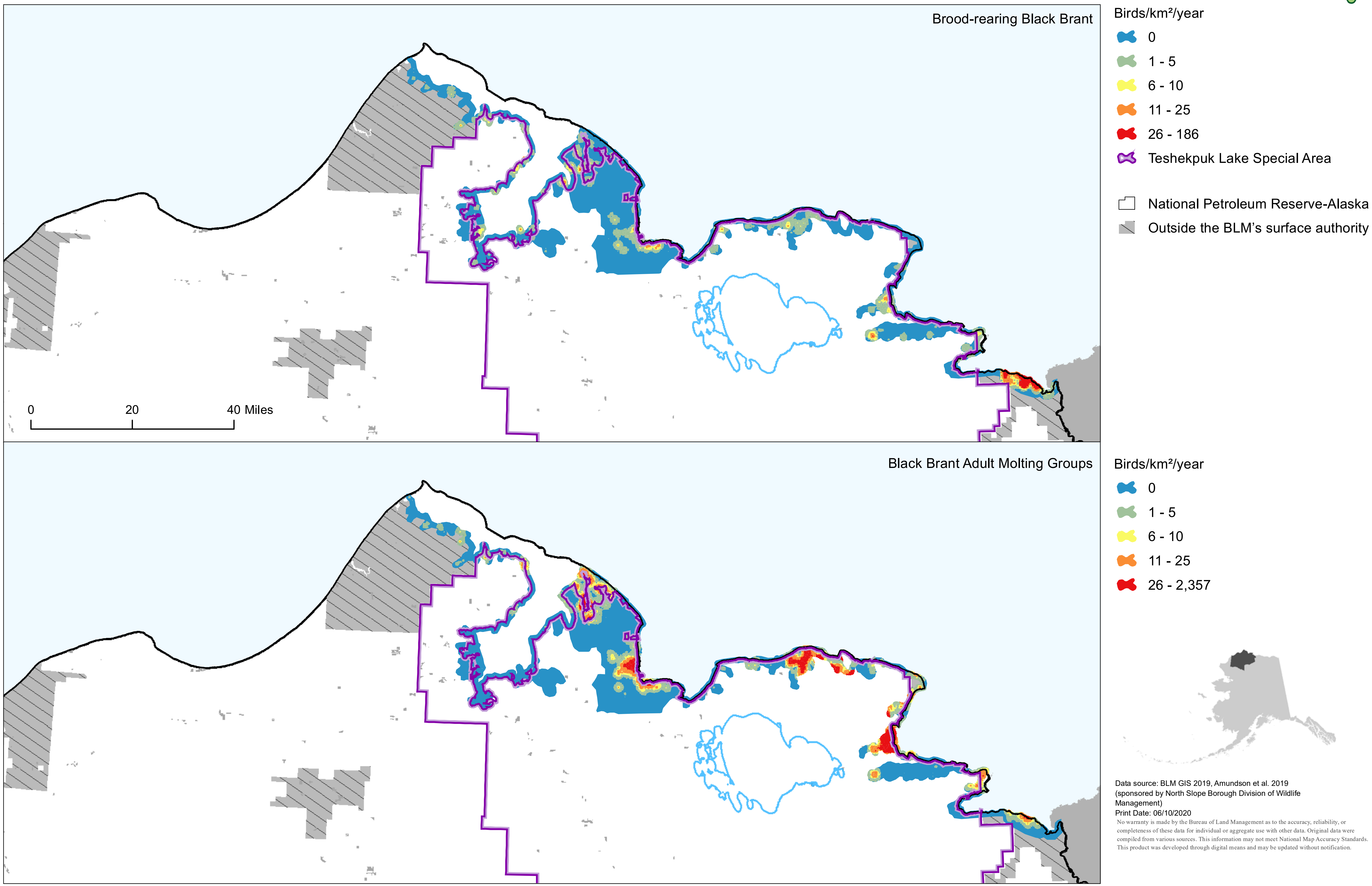
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

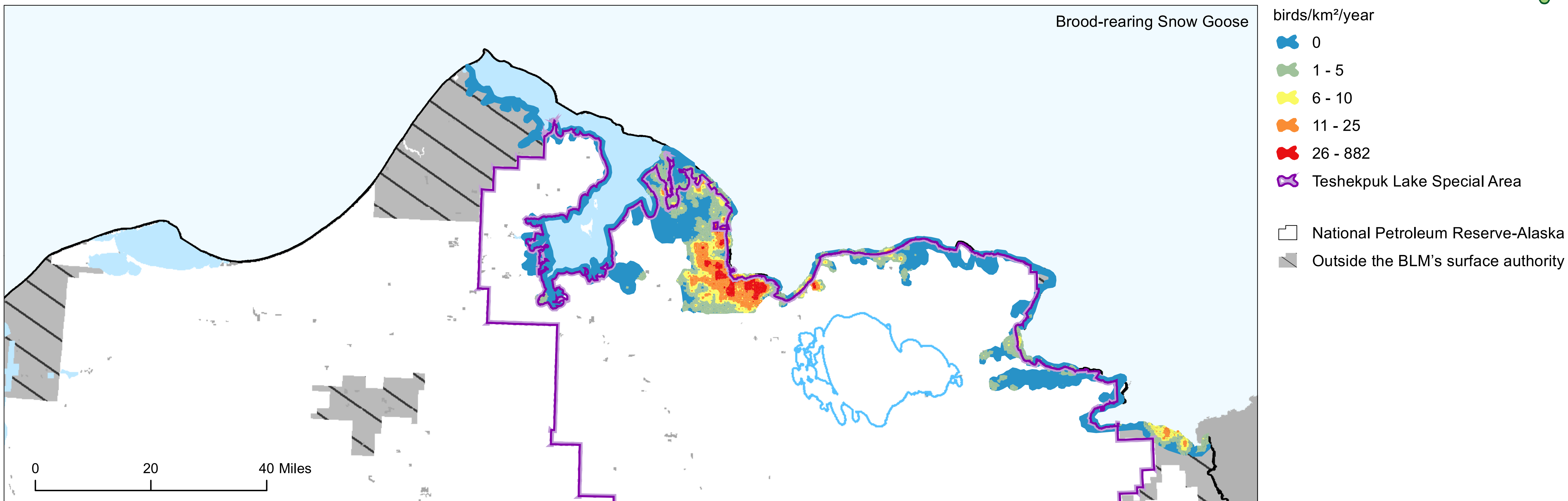
Map 3-12

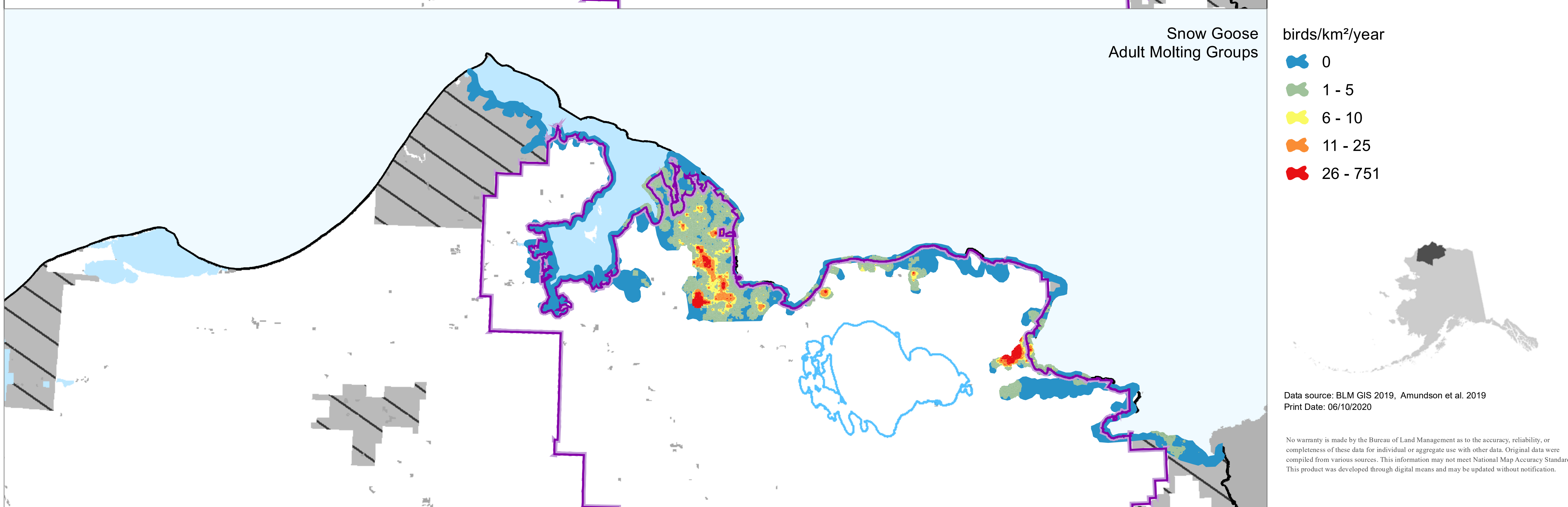

Snow Goose
Black Brant
Greater White-fronted Goose
King Eider
Spectacled Eider
Steller's Eider
Yellow-billed Loon
Pacific Loon
Red-throated Loon
Dalton Highway
0
70
140
Miles
Bird density
High
Medium
Low
Teshekpuk Lake Special Area
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
The bird area of analysis includes all terrestrial areas within the NPR-A borders and 5 miles off shore to include the sand spits, lagoons, nearshore islands.
Data source: BLM GIS 2019, Amundson et al. 2019
Print Date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-13

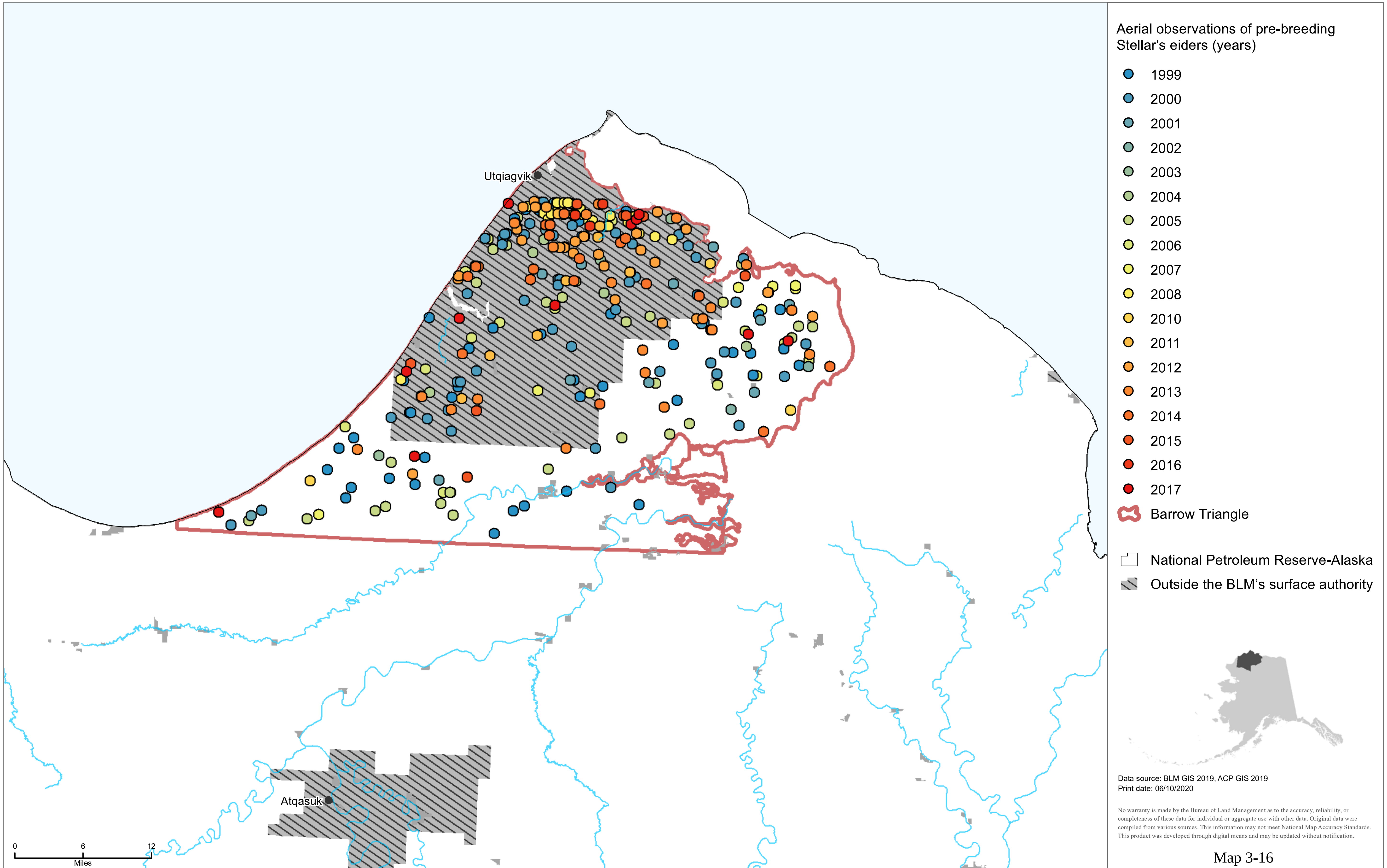
Bird Densities from USFWS ACP Study, as Analyzed by USGS, Black Brant



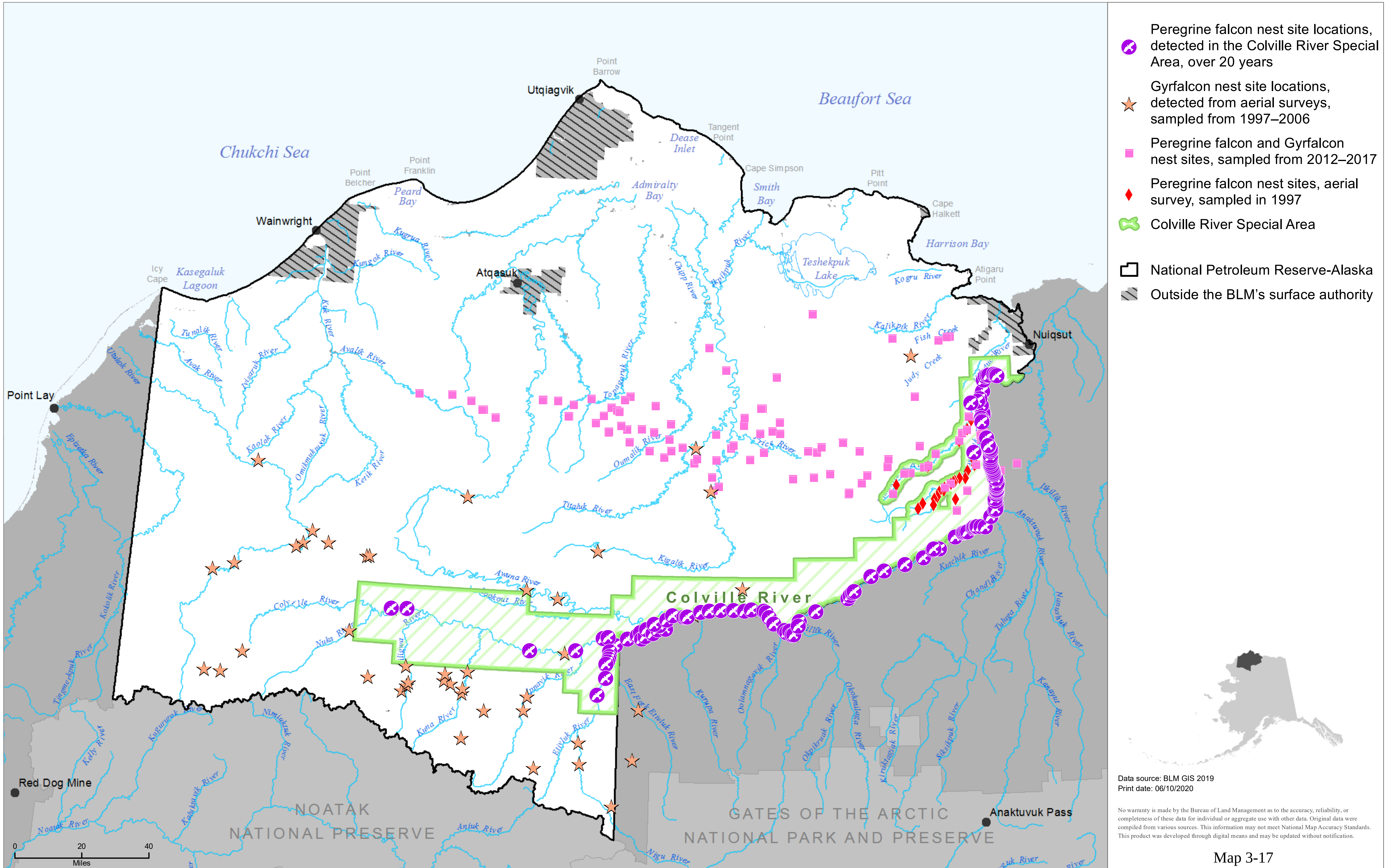




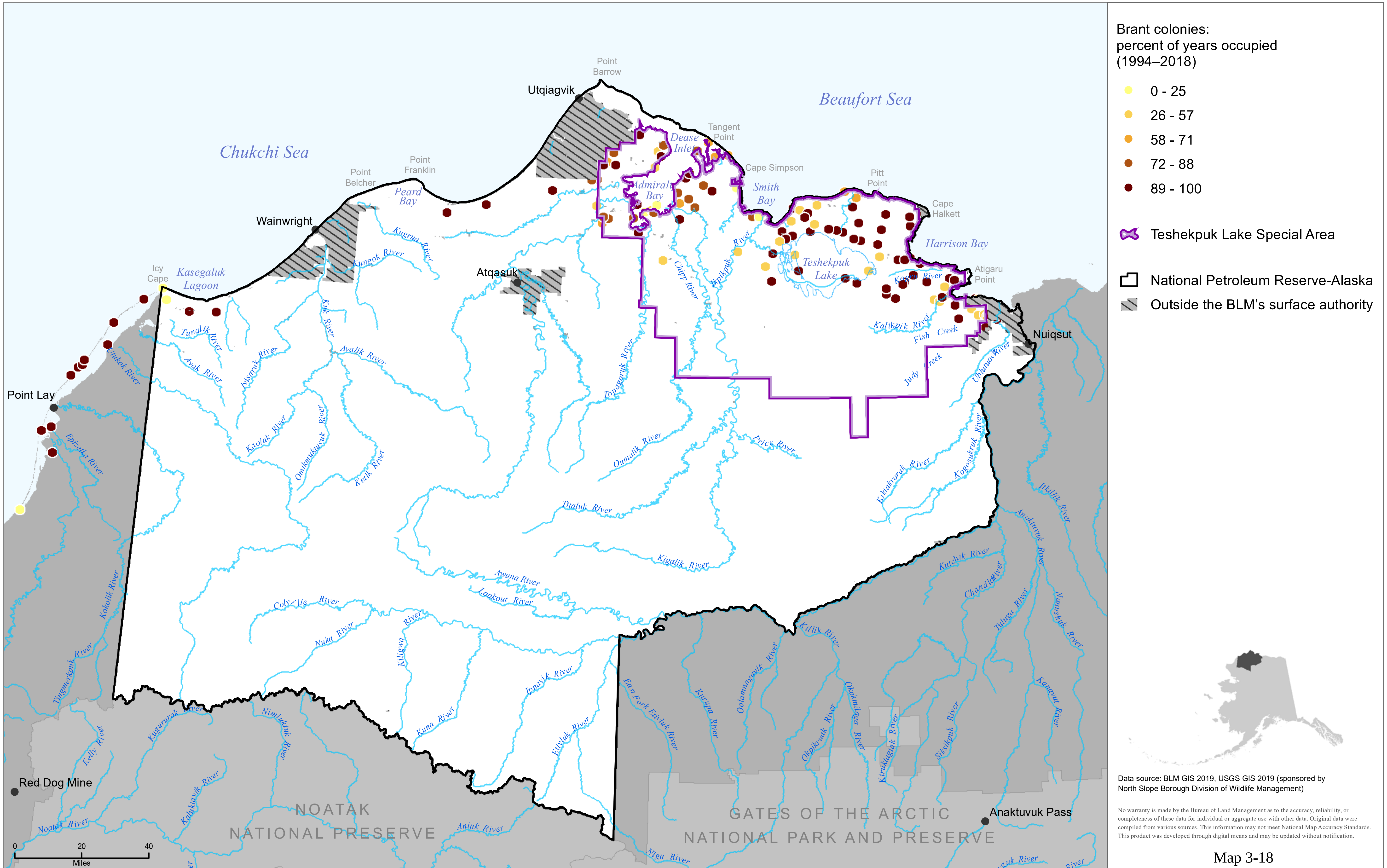
Data source: BLM GIS 2019, Amundson et al. 2019
Print Date: 06/10/2020


Utqiagvik
Atqasuk
0
6
12
Miles
Aerial observations of pre-breeding Stellar's eiders (years)
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2010
2011
2012
2013
2014
2015
2016
2017
Barrow Triangle
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: BLM GIS 2019, ACP GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

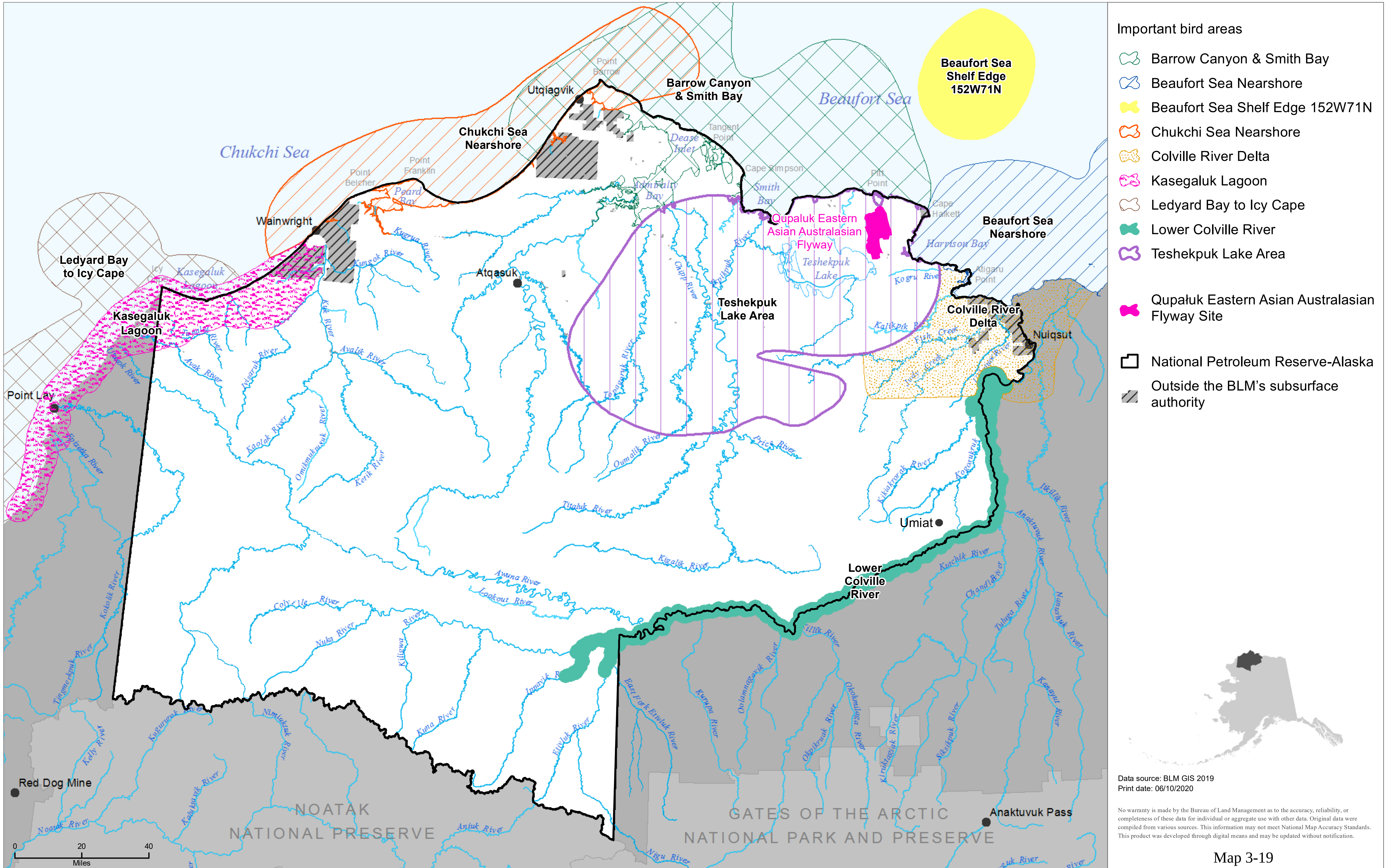
Map 3-16


Peregrine falcon nest site locations, detected in the Colville River Special Area, over 20 years
Gyrfalcon nest site locations, detected from aerial surveys, sampled from 1997–2006
Peregrine falcon and Gyrfalcon nest sites, sampled from 2012–2017
Peregrine falcon nest sites, aerial survey, sampled in 1997
Colville River Special Area
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Colville River
Red Dog Mine
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
0
20
40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

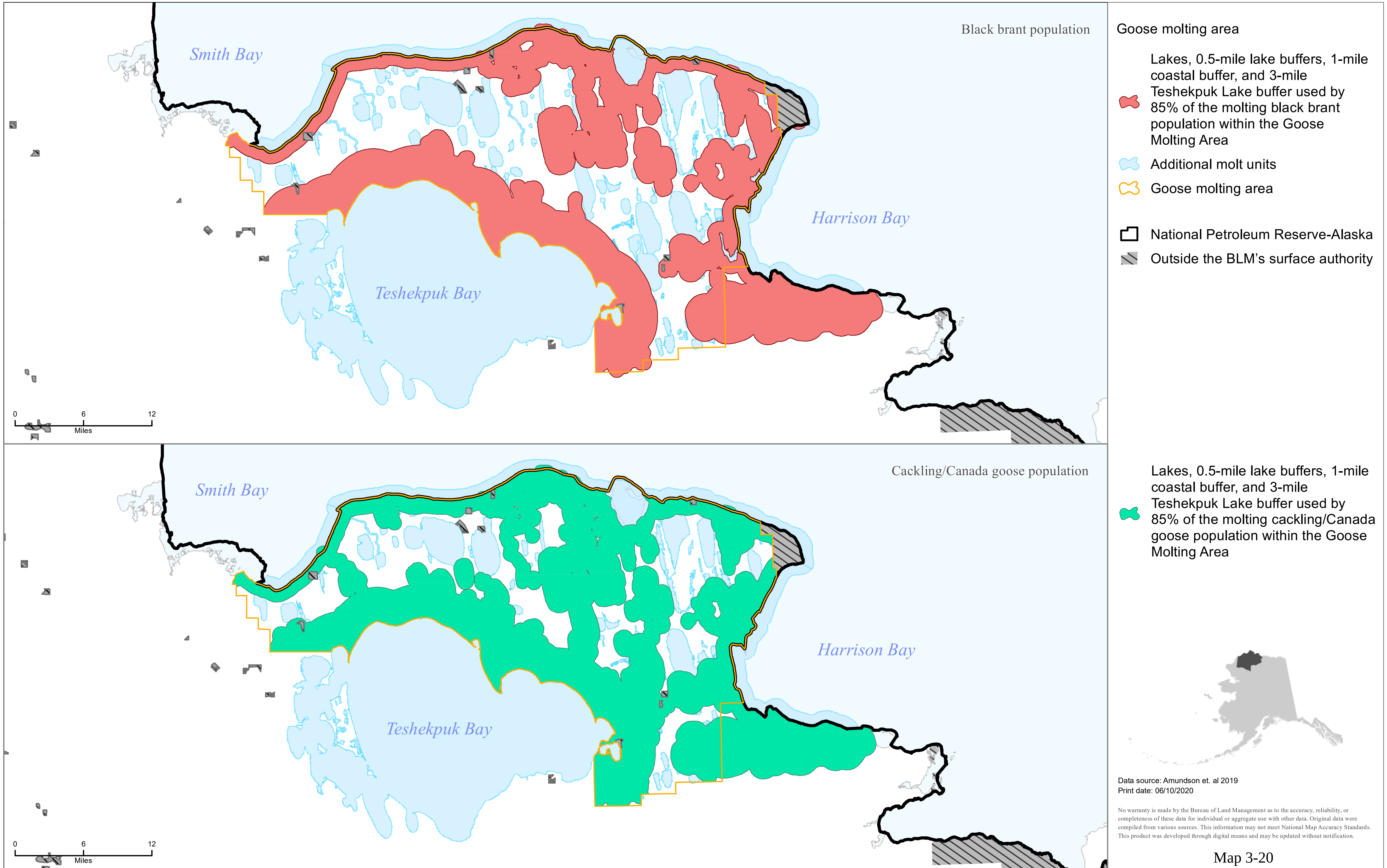
Map 3-17


Brant colonies:
percent of years occupied
(1994–2018)
0 - 25
26 - 57
58 - 71
72 - 88
89 - 100
Teshekpuk Lake Special Area
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Topagoruk River
Meade River
Kuk River
Utukok River
Kokolik River
Fish Creek
Judy Creek
Kalikpik River
Price River
Oumalik River
Titaluk River
Kigalik River
Awuna River
Lookout River
Nuka River
Killik River
Etivluk River
Ipnavik River
Kuna River
Kiligwa River
0 20 40
Miles
Data source: BLM GIS 2019, USGS GIS 2019 (sponsored by North Slope Borough Division of Wildlife Management)
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-18

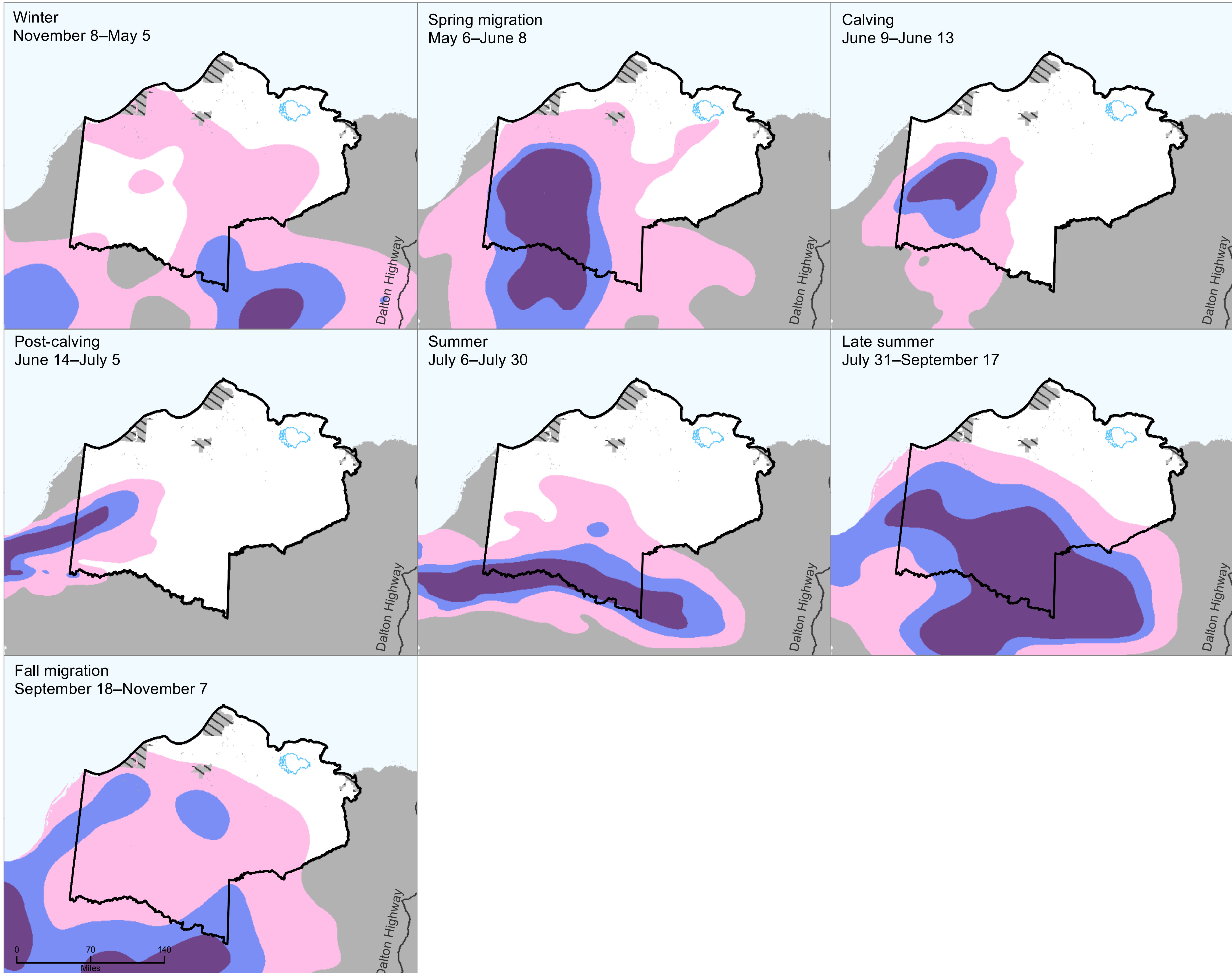

Important bird areas
Barrow Canyon & Smith Bay
Beaufort Sea Nearshore
Beaufort Sea Shelf Edge 152W71N
Chukchi Sea Nearshore
Colville River Delta
Kasegaluk Lagoon
Ledyard Bay to Icy Cape
Lower Colville River
Teshekpuk Lake Area
Qupałuk Eastern Asian Australasian Flyway Site
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Beaufort Sea Shelf Edge 152W71N
Beaufort Sea
Barrow Canyon & Smith Bay
Utqiagvik
Chukchi Sea Nearshore
Chukchi Sea
Wainwright
Ledyard Bay to Icy Cape
Kasegaluk Lagoon
Point Lay
Atqasuk
Teshekpuk Lake Area
Qupałuk Eastern Asian Australasian Flyway
Beaufort Sea Nearshore
Colville River Delta
Nuiqsut
Umiat
Lower Colville River
Red Dog Mine
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-19


Black brant population
Smith Bay
Harrison Bay
Teshekpuk Bay
0 6 12
Miles
Cackling/Canada goose population
Smith Bay
Harrison Bay
Teshekpuk Bay
0 6 12
Miles
Goose molting area
Lakes, 0.5-mile lake buffers, 1-mile coastal buffer, and 3-mile Teshekpuk Lake buffer used by 85% of the molting black brant population within the Goose Molting Area
Additional molt units
Goose molting area
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Lakes, 0.5-mile lake buffers, 1-mile coastal buffer, and 3-mile Teshekpuk Lake buffer used by 85% of the molting cackling/Canada goose population within the Goose Molting Area
Data source: Amundson et. al 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-20

Seasonal Distribution of the Western Arctic Herd



Kernel density isopleth

- 50% (high density)
- 75% (medium density)
- 95% (low density)
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

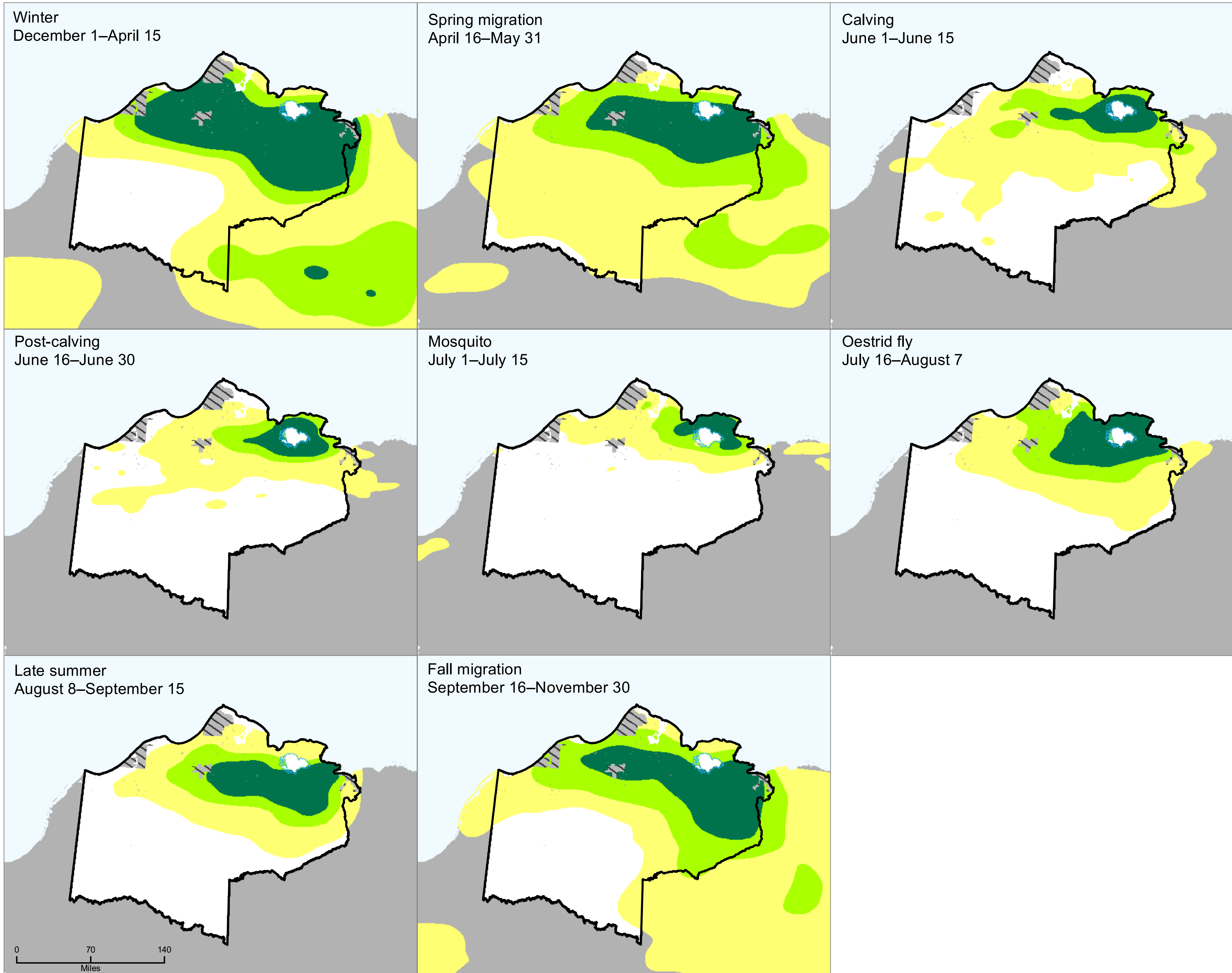
Utilization distribution contours for the Western Arctic Herd were calculated using fixed-kernel density estimation analysis of locations of radio-collared female caribou (telemetry database from Alaska Department of Fish and Game [ADF&G]). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated using the plug-in method. Final seasonal kernels were calculated as the average of kernels calculated for every 2-day period during the season to account for intra-season movements.

The study years are from 2001-2018. Funding for telemetry collars came from ADF&G and the National Park Service.

Data source: BLM GIS 2019, ADFG GIS 2019
Print Date: 06/10/2020

Map 3-21

Seasonal Distribution of the Teshekpuk Lake Caribou Herd



Kernel density isopleth

- 50% (high density)
- 75% (medium density)
- 95% (low density)

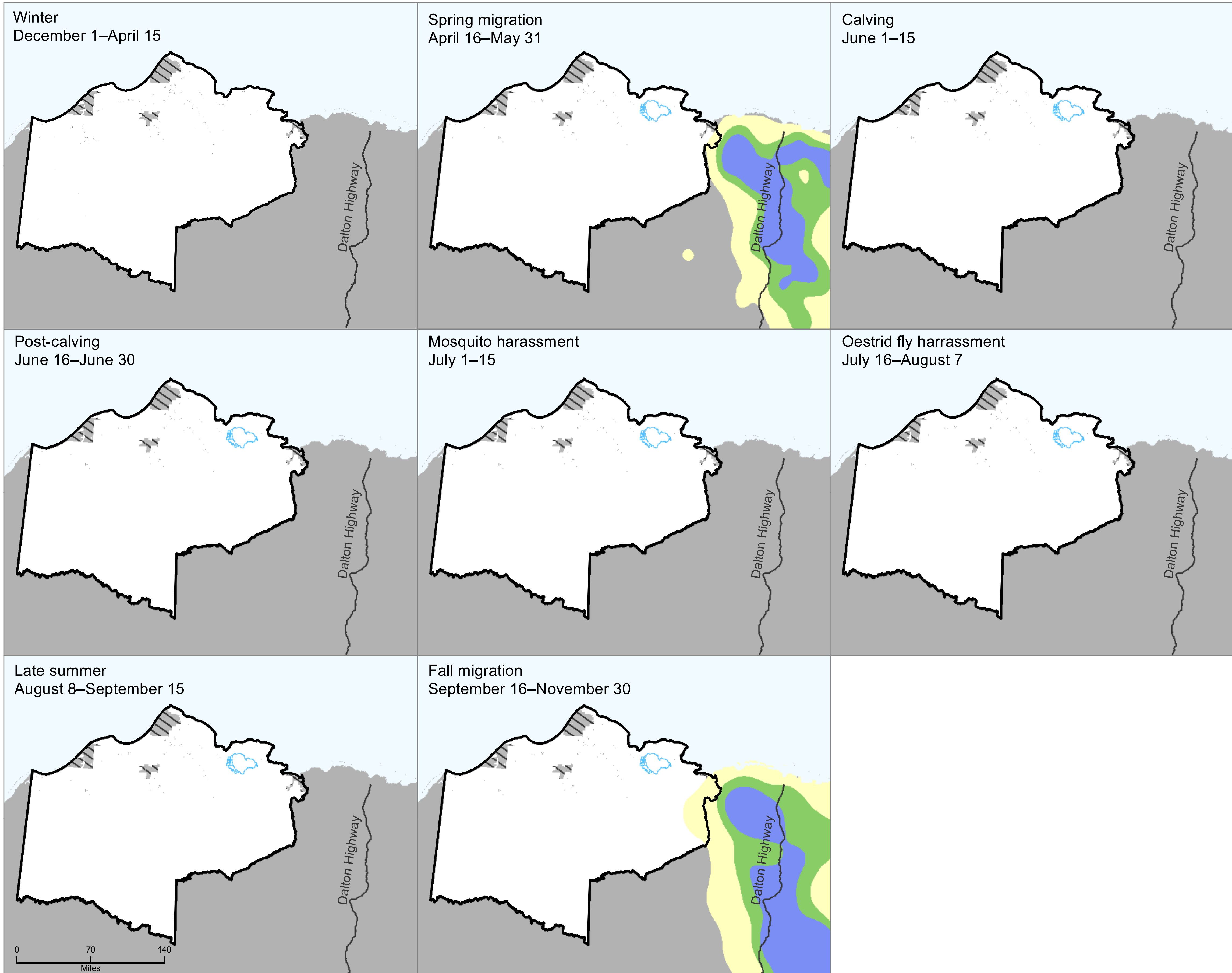
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Utilization distribution contours for the Teshekpuk Lake Caribou Herd were calculated using fixed-kernel density estimation analysis of locations of radio-collared female caribou (telemetry database from Alaska Department of Fish and Game [ADF&G]). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated using the plug-in method. Final seasonal kernels were calculated as the average of kernels calculated for every 2-day period during the season to account for intra-season movements.

The study years are from 1990-2018. Funding for telemetry collars came from ADF&G, BLM, North Slope Borough, and Conoco Phillips Inc.

Data source: BLM GIS 2019,
ADFG GIS 2019

Map 3-22



Kernel density isopleth

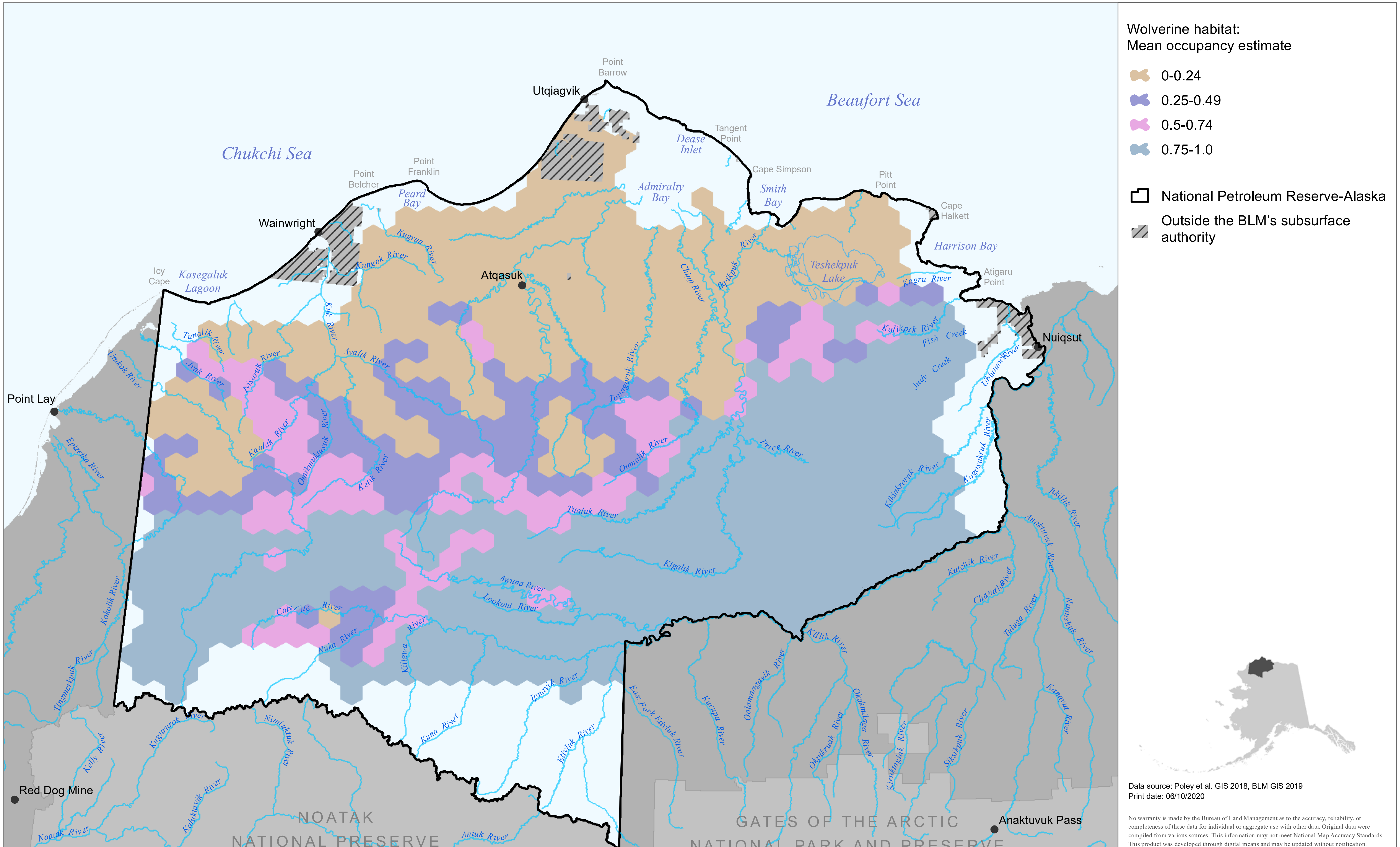
- 50% (high density)
- 75% (medium density)
- 95% (low density)
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Utilization distribution contours for the Central Arctic Herd were calculated using fixed-kernel density estimation analysis of locations of radio-collared female caribou (telemetry database from Alaska Department of Fish and Game [ADF&G]). Contours enclose stated percentages of all collar locations. High-, medium-, and low-density areas are the 50%, 75%, and 95% utilization distribution contours, respectively. Bandwidth calculated using the plug-in method. Final seasonal kernels were calculated as the average of kernels calculated for every 2-day period during the season to account for intra-season movements.

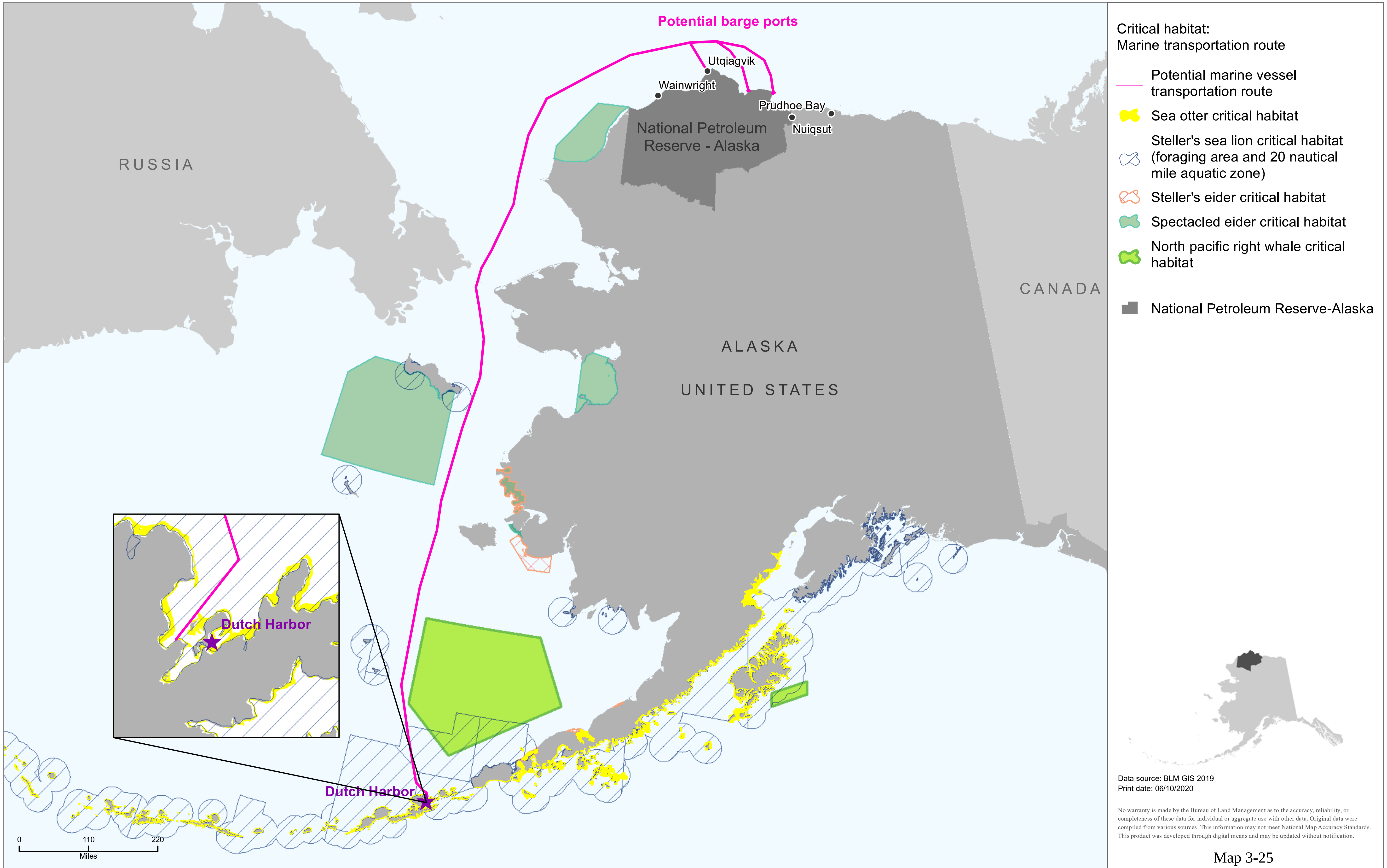
The study years are from 2001-2018. Funding for telemetry collars came from ADF&G and Conoco Phillips Inc.

Data source: BLM GIS 2019, ADFG GIS 2019
Print Date: 06/10/2020

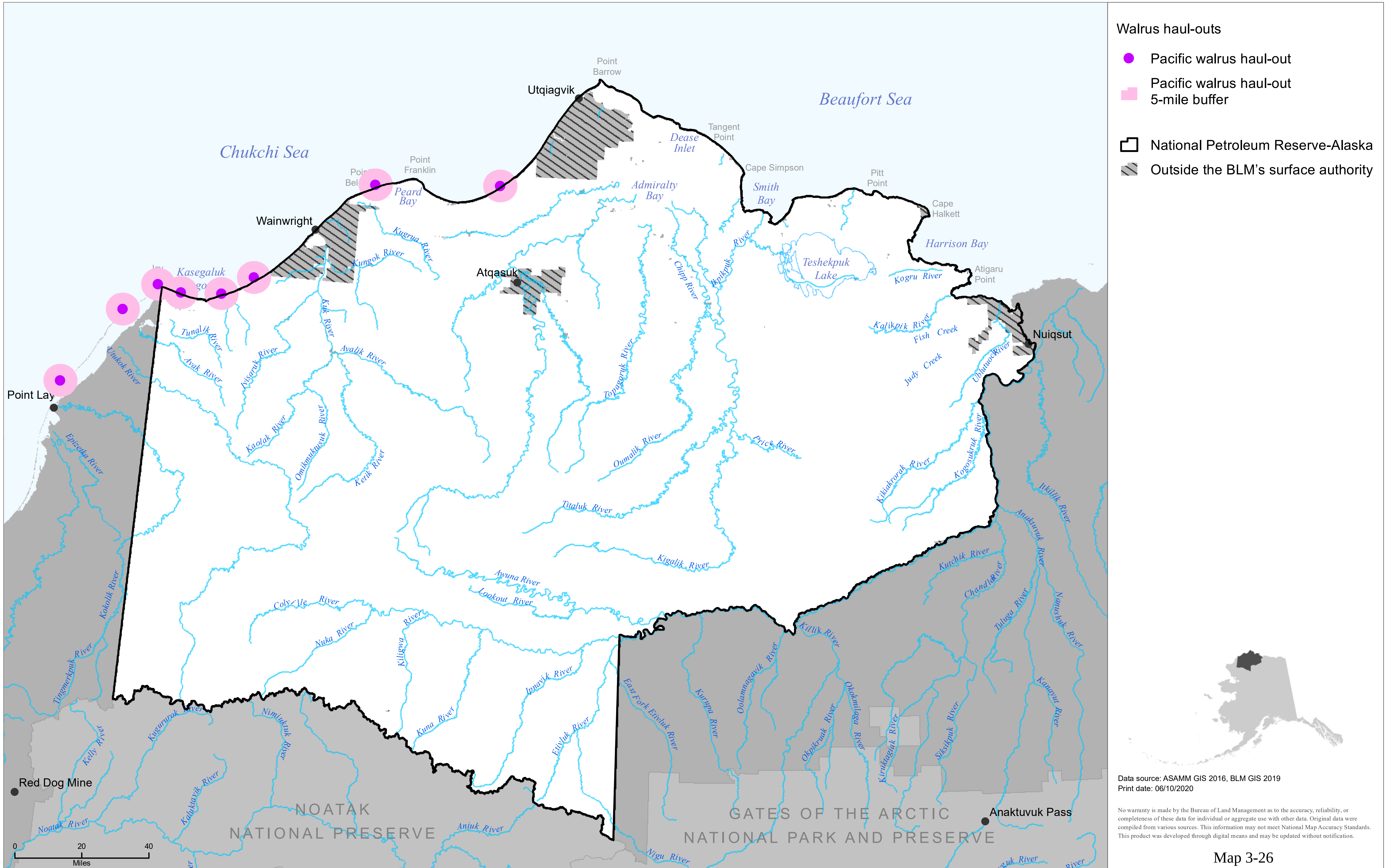
Map 3-23


Wolverine habitat:
Mean occupancy estimate
0-0.24
0.25-0.49
0.5-0.74
0.75-1.0
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Teshekpuk Lake
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kugrua River
Kungok River
Kuk River
Chipp River
Ikpikpuk River
Kogru River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Tunalik River
Avalik River
Nigisaktuvik River
Avak River
Utukok River
Kaolak River
Omalik River
Topagoruk River
Price River
Oumalik River
Titaluk River
Ketik River
Kigalik River
Awuna River
Lookout River
Colville River
Nuka River
Kiligwa River
Ipnavik River
Kuna River
Etivluk River
Kuchik River
Chandler River
Killik River
Kokolik River
Epizetka River
Itkillik River
Anaktuvuk River
Nanushuk River
Tuluga River
Kanayut River
Noatak River
Aniuk River
Nigu River
0 20 40
Miles
Data source: Poley et al. GIS 2018, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

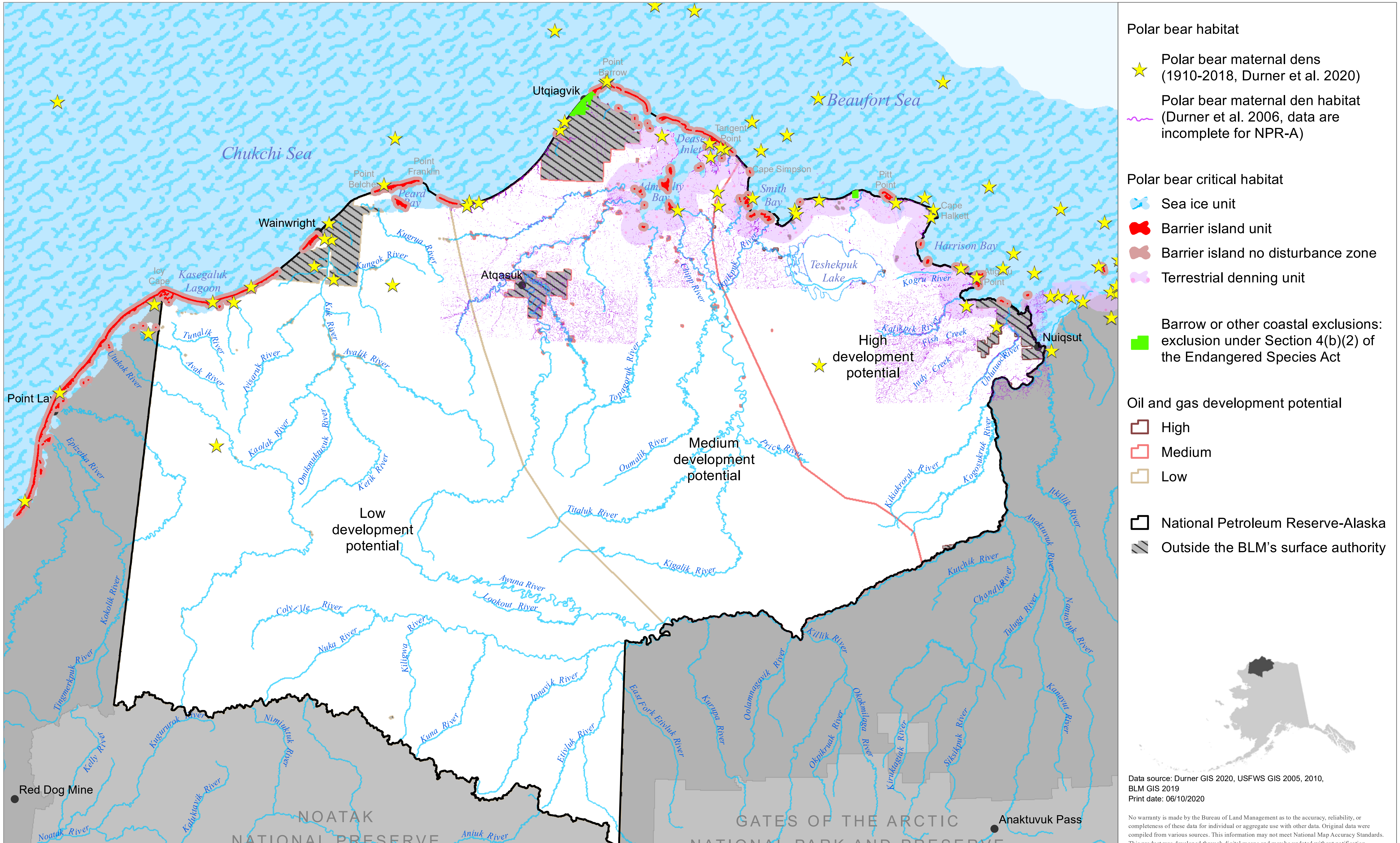
Map 3-24


Potential barge ports
Utqiagvik
Wainwright
Prudhoe Bay
Nuiqsut
National Petroleum Reserve - Alaska
RUSSIA
ALASKA
UNITED STATES
CANADA
Dutch Harbor
Dutch Harbor
0
110
220
Miles
Critical habitat:
Marine transportation route
Potential marine vessel transportation route
Sea otter critical habitat
Steller's sea lion critical habitat (foraging area and 20 nautical mile aquatic zone)
Steller's eider critical habitat
Spectacled eider critical habitat
North pacific right whale critical habitat
National Petroleum Reserve-Alaska
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

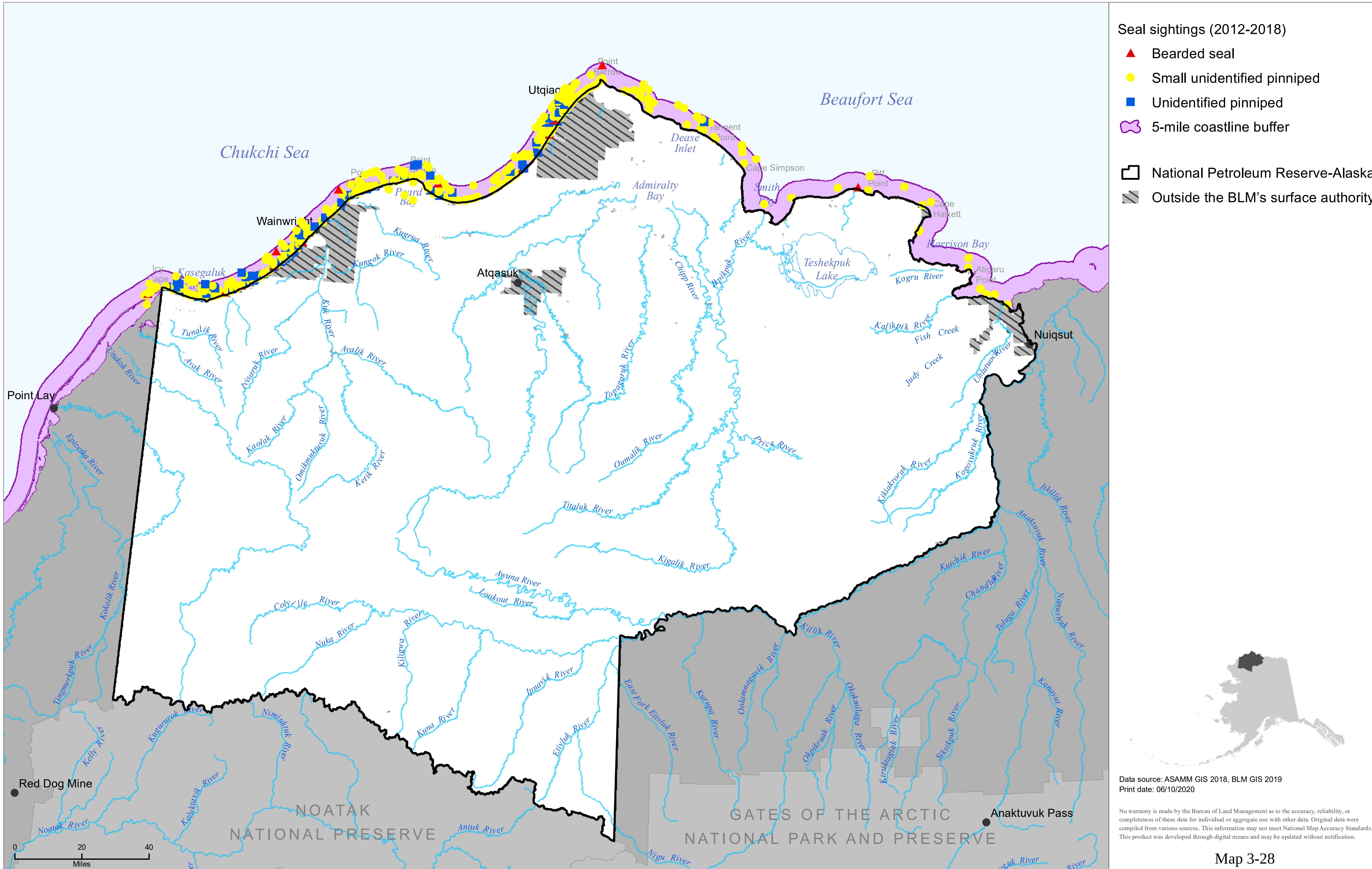
Map 3-25


Walrus haul-outs
Pacific walrus haul-out
Pacific walrus haul-out 5-mile buffer
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Nuiqsut
Point Franklin
Peard Bay
Wainwright
Atqasuk
Kasegaluk
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kugrua River
Kuk River
Avalik River
Topagoruk River
Chipp River
Ikpikpuk River
Meade River
Price River
Titaluk River
Kigalik River
Colville River
Nuka River
Kiligwa River
Kuna River
Etivluk River
Ipnavik River
Awuna River
Lookout River
Kaolak River
Utukok River
Kokolik River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Killik River
Chandler River
Anaktuvuk River
Noatak River
Aniuk River
Nigu River
0 20 40
Miles
Data source: ASAMM GIS 2016, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-26


Polar bear habitat
Polar bear maternal dens (1910-2018, Durner et al. 2020)
Polar bear maternal den habitat (Durner et al. 2006, data are incomplete for NPR-A)
Polar bear critical habitat
Sea ice unit
Barrier island unit
Barrier island no disturbance zone
Terrestrial denning unit
Barrow or other coastal exclusions: exclusion under Section 4(b)(2) of the Endangered Species Act
Oil and gas development potential
High
Medium
Low
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Chukchi Sea
Beaufort Sea
Utqiagvik
Point Barrow
Wainwright
Atqasuk
Nuiqsut
Point Lay
Icy Cape
Kasegaluk Lagoon
Point Belcher
Point Franklin
Peard Bay
Dease Inlet
Admiralty Bay
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
High development potential
Medium development potential
Low development potential
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0 20 40
Miles
Data source: Durner GIS 2020, USFWS GIS 2005, 2010, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

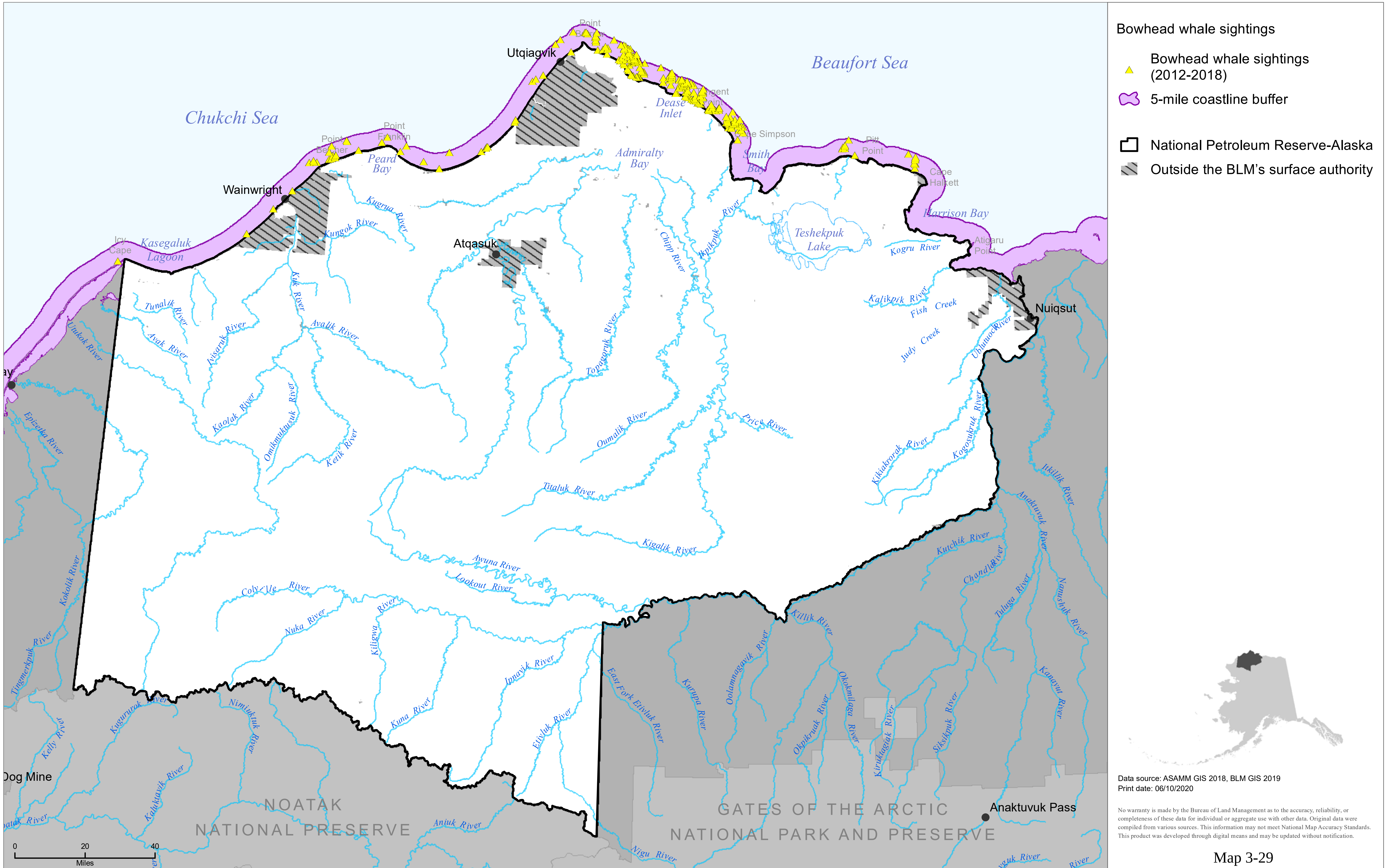
Map 3-27



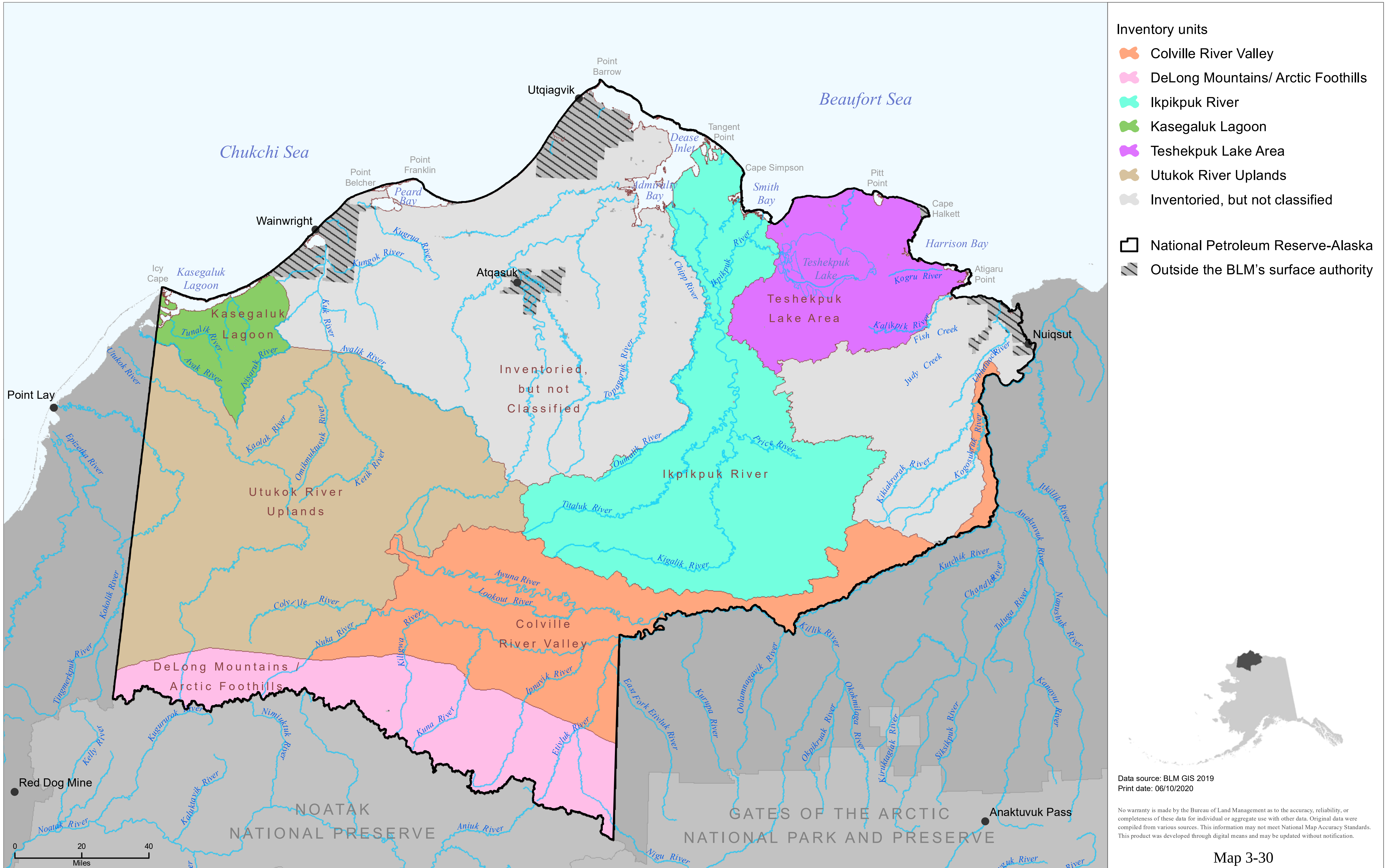
Data source: ASAMM GIS 2018, BLM GIS 2019
Print date: 06/10/2020

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

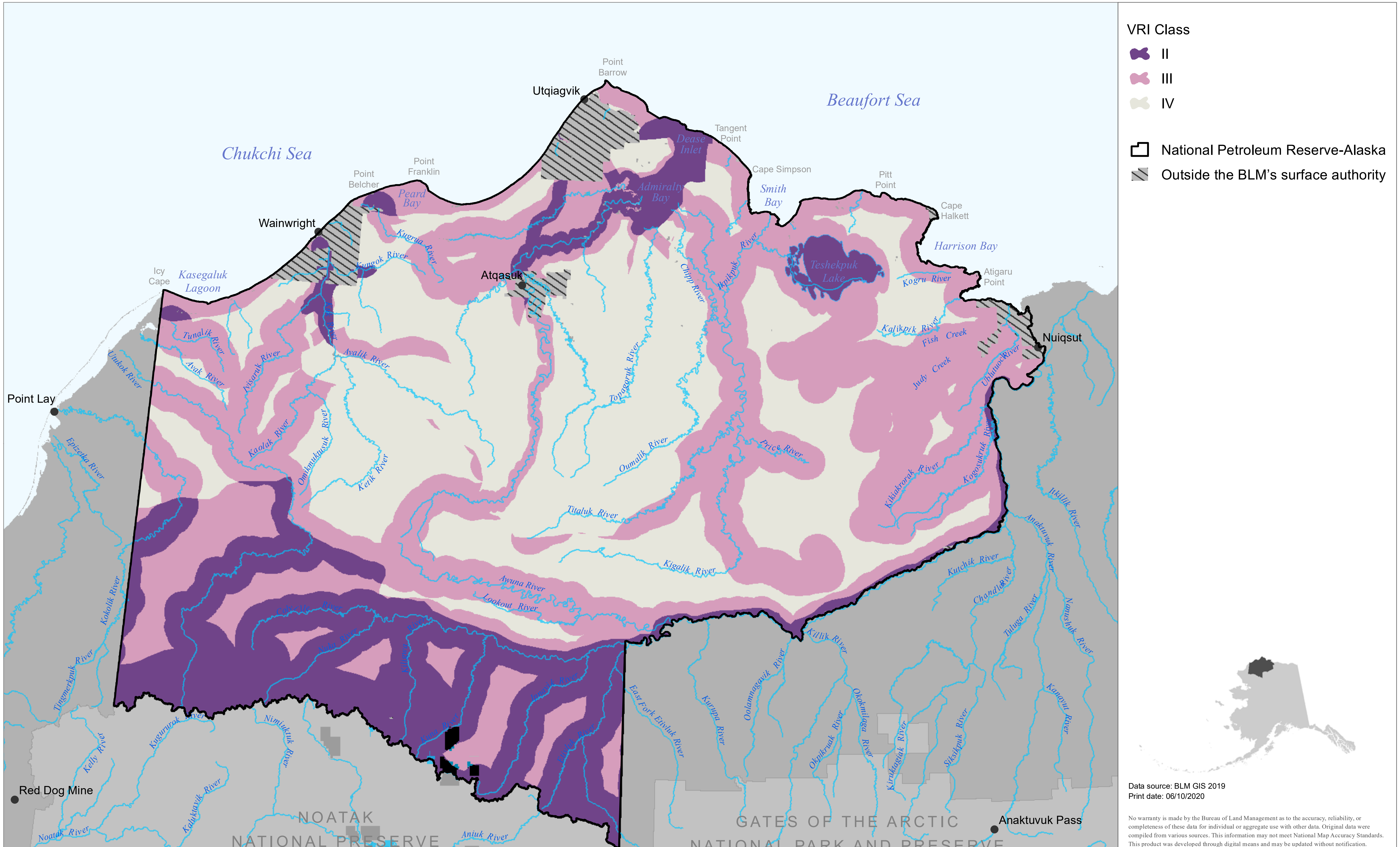
Map 3-28


Bowhead whale sightings
Bowhead whale sightings (2012-2018)
5-mile coastline buffer
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Utqiagvik
Wainwright
Atqasuk
Nuiqsut
Anaktuvuk Pass
Teshekpuk Lake
Dease Inlet
Admiralty Bay
Peard Bay
Kasegaluk Lagoon
Harrison Bay
Smith Bay
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Colville River
Ikpikpuk River
Topagoruk River
Meade River
0 20 40 Miles
Data source: ASAMM GIS 2018, BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-29


Inventory units
Colville River Valley
DeLong Mountains/ Arctic Foothills
Ikpikpuk River
Kasegaluk Lagoon
Teshekpuk Lake Area
Utukok River Uplands
Inventoried, but not classified
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Smith Bay
Admiralty Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Teshekpuk Lake
Teshekpuk Lake Area
Kasegaluk Lagoon
Inventoried, but not Classified
Utukok River Uplands
Ikpikpuk River
Colville River Valley
DeLong Mountains Arctic Foothills
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Red Dog Mine
Anaktuvuk Pass
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-30


VRI Class
II
III
IV
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Teshekpuk Lake
Nuiqsut
Point Belcher
Point Franklin
Peard Bay
Wainwright
Atqasuk
Icy Cape
Kasegaluk Lagoon
Point Lay
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kugrua River
Kuk River
Chipp River
Ikpikpuk River
Kogru River
Kalikpik River
Fish Creek
Judy Creek
Ublutuoch River
Tunalik River
Avak River
Utukok River
Nigisaktuvik River
Avalik River
Topagoruk River
Kaolak River
Omalik River
Ketik River
Meade River
Price River
Oumalik River
Titaluk River
Kigalik River
Awuna River
Lookout River
Ikpikpuk River
Kikiakrorak River
Kogosukruk River
Kuchik River
Chandler River
Killik River
Itkillik River
Anaktuvuk River
Nanushuk River
Tuluga River
Kanayut River
Epizetka River
Kokolik River
Kukpowruk River
Kelly River
Kugururok River
Nimiuktuk River
Noatak River
Kaluktavik River
Aniuk River
Nigu River
East Fork Etivluk River
Karupa River
Oolamnagavik River
Okokmilaga River
Okpikruak River
Kiruktagiak River
Siksikpuk River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 06/10/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map 3-31

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REFERENCES

ACP GIS (Arctic Coastal Plain Geographic Information System). 2019. Steller's Eider Observations in the Barrow Triangle 1999-2017. Data provided by Alaska Fish and Wildlife Service to be used in the NPR-A IAP/EIS alternatives, affected environment, and impact analysis. Anchorage, Alaska.

ADEC GIS (Alaska Department of Environmental Conservation Geographic Information System). 2020. State of Alaska Department of Environmental Concern, Division of Spill Prevention and Contaminated Sites. Internet website: https://dec.alaska.gov/spar/csp.aspx.

ADFG GIS (Alaska Department of Fish and Game Geographic Information System). 2019. Western Arctic caribou herd increases after years of decline. State of Alaska press release, Department of Fish and Game, Division of Wildlife Conservation (Northwest), Fairbanks. January 10, 2018. Internet website: http://www.adfg.alaska.gov/index.cfm?adfg=pressreleases.pr&release=2018_01_10.

_____. 2019. Anadromous Waters Catalog Streams. Alaska Department of Fish and Game. Internet website: https://www.adfg.alaska.gov/sf/SARR/AWC/.

Amundson, C. L., P. L. Flint, R. A. Stehn, R. M. Platte, H. M. Wilson, W. W. Larned. and J. B. Fischer. 2019. "Spatio-temporal population change of Arctic-breeding waterbirds on the Arctic Coastal Plain of Alaska." GIS data supporting this study. *Avian Conservation and Ecology* 14(1): 18.

ASAMM GIS (Aerial Surveys of Arctic Marine Mammals Geographic Information System). 2016. Marine Mammal Aerial Surveys in the Bering, Chukchi and Beaufort Seas, 1979-2016. Available from Alaska Fisheries Science Center. Internet website: https://www.afsc.noaa.gov/nmml/software/bwasp-comida.php.

Beikman, H. M. GIS. 1980. Geologic map of Alaska: U.S. Geological Survey, 1 sheet, scale 1:2,500,000. Anchorage, Alaska.

BLM GIS (U.S. Bureau of Land Management Geographical Information System). 2019. GIS data used in the NPR-A IAP/EIS alternatives, affected environment, and impact analysis. Anchorage, Alaska.

Durner, G. et al. GIS. 2006. USGS Alaska Science Center. Internet website: https://www.usgs.gov/centers/asc/science/polar-bear-maternal-denning?qt-science_center_objects=0#qt-science_center_objects.

Durner, G. et al. GIS. 2020. USGS Alaska Science Center. Internet website: https://www.usgs.gov/centers/asc/science/polar-bear-maternal-denning?qt-science_center_objects=0#qt-science_center_objects.

EPA GIS (U.S. Environmental Protection Agency Geographic Information System). 2018. Available from EnviroMapper for Envirofacts. Internet website: https://geopub.epa.gov/myem/efmap/index.html?ve=15,44.279221,-88.315926&pText=513%20Grand%20Ave,%20Little%20Chute,%20WI%2054140-1707.

Mellor , J. C. GIS. 1985. A Statistical Analysis and Summary of Radar-Interpreted Arctic Lake Depths. U.S. Bureau of Land Management Alaska Technical Report 11. Anchorage, Alaska.

NSSI (North Slope Science Initiative) Landcover GIS (Geographic Information System). 2019. Landcover/Vegetation Mapping for North Slope of Alaska. Available from NSSI Catalog. Internet website: http://catalog.northslopescience.org/catalog/entries/8309-nssi-landcover-gis-data-landcover-vegetation.

Poley, L.G, A.J. Magoun, M. D. Robards, and R. L. Klimstra GIS (Geographic Information System). 2018. GIS data supporting the paper Distribution and Occupancy of Wolverines on Tundra, Northwestern Alaska. Received from Alex Prichard at ABR Inc., Fairbanks, Alaska.

SNAP GIS (Scenarios Network for Alaska and Arctic Planning Geographic Information System). 2019. Depth to Permafrost - Alaska LandCarbon Project. Available from SNAP's GeoNetwork Datasets. Internet website: http://data.snap.uaf.edu/data/Base/Other/LandCarbon/Permafrost/.

USGS GIS (U.S. Geological Survey Geographical Information System). 2015 and 2019. GIS data used in the NPR-A IAP/EIS alternatives, affected environment, and impact analysis. Anchorage, Alaska.

USFWS GIS (U.S. Fish and Wildlife Service Geographical Information System). 2005, 2010. Polar Bear critical habitat. Data provided by Alaska Fish and Wildlife Service to be used in the NPR-A IAP/EIS alternatives, affected environment, and impact analysis. Anchorage, Alaska.

Wahrhaftig, C. GIS. 1965. Physiographic divisions of Alaska. 482, Professional Paper. Washington, DC: U.S. Geological Survey. Anchorage, Alaska.

Appendix B

Reasonably Foreseeable Development Scenario for the National Petroleum Reserve in Alaska Integrated Activity Plan Environmental Impact Statement

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MAPS

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
BBO	billion barrels of oil
BLM	Bureau of Land Management
BOPD	barrels of oil per day
CPF	central processing facility
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska
TCF	trillion cubic feet
U.S.	United States
VSM	vertical support member

Appendix B. Reasonably Foreseeable Development Scenario for the National Petroleum Reserve in Alaska Integrated Activity Plan Environmental Impact Statement

Details of the processes and disturbance of oil development and infrastructure are described in section 4.2.1.2 of the 2012 National Petroleum Reserve in Alaska (NPR-A) Integrated Activity Plan (IAP; BLM 2012). Information from the 2012 IAP generally has remained valid and accurate; this document focuses on new and revised information that has become available since the publication of that document. This document projects reasonably foreseeable development scenarios for the purposes of impact analysis only.

B.1 General Assumptions and Timeline

Following a lease sale, exploration would commence on prospective leases. Assuming a discovery on an exploration well, additional wells would be drilled to delineate the resource. Delineation and development activities could take from 3 to 6 years after discovery. Delineation of the resource would lead to unitization as well as establishment of the initial participating area. A participating area is a specific hydrocarbon reservoir (i.e., field or pool) contained within a geologic formation. Development of surface facilities would lead to new oil production from the participating area. This process could take a minimum of 7 to 8 years following a lease sale. Considering economic viability; logistics of oil and gas permitting, exploration, and development; and distances between existing operations and potential future operations in the NPR-A, it is more likely that 10 years or more would pass between a lease sale and the first oil production from a discovery.

Production activities continue year-round for 10 to 70 years, depending on the field size and number of satellite pads necessary to produce it. Field abandonment, including well plugging and site restoration, can take from 2 to 5 years after production ends. It is also assumed that sufficient gravel would be available for all theoretical development infrastructure in the projections made in this document.

B.2 Formations, Geology, and Petroleum Systems

The Topset Play (inclusive of the uppermost portion of the Torok and overlying Nanushuk formations) is expected to be the primary target for development over the life of this updated IAP. Several discoveries have been identified, and seismic data suggest that unexplored trapping mechanisms are present. Oil was discovered at Pikka in 2015 and confirmed to be connected with Horseshoe to the south. The Pikka-Horseshoe discovery is estimated to hold a technically recoverable volume of 1.2 billion barrels of oil (BBO; Houseknecht et al. 2017). The Willow discovery, also located in the Topset Play, is estimated to contain approximately 300 million barrels of recoverable oil. The Smith Bay discovery is estimated to contain 1.8 to 2.4 BBO technically recoverable, and an estimated 200,000 barrels of oil per day (BOPD) production rate (Decker 2018).

The Beaufortian sequence is the second-most probable target for new oil discoveries and includes the Alpine sands. In 2003, the United States (U.S.) Geological Survey estimated that there were approximately 7.2

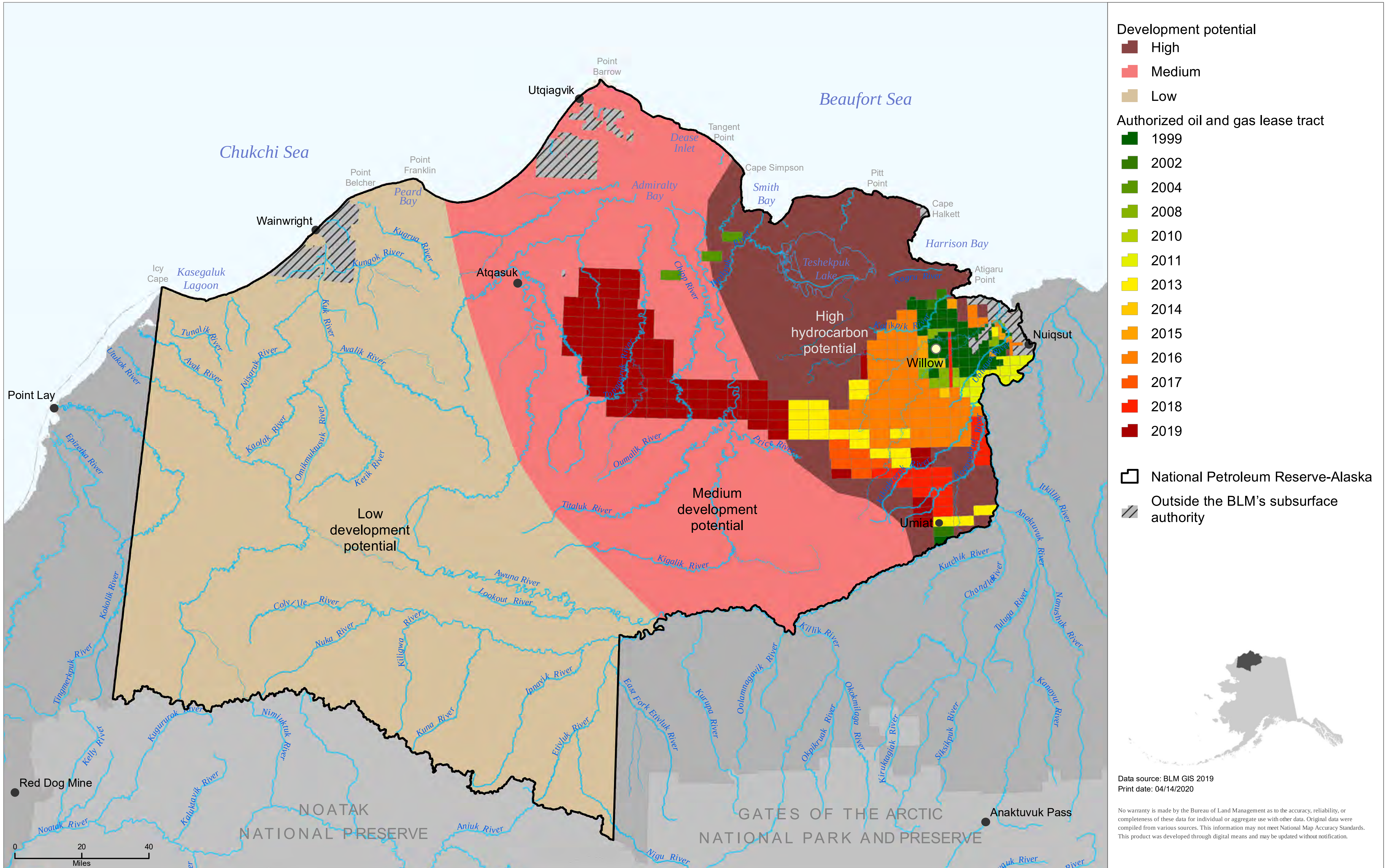
million barrels of undiscovered technically recoverable oil within the sequence in the NPR-A. The report estimated that oil reserves are located predominantly in the northeast and that this area contains numerous oil accumulations large enough for a stand-alone or satellite development (Houseknecht 2003); however, more recent exploration drilling in the sequence found that reservoir quality was generally poor, with high gas-to-oil ratios, and much of the oil trapped in relatively small pools. The sequence is now considered less productive than the U.S. Geological Survey estimated in 2003, with the most recent estimate that the formation contains a mean projected amount of approximately 41 million barrels of recoverable oil (Houseknecht et al. 2017).

The Ellesmerian system extends across much of the North Slope and is estimated to contain up to 77 BBO equivalent (Bird 1994). The system contains predominantly gas, but it is theorized it could contain some oil. Houseknecht et al. (2017) estimate that the mean amount the Ellesmerian system assessment units contain is approximately 32 million barrels of recoverable oil, but it is most likely that no economically viable oil pools exist in this system.

Approximately 4,082,000 acres of the NPR-A planning area have been classified as having high petroleum development potential (**Map B-1**). Only high-potential areas are considered to be reasonable targets for development at this time; however, understanding of the location of oil and gas reserves is incomplete, and development may occur outside these areas. Petroleum development potential was based on a combination of factors, including known and theorized discoveries, seismic study information, production rates of similar developments, the locations and extent of formations of interest, the hypothesized location of the oil-gas line, the distance to infrastructure, and leasing interest from operators. In high-potential areas it is considered likely that additional oil accumulations will be discovered and developed. In medium-potential areas it is considered likely that additional gas accumulations will be discovered and possible that oil accumulations will be discovered; development could occur in these areas. In low-potential areas it is considered less likely that oil or gas accumulations of any significant size will be discovered, and unlikely that any development will occur.

In recognition that the petroleum resources in the NPR-A have not been extensively explored and documented, and that development of petroleum resources is affected by a variety of factors, including oil price, the distance to existing infrastructure, and operator interest, this document is intended to present a variety of possible development levels to allow for a thorough analysis of impacts on other resource values. Production scenarios were developed based on the characteristics and traits of existing and planned developments from across the Alaska North Slope. This document is not intended be a plan or guidebook for future development. Information used and presented is based on best information and operational technology available at the time of publication.

In 2010 the U.S. Geological Survey estimated that the total volume of non-associated gas in the NPR-A planning area was approximately 52.8 trillion cubic feet (TCF). Most gas reserves are expected to be in the southern and central parts of the NPR-A (Houseknecht et al. 2010). In another study of the six assessment units in the Nanushuk and Torok formations, across the northern portion of the NPR-A, the U.S. Geological Survey estimated approximately 6.9 TCF of associated recoverable gas and 17.5 TCF of non-associated recoverable gas in those units (Houseknecht et al. 2017).


Development potential
High
Medium
Low
Authorized oil and gas lease tract
1999
2002
2004
2008
2010
2011
2013
2014
2015
2016
2017
2018
2019
National Petroleum Reserve-Alaska
Outside the BLM's subsurface authority
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Dease Inlet
Tangent Point
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Atigaru Point
Admiralty Bay
Point Belcher
Point Franklin
Peard Bay
Wainwright
Icy Cape
Kasegaluk Lagoon
Atqasuk
Teshekpuk Lake
Nuiqsut
Willow
Umiat
Point Lay
Red Dog Mine
Anaktuvuk Pass
High hydrocarbon potential
Medium development potential
Low development potential
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Kuk River
Avalik River
Kaolak River
Ketik River
Titaluk River
Kigalik River
Awuna River
Lookout River
Colville River
Nuka River
Killik River
Chandler River
Anaktuvuk River
Itkillik River
Price River
Oumalik River
Noatak River
Aniuk River
Nigu River
0 20 40
Miles
Data source: BLM GIS 2019
Print date: 04/14/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

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B.3 EXISTING AND PROBABLE UPCOMING DEVELOPMENTS AND INFRASTRUCTURE

Colville Delta 5 is a satellite field that transfers oil to the Alpine processing unit on state lands. The Colville Delta 5 pad is on Native-owned private lands within the NPR-A boundary. The participating areas produced from the Colville Delta 5 pad are primarily state and Native with some minor federal holdings. Colville Delta 5 began production in 2017 and is producing approximately 37,000 BOPD from the encompassing Colville River Unit (ConocoPhillips 2019a).

Greater Mooses Tooth 1 began production in late October 2018 and was recently producing from federal leases and Alaska Native lands at a rate of 11,500 BOPD (ConocoPhillips 2019b). Peak production for Greater Mooses Tooth 1 could eventually reach 25,000 to 30,000 BOPD (ConocoPhillips 2018). Production from Greater Mooses Tooth 1 is processed through the Alpine central processing facility (CPF). Greater Mooses Tooth 2 is a planned development connected by an 8-mile road to Greater Mooses Tooth 1 within the Greater Mooses Tooth Unit. Construction and drilling are ongoing, with 36 wells permitted in the initial development phase. The pad can accommodate 48 well slots. Production will occur from both federal minerals and Alaska Native minerals. Peak production is projected to be 35,000 to 40,000 BOPD (ConocoPhillips 2019c). ConocoPhillips is expected to conduct additional seismic exploration in support of Greater Mooses Tooth 1 and Greater Mooses Tooth 2 in the near future.

The Willow development is a planned development in the Bear Tooth Unit. The permitting process for the location is ongoing. The project would construct five drill sites, with each designed and sized to accommodate all drilling and operations facilities, wellhead shelters, drill rig movement, and material storage. Each drill site is sized to accommodate 40 to 70 wells, at a typical 20-foot wellhead spacing, and up to 251 total wells across the 5 pads (ConocoPhillips 2019d). First oil production would occur in 2025. When operational, it is estimated that the Willow development production would have a peak production of approximately 160,000 BOPD (BLM 2020).

On December 11, 2019, the Bureau of Land Management (BLM) announced the results of a lease sale in the NPR-A with approximately 1 million acres leased (BLM 2019a). Most of the area leased were in areas ranked as medium potential in this document. Petroleum reservoirs in medium-potential areas are generally expected to contain predominantly gas and little oil. Rather than oil producers, exploration companies purchased the leases in these areas, and the leases are generally regarded as speculative or exploratory leases (Treinen 2019). Should the lessee discover a reservoir with economic potential, that resource could be exploited in a development similar to the ones described in this document.

Umiat is a historic field that was first explored in 1944 by the U.S. Navy. Twelve exploration wells were drilled by the federal government between 1944 and 1979, with industry drilling two additional wells in 2013 and 2014. Shallow oil was discovered in the Grandstand formation. Information from wells suggests that a larger pool exists with an estimated 1 BBO in place (Oil and Gas Journal 2010). The BLM approved an exploratory unit at Umiat in September 2019 that encompasses two federal leases. It is approximately 60 miles from the nearest infrastructure and 92 miles from the Trans-Alaska Pipeline System. Initial development would require a substantial investment for infrastructure connection.

Smith Bay is located on the northeast coastline of the NPR-A. Caelus Energy Alaska LLC announced in 2018 results of a three-dimensional seismic survey and drilled two exploration wells within the waters of Smith Bay on State minerals, estimating 6 to 10 BBO in place (Lidji 2018). The distance to existing infrastructure means that a large investment would be required to develop the location. There is an assumption that the reservoir also extends onshore into the NPR-A, but no development plans have been announced for either onshore or offshore development. Offshore development would be outside the NRP-A planning area; it would require onshore pipelines to transport oil to market and gravel pads for barge landing and equipment staging and storage.

Operators have expressed interest in conducting exploration and potential development in the Teshekpuk Lake area, which is currently closed to development. Exploration is limited to some three-dimensional seismic surveys and several legacy wells prior to 1982. This location around Teshekpuk Lake would be attractive for leasing due the ability to tie into infrastructure at the nearby Alpine or future Willow developments.

The Gubik field is a gas field that likely extends into the NPR-A. No development is expected. If gas infrastructure were extended to the North Slope, this field could become viable for development at some point.

Two gas pipelines to connect the North Slope to southern Alaska or an export terminal are in the planning process. Proponents of the Alaska-LNG project propose to construct an approximately 800-mile pipeline connecting a natural gas liquefaction facility and export terminal in Nikiski, Alaska, to developments in Prudhoe Bay and Point Thompson. It is expected to deliver approximately 3.5 billion cubic feet of gas per day when complete (AGDC 2019). The proponents of the Alaska Stand-Alone Pipeline project propose to connect Prudhoe Bay to an existing ENSTAR gas pipeline system in the Matanuska-Susitna Borough and to a pipeline connecting to Fairbanks. The pipeline is designed to deliver approximately 500 million cubic feet of gas per day when complete (ASAP 2017).

It is expected that lease-level winter exploration would continue to occur outside the existing federal units. The exploration drilling would likely be informed by new or existing seismic survey data. Much of the NPR-A has been explored by two-dimensional seismic surveys, with three-dimensional seismic surveys now covering much of the eastern portion of the NPR-A. It is expected that additional three-dimensional surveys will be conducted in the NPR-A at the lease-block level (as opposed to NPR-A wide) as operators acquire subsurface information.

In contrast to historic practices, modern seismic surveying uses fewer heavy vibroseis vehicles and occurs only on snow roads when the tundra is frozen in order to minimize any impacts on the surface. Only rubber-tracked and ski-mounted vehicles, which exert a lower ground pressure, are used. Modern seismic vehicles have leak detection and containment systems to reduce the risk of spill damage. Additionally, seismic equipment has shrunk in size and weight due to improvements in battery and sensor technology, as well as a desire to reduce impacts. Exploration drilling is expected to occur within the high- and medium-potential zones but is not limited to those locations. Exploration drilling locations will be dictated by geologic and seismic information and as new information is gathered. Any future discoveries may lead to future unitization or unit expansion.

B.4 PROJECTED DEVELOPMENT

Existing and planned developments, including the Willow development, are not included in the production and disturbance calculations presented below for the range of alternatives. The impacts associated with existing and planned developments will not change regardless of which alternative is selected; including them in the reasonably foreseeable development scenario is not useful in allowing readers and the decision-maker to compare impacts across alternatives. Impacts associated with existing and planned developments are therefore considered in the cumulative impacts analysis rather than the reasonably foreseeable development scenario.

Areas where new development is likely to occur are Teshekpuk Lake, Umiat, and Smith Bay, and additional development near the Willow development. Possible new development projects are described below in terms of projected oil production, construction surface disturbance, water use, and gravel use. The projections of development locations and sizes were based on known and theorized discoveries, seismic study information, the production rates of similar developments, operator interest or announcements, and leasing information. Projections are designed to present maximum reasonable development speed scenarios to provide for analysis under the National Environmental Policy Act of 1969.

Proposed natural gas pipelines connecting to the Alaska North Slope are planned to connect first to the existing gas resource at Prudhoe Bay, which contains approximately 25 TCF of gas (ConocoPhillips 2019e). Additional pipeline extensions are expected to go to Point Thompson, Burger Field, and existing oil fields with simultaneous development of gas. Approximately 45 TCF of known gas resources are in the North Slope, and estimates suggests the possibility of an additional 200 TCF of undiscovered gas across the entire North Slope (Mack 2016). The timeline for NPR-A connection to one of the proposed gas pipelines would depend on the size of gas accumulations discovered and the distance from those accumulations to existing infrastructure. Connection to a natural gas pipeline is not expected to occur during the 20-year timeframe analyzed in this reasonably foreseeable development scenario and the NPR-A IAP/ environmental impact statement (EIS).

Some exploration drilling has occurred for oil shale on the North Slope, but development remains highly speculative and has not yet been proven to be commercially or technically viable. No shale oil development is expected during the life of the IAP/EIS.

Coal is present in the planning area, but development of coal resources is prohibited by the statutory mineral withdrawal in the 1976 Naval Petroleum Reserves Production Act. Development of coalbed methane is unlikely due to the challenging operating environment and distance to any potential markets. As part of the Alaska Rural Energy Project, four shallow coalbed methane wells were drilled on federal mineral estate and tested from 2007 through 2009 for potential use by the village of Wainwright for heat and power generation; however, the village has not taken the necessary steps to further develop the wells (Clark et al. 2010).

B.5 INFRASTRUCTURE REQUIREMENTS AND DEVELOPMENT ACTIVITIES

A typical 6-acre ice pad for exploration drilling is 1 foot thick and requires 1.5 million gallons of water (BLM 2018a). Current drilling technology is self-contained; there are no reserve pits. Drilling of a test well can take from 10 days to 4 weeks depending on how well the stratigraphic succession of the area is understood and the total vertical depth or measured depth of the exploration well.

A CPF is the operational center for long-term production. A typical pad for a CPF and associated facilities, which include an airstrip, workers' camp, and production well pad, is approximately 80 acres (BLM 2012). Similar projects estimate gravel needs at 10,000 to 14,000 cubic yards of gravel per acre (BLM 2019b), for a total of 1,500,000 cubic yards per 80-acre CPF and associated facilities.

A typical satellite well pad associated with potential future development in the NPR-A is projected to have approximately 30 to 40 wells and occupy approximately 15 acres. A well pad of this size would require approximately 185,000 cubic yards of gravel. Pads would be constructed to a thickness sufficient to maintain a stable thermal regime. This hypothetical scenario assumes an average 7-foot thickness, based on data from the Willow Master Development Plan (BLM 2019b). Technology has resulted in a reduction in the size of development ground disturbance over time relative to the amount of oil produced. Should that trend continue, impacts and facility sizes could be less than assumed here. Drilling and completing each production well would require anywhere from 420,000 gallons of water for a shallow vertical well to 8 million gallons of water for a deep well with an extended lateral[1].

Well laterals are assumed to extend an average of 4 miles based on current developments and the anticipated subsurface geology across most of the NPR-A. However, current technology allows for up to 7-mile laterals depending on formation depth and continuity. Wells would be hydraulically fractured for initial stimulation; however, hydraulic stimulation will only occur in the initial stage of drilling to stimulate flow at the production wells and is not used for continued production during the life of the well. Water use for hydraulic fracturing in the NPR-A will be less than the multistage hydraulic fracturing used in unconventional reservoirs. Water flooding using parallel injection wells would be used to maintain reservoir pressure and increase production. Water demand for maintaining reservoir pressure is proportional to the oil production from the field; a field with a daily production rate of 50,000 BOPD would require approximately 2 million gallons of water per day. Water resources are generally abundant across the NPR-A. An approved permit is required to withdraw water. Natural gas can also be reinjected to stimulate oil production. North Slope producers will frequently alternate water flooding with gas injection to stimulate oil recovery.

Roads in North Slope oil and gas developments create a ground disturbance of approximately 7.5 acres per mile and require approximately 56,000 cubic yards of gravel per mile (BLM 2019b).

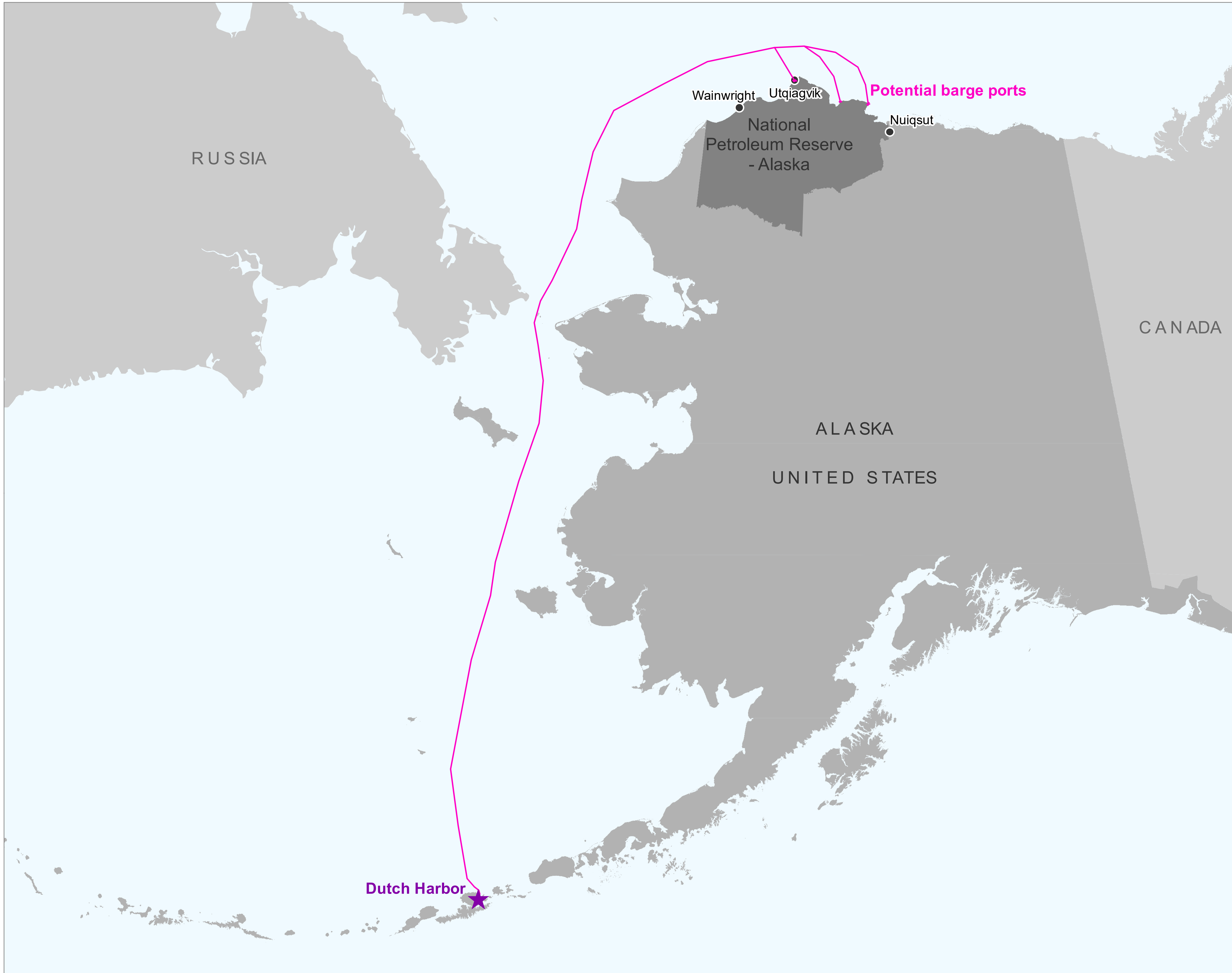
Pipelines would be used to transport oil to CPFs and eventually to the Trans-Alaska Pipeline System. They are also used to transport water, fuel, and electricity to satellite pads. Pipeline vertical support members (VSMs) in the Arctic create approximately 0.04 acres of surface disturbance per pipeline mile (BLM 2012).

In the event that sufficient water resources are not available in the NPR-A, a seawater treatment plant could be constructed to supply the water needed for drilling and water flooding. The total area for comparable Arctic seawater treatment plants and their required support pads is approximately 15 acres. A potential pad of this size would require approximately 150,000 cubic yards of gravel.

A barge landing and storage pad could be required to transport large equipment, such as CPF modules and drill rigs, into the development area. This type of pad would cover approximately 10 acres and require approximately 100,000 cubic yards of gravel. Alternatively, a module transfer island could be constructed; this type of facility covers approximately 12 acres and allows the transfer of larger modules, which would require fewer trips (BLM 2018b). Alternatively, dock infrastructure from the Willow project could be reused. Possible locations for the barge landing include Atigaru Point, Smith Bay, and Utqiagvik; however, additional study would be needed to confirm site suitability. Barges with supplies would be transported from Dutch Harbor in Unalaska (see **Map B-2**). One to two barge landings per year are expected.

In the event that planned North Slope gas pipelines are extended to the NPR-A, the pipeline VSMs would create approximately the same disturbance as VSMs for oil pipelines. Gas wells require approximately the same pad area per well as oil wells; however, the number of wells per pad may be different. In the contiguous U.S., wells per pad can vary from 1 or 2 up to 60 gas wells, depending on the underlying geology of the area and the length of horizontal wells (Litvak 2018). Because well spacing depends on reservoir characteristics, which are unknown at this time, it is impossible to predict the number of gas wells per pad that would be used in any NPR-A operations. Gas separation and processing facilities would also be

[1]Rob Brumbaugh, BLM Alaska Oil and Gas Section Chief, personal communication to Francis Craig, EMPSi Minerals Specialist, on May 29, 2019.



Potential marine vessel transportation route

National Petroleum Reserve-Alaska

Data source: BLM GIS 2019
Print date: 04/14/2020

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required before the gas could be added to the production pipeline; however, NPR-A developments would likely use gas facilities constructed for earlier gas developments outside the project area. If natural gas were being produced from existing oil developments, gas transport pipelines could likely be mounted on the existing VSMs used for oil and water pipelines; otherwise, additional infrastructure would be required.

B.6 GRAVEL NEED AND RESOURCES

Gravel resources in the planning area are generally scarce and may be a major factor in the viability of future developments. Operators on the North Slope have found that roadless developments present operational and logistical difficulties, so future developments are expected to be connected by gravel roads in most cases. Gravel resources are scarce near current infrastructure. Gravel studies are ongoing by both industry and the federal government. The Clover deposit is relatively small with a fairly poor resource. The Tingmiaqiaq location recently discovered by ConocoPhillips for Willow infrastructure needs is located near the confluence of Bills Creek and the Ublutuoch River. Much of the Colville River is currently closed to entry for gravel mining. Operators may need to transport gravel from outside the planning area to facilitate development.

Based on data from Willow development planning and other North Slope developments, average facility acreages and gravel needs were developed. A CPF and associated facilities, such as an airstrip and workers' camp, would encompass 80 acres and require 1.5 million cubic yards of gravel. A satellite pad would cover 15 acres and require 185,000 cubic yards of gravel. Roads would cover 7.5 acres per mile and would require 56,000 cubic yards of gravel per mile. A seawater treatment plant would cover 15 acres and require 150,000 cubic yards of gravel. A barge landing and storage area would require 100,000 cubic yards of gravel. Pipeline supports would disturb 0.04 acres per mile and not require gravel.

B.7 WATER USAGE

Ice road construction uses approximately 1 million gallons of water per mile, although use of ice chips can reduce water use substantially (BLM 2012).

Similar to other North Slope developments, drilling and completing each potential well would require anywhere from 420,000 gallons of water for a shallow vertical well to 8 million gallons of water for a deep well with an extended lateral[2]. Additionally, water is injected into formations to maintain reservoir pressure. Water demand for maintaining reservoir pressure is equal to the oil production from the field; a field with a daily production rate of 50,000 BOPD would require approximately 2 million gallons of water per day (1 barrel is equal to 42 gallons).

B.8 THEORETICAL DEVELOPMENT SCENARIOS

Theoretical development scenarios are presented as entirely hypothetical development cases and are not intended to be used for locations of impacts. Scenarios are unconstrained, meaning they are developed without consideration of existing or potential restrictions on development activities. Existing developments and planned developments that are already in the permitting process, such as the Willow development, are not included in the development or production projections below.

[2]Rob Brumbaugh, BLM Alaska Oil and Gas Section Chief, personal communication to Francis Craig, EMPSi Minerals Specialist, on May 29, 2019.

B.8.1 Low

Under a low development scenario, future development would occur only in the most promising areas and would connect to existing or planned infrastructure in the Willow development. Under this scenario, peak production from NPR-A developments could reach a maximum of 120,000 BOPD sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct 2 satellite pads, 40 miles of roads, 30 miles of elevated pipeline, 1 seawater treatment plant, and 1 barge landing, a total of 356 acres would be disturbed and a total of 2,860,000 cubic yards of gavel would be required. These figures do not include disturbance from ice roads and pads or from gravel supply pits.

Under this scenario, the peak production of 120,000 BOPD would require approximately 5 million gallons of water per day to maintain reservoir pressure. Natural gas may be injected alternatively for a period of time as a substitute to continuous water injection.

B.8.2 Medium

Under a medium development scenario, additional satellite developments would be added in the Bear Tooth Unit and connected to the Willow development CPF. A new CPF and development would likely be constructed in the area south or west of Teshekpuk Lake. Under this scenario, peak production from NPR-A developments could reach a maximum of 210,000 BOPD sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year.

Assuming this development would construct 1 CPF, 10 satellite pads, 160 miles of roads, 150 miles of elevated pipeline, 1 seawater treatment plant, and 1 barge landing, a total of 1,461 acres would be disturbed and a total of 12,560,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel supply pits.

Under this scenario, the peak production of 210,000 BOPD would require approximately 9 million gallons of water per day to maintain reservoir pressure. Natural gas may be injected alternatively for a period of time as a substitute to continuous water injection.

B.8.3 High

Under a high development scenario, three CPFs and associated satellite pads would be constructed in the planning area, most likely at Smith Bay, south of Teshekpuk Lake, and north of Umiat, Alaska. Under this scenario, peak production from NPR-A developments could reach a maximum of 500,000 BOPD sometime in approximately the next 20 years, after which production is expected to decline at a rate of approximately 8 percent per year. Total lifetime production under this scenario is expected to be approximately 2.6 BBO.

Assuming this development would construct 3 CPFs, 20 satellite pads, 250 miles of roads, 240 miles of elevated pipeline, 2 seawater treatment plants, and 2 barge landings, a total of 2,475 acres would be disturbed and a total of 22,700,000 cubic yards of gravel would be required. These figures do not include disturbance from ice roads and pads or from gravel pits.

Under this scenario, the peak production of 500,000 BOPD would require approximately 21 million gallons of water per day to maintain reservoir pressure. Natural gas may be injected alternatively for a period of time as a substitute to continuous water injection.

B.9 Development Projections by Alternative

See Chapter 2 of the Final IAP/EIS for detailed descriptions and maps of areas open to leasing under standard terms and conditions, areas open to leasing with limitations, and areas closed to leasing. **Table B-1**, below, shows management allocations by alternative in areas classified as having high petroleum development potential. Existing leases are not subject to new restrictions, and closed areas that have been leased are included as potentially producing area in the projections.

Table B-1
Acres of Oil and Gas Leasing Allocations in High Petroleum Development Potential Areas, by Alternative

Alternative	A	B	C	D	E
Open with standard terms and conditions	1,436,000	1,199,000	1,546,000	1,567,000	1,487,000
No surface occupancy	638,000	779,000	1,381,000	1,571,000	1,631,000
Timing limitation	0	0	137,000	761,000	777,000
Controlled surface use	0	0	0	183,000	187,000
Closed	2,008,000	2,103,000	1,017,000	0	0
Closed area under preexisting lease	19,000	302,000	0	0	0
No surface occupancy area under preexisting lease	485,000	537,000	585,000	514,000	651,000

BLM GIS 2019

Table B-2, below, shows projected peak oil production, surface disturbance, and gravel volume required by alternative.

Table B-2
Production, Surface Disturbance, Gravel Needs and Water Use, by Alternative

Alternative	Production Case	Low	Medium	High
A	Peak production in BOPD	61,529	107,675	256,369
	Surface disturbance (acres)	183	749	1,269
	Gravel needs (cubic yards)	1,466,433	6,440,000	11,639,172
	Peak water use (gallons per day)	2,584,204	4,522,357	10,767,516
B	Peak production in BOPD	67,026	117,295	279,275
	Surface disturbance (acres)	199	816	1,382
	Gravel needs (cubic yards)	1,597,452	7,015,385	12,679,079
	Peak water use (gallons per day)	2,815,091	4,926,409	11,729,544
C	Peak production in BOPD	90,073	157,629	375,306
	Surface disturbance (acres)	267	1,097	1,858
	Gravel needs (cubic yards)	2,146,752	9,427,692	17,038,902
	Peak water use (gallons per day)	3,783,066	6,620,418	15,762,852
D	Peak production in BOPD	120,000	210,000	500,000
	Surface disturbance (acres)	356	1,461	2,475
	Gravel needs (cubic yards)	2,860,000	12,560,000	22,700,000
	Peak water use (gallons per day)	5,040,000	8,820,000	21,000,000
E	Peak production in BOPD	120,000	210,000	500,000
	Surface disturbance (acres)	356	1,461	2,475
	Gravel needs (cubic yards)	2,860,000	12,560,000	22,700,000
	Peak water use (gallons per day)	5,040,000	8,820,000	21,000,000

B.9.1 Alternative A

The reduction in areas open to leasing and the continued closure of the area around Teshekpuk Lake and Smith Bay would result in an estimated reduction in oil production of approximately 49 percent compared with the unconstrained projection. **Table B-1,** above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative A, a development would be expected around Umiat, as well as additional satellite developments using the Alpine or Willow CPF for processing. The possibility exists that a discovery and development could occur in other areas of the NPR-A. Developments near Smith Bay and near Teshekpuk Lake would not be possible due to closures.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative A. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-3**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 1.35 BBO.

Table B-3
Alternative A—Number of Facilities

Alternative A	High	Med	Low
CPF, airstrip, anchor well pad	2	1	0
Satellite pads	10	5	1
Gravel roads (miles)	128	82	20
VSMs (miles)	122	77	15
Seawater treatment plant	1	1	1
Barge landing and equipment storage	1	1	1

B.9.2 Alternative B

The reduction in area open to leasing and especially the closure of the area around Teshekpuk Lake and Smith Bay would result in an estimated reduction in oil production of approximately 44 percent compared with the unconstrained projection. A lease deferral around Nuiqsut could delay development in this area; however, much of the deferral area is already under lease. The lease deferral around Atqasuk is unlikely to affect development, as no development is expected in that area. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative B, a development would be expected around Umiat, as well as additional satellite developments using the Alpine or Willow CPF for processing. The possibility exists that a discovery and development could occur in other areas of the NPR-A. Developments near Smith Bay and near Teshekpuk Lake would not be possible due to closures.

Table B-2, above, shows the estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative B. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-4**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 1.27 BBO.

Table B-4
Alternative B—Number of Facilities

Alternative B	High	Med	Low
CPF, airstrip, anchor well pad	2	1	0
Satellite pads	11	6	1
Gravel roads (miles)	140	90	22
VSMs (miles)	134	84	17
Seawater treatment plant	1	1	1
Barge landing and equipment storage	1	1	1

B.9.3 Alternative C

The reduction in area open to leasing would result in an estimated reduction in oil production of approximately 25 percent compared with the unconstrained projection. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative C, developments would be expected around Umiat and Smith Bay. Additional satellite pads are possible in the area south or east of Teshekpuk Lake. The possibility exists that a discovery and development could occur in other areas of the NPR-A. Large-scale developments near Teshekpuk Lake would not be possible due to closures.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative C. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-5**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 1.98 BBO.

Table B-5
Alternative C—Number of Facilities

Alternative C	High	Med	Low
CPF, airstrip, anchor well pad	2	1	0
Satellite pads	15	8	2
Gravel roads (miles)	188	120	30
VSMs (miles)	180	113	23
Seawater treatment plant	2	1	1
Barge landing and equipment storage	2	1	1

B.9.4 Alternative D

Leasing management under this alternative would result in the same amount of estimated oil production as the unconstrained scenarios described in **Section B.8**. A small portion of the no surface occupancy area under Teshekpuk Lake would not be accessible using current directional drilling technologies, but it could become accessible in the future with technological advancements. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative D, developments would be expected around Umiat, Smith Bay, and Teshekpuk Lake. The possibility exists that a discovery and development could occur in other areas of the NPR-A.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative D. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-6**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 2.64 BBO.

Table B-6
Alternative D—Number of Facilities

Alternative D	High	Med	Low
CPF, airstrip, anchor well pad	3	1	0
Satellite pads	20	10	2
Gravel roads (miles)	250	160	40
VSMs (miles)	240	150	30
Seawater treatment plant	2	1	1
Barge landing and equipment storage	2	1	1

B.9.5 Alternative E

Leasing management under this alternative would result in the same amount of estimated oil production as the unconstrained scenarios described in **Section B.8**. A small portion of the no surface occupancy area under Teshekpuk Lake would not be accessible using current directional drilling technologies, but it could become accessible in the future with technological advancements. The Teshekpuk Lake 10-year lease deferral could delay the start date of some development that is expected to occur. **Table B-1**, above, shows acres of high petroleum development potential that are open to leasing subject to standard terms and conditions, open with development restrictions, and closed. Under Alternative E, developments would be expected around Umiat, Smith Bay, and Teshekpuk Lake. The possibility exists that a discovery and development could occur in other areas of the NPR-A.

Table B-2, above, shows estimated peak daily production, acres of disturbance, gravel requirements, and water use following the high, medium, and low production levels from the theoretical development projections adjusted for management under Alternative E. Production is expected to peak within 3 years of the completion of drilling and decline at a rate of approximately 8 percent after that. **Table B-7**, below, shows the approximate number of facilities for each case under this alternative.

Total lifetime production from new developments under this alternative could reach 2.64 BBO.

Table B-7
Alternative E—Number of Facilities

Alternative E	High	Med	Low
CPF, airstrip, anchor well pad	3	1	0
Satellite pads	20	10	2
Gravel roads (miles)	250	160	40
VSMs (miles)	240	150	30
Seawater treatment plant	2	1	1
Barge landing and equipment storage	2	1	1

B.10 GRAVEL SUPPLY SURFACE DISTURBANCE

Based on other developments on the North Slope, gravel pits, associated overburden storage, and operational pads require approximately 26.8 acres per 1 million cubic yards of gravel. **Table B-8**, below, shows projected acreage required for gravel supply for each alternative and development case. This figure is broken out from other calculations above due to the fact that some gravel supplies could be transported from outside the planning area.

Table B-8
Acres of Gravel Mine Disturbance, by Alternative

Alternative	High Production Scenario	Medium Production Scenario	Low Production Scenario
A	312	173	39
B	340	188	43
C	457	253	58
D	608	337	77
E	608	337	77

B.11 References

AGDC (Alaska Gasoline Development Corporation). 2019. Project Overview—Alaska LNG. Internet website: https://alaska-lng.com/project-overview/.

ASAP (Alaska Stand Alone Pipeline). 2017. Alaska Stand Alone Pipeline Supplemental Environmental Impact Statement Project Overview. Internet website: http://www.asapeis.com/.

Bird, K. J. 1994. Ellesmerian(!) Petroleum System, North Slope of Alaska, USA: Chapter 21: Part V. Case Studies: Western Hemisphere. M 60: *The Petroleum System--From Source to Trap*. Pp. 339–358.

BLM (Bureau of Land Management). 2012. National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement. Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=67091.

_____. 2018a. ConocoPhillips Alaska, Inc. Exploration 2018-2019 Environmental Assessment. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/116310/163834/199864/Final_Conoco-Exploration_2019EA.pdf.

_____. 2018b. Willow Master Development Plan Environmental Impact Statement, ConocoPhillips Alaska, Inc. Proposed Action Summary. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/154307/188924/Willow_Detials_for_ePlanning.pdf.

_____. 2019a. December 11, 2019, NPR-A Lease Sale Summary. Internet website: https://www.blm.gov/sites/blm.gov/files/uploads/OilandGas_Alaska_2019_NPR-A_Lease-Sale-Bid-Recap.pdf.

_____. 2019b. Willow Master Development Plan Draft Environmental Impact Statement, Volume 3: Appendices B through E.12. August 2019. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/20006563/250007685/Willow_MDP_DEIS_Vol_3_508_2019-10-01.pdf.

_____. 2020. Willow Master Development Plan Environmental Impact Statement, Supplement to the Draft, Volume 1. March 2020. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/20015058/250020199/Willow_MDP_SDEIS_Vol_1_Chapters_1-5.pdf.

BLM GIS (U.S. Department of the Interior, Bureau of Land Management Geographic Information System). 2019. GIS data used in the NPR-A IAP EIS reasonably foreseeable development scenario.

Clark, A. C., S. B. Roberts, and P. D. Warwick. 2010. Geologic Cross Section, Gas Desorption, and Other Data from Four Wells Drilled for Alaska Rural Energy Project, Wainwright, Alaska, Coalbed Methane Project, 2007-2009. United States Geological Survey Open File Report 2010-1210. Internet website: https://pubs.usgs.gov/of/2010/1210/pdf/OF10-1210.pdf.

ConocoPhillips. 2018. Greater Mooses Tooth #1. Internet website: https://static.conocophillips.com/files/resources/fact-sheet-gmt1-2018update-finalpptx.pdf.

____. 2019a. Colville Delta 5. Internet website: http://alaska.conocophillips.com/who-we-are/alaska-operations/alpine/.

_____. 2019b. Greater Mooses Tooth #1. Internet website: https://static.conocophillips.com/files/resources/fact-sheet-gmt1-2019update-2.pdf.

_____. 2019c. Greater Mooses Tooth #2. Internet website: https://static.conocophillips.com/files/resources/fact-sheet-gmt2-2018-final.pdf.

_____. 2019d. Environmental Evaluation Document Chapter 2, Willow Master Development Plan, Revision No. 3. November 8, 2019. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/20011086/250015192/Willow_EED_CH2_Alts_Rev_3_2019-11-08.pdf.

_____. 2019e Greater Prudhoe Bay. Internet website: http://alaska.conocophillips.com/who-we-are/alaska-operations/greater-prudhoe-bay/.

Decker, P. L. 2018. Nanushuk Formation Discoveries: World-class exploration potential in a newly proven stratigraphic play, Alaska North Slope. Alaska Department of Natural Resources. 2018 AAPG ACE Discovery Thinking Forum. May 21, 2018. Internet website: http://dog.dnr.alaska.gov/Documents/ResourceEvaluation/20180521_DiscovThinking_Decker.pdf.

Houseknecht, D. W. 2003. Beaufortian Stratigraphic Plays in the National Petroleum Reserve—Alaska (NPRA). U.S. Geological Survey Open-File Report 03-040. Internet website: https://pubs.usgs.gov/of/2003/of03-040/text.htm.

Houseknecht, D. W., K. J. Bird, J. H. Schuenemeyer, E. D. Attanasi, C. P. Garrity, C. J. Schenk, R. R. Charpentier, et al. 2010 Updated Assessment of Undiscovered Oil and Gas Resources of the National Petroleum Reserve in Alaska (NPRA). U.S. Geological Survey Fact Sheet 2010-3102. Internet website: https://pubs.usgs.gov/fs/2010/3102/pdf/FS10-3102.pdf.

Houseknecht, D. W., R. O. Lease, C. J. Schenk, T. J. Mercier, W. A. Rouse, P. J. Jarboe, K. J. Whidden, et al. 2017. Assessment of undiscovered oil and gas resources in the Cretaceous Nanushuk and Torok Formations, Alaska North Slope, and summary of resource potential of the National Petroleum Reserve in Alaska, 2017: U.S. Geological Survey Fact Sheet 2017–3088. Internet website: https://doi.org/10.3133/fs20173088.

Lidji, E. 2018. "Challenge at Smith Bay." *Petroleum News* 23(13). April 01, 2018. Internet website: http://www.petroleumnews.com/pntruncate/89792655.shtml.

Litvak, A. 2018. "These days, oil and gas companies are super-sizing their well pads." *Pittsburgh Post-Gazette*. January 15, 2018. Internet website: https://www.post-gazette.com/business/powersource/2018/01/15/These-days-oil-and-gas-companies-are-super-sizing-their-well-pads/stories/201801140023.

Mack, Andrew. 2016. Alaska Stand Alone Pipeline Supplemental Environmental Impact Statement Project Overview. Alaska Stand Alone Pipeline. Internet website http://dnr.alaska.gov/commis/Presentations/Alaska_North_Slope_Gas_Potential_Sept_2016.pdf.

Oil and Gas Journal. 2010. Umiat: A North Slope Giant Primed for Oil Development. January 11, 2010. Internet website: https://www.ogj.com/drilling-production/production-operations/article/17209334/umiat-a-north-slope-giant-primed-for-oil-development.

Treinen, L. 2019. North Slope lease sales generate millions for state, but low prices dampen enthusiasm. KTUU-TV Anchorage. December 11, 2019. Internet website: https://www.ktuu.com/content/news/North-Slope-lease-sales-generate-millions-but-low-prices-dampen-enthusiasm-566112761.html.

Appendix C
Collaboration and Coordination

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ACRONYMS AND ABBREVIATIONS

Acronym	Full Phrase
ANCSA	Alaska Native Claims Settlement Act of 1971
BLM	Bureau of Land Management
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska

Appendix C. Collaboration and Coordination

C.1 Overview

C.1.1 Introduction

As the lead agency for the National Petroleum Reserve in Alaska (NPR-A) Integrated Activity Plan/Environmental Impact Statement (IAP/EIS), the Bureau of Land Management (BLM) collaborated and consulted with other federal agencies, state and local government agencies, tribal governments, and Alaska Native Claims Settlement Act of 1971 (ANCSA) corporations during preparation of the IAP/EIS. The extent and purpose of collaboration and consultation with these agencies and organizations varied, based on their expertise and interests, as detailed below. This appendix also includes a list of preparers of the NPR-A IAP/EIS (see **Section C.6**, below).

C.1.2 Cooperating Agencies

The following are participating in the NPR-A IAP/EIS as cooperating agencies: the Bureau of Ocean Energy Management, Iñupiat Community of the Arctic Slope, National Park Service, North Slope Borough, State of Alaska, and U.S. Fish and Wildlife Service. The BLM requested their participation because of their expertise. Their participation does not constitute their approval of the analysis, conclusions, or alternatives presented in the IAP/EIS; the BLM is solely responsible for these.

C.1.3 Tribes, ANCSA Corporations, and North Slope Communities

The BLM, as the lead federal agency, consulted with federally recognized tribal governments during preparation of this IAP/EIS and identified seven tribes that could be substantially affected by it. Consistent with the Department of the Interior policy on government-to-government consultation with tribes, the BLM first sent a letter of notification and inquiry on November 8, 2018, to the federally recognized tribes in the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright and to the Iñupiat Community of the Arctic Slope.

In its letter, the BLM informed these entities of the upcoming IAP/EIS and offered them the opportunity to participate in formal government-to-government consultations, to consult on cultural resources under Section 106 of the National Historic Preservation Act of 1966, or to simply receive information about the project. The dates and locations of government-to-government meetings that have taken place are provided below in **Section C.2**; the dates and locations of public meetings in North Slope communities are provided below in **Section C.3**. Additional information on the initiation and extent of consultation is provided in **Chapter 1, Section 1.7** of the IAP/EIS.

The BLM also sent a letter of notification on November 8, 2018, to the Arctic Slope Regional Corporation and the village corporations for the communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright. In this letter the BLM offered them the opportunity to participate in formal ANCSA corporation consultation on the IAP/EIS. The BLM has held consultations with the Arctic Slope Regional Corporation and the Kuukpik Corporation to discuss the IAP/EIS process (see **Section C.4**, below).

In November 2018, the BLM also sent letters to the North Slope Subsistence Resource Advisory Council and the 32 representatives that make up the Western Arctic Caribou Herd Working Group, inviting them to consult on the new IAP/EIS. Points of contact for all North Slope entities (tribes, corporations, government, and nongovernmental organizations) are included on the BLM's mailing list, and they receive all public email updates.

C.1.4 Local Consultation Under Federal Law

In accordance with Section 106 of the National Historic Preservation Act, the BLM requested to consult with the Alaska State Historic Preservation Office to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places. The State Historic Preservation Office declined to consult with the BLM on the IAP/EIS; acknowledging that the NPR-A IAP/EIS, as a land use plan, is an administrative action without the potential to affect historic properties. Formal consultations with the State Historic Preservation Office may be required when individual projects are implemented in the future.

To comply with Section 7(a)(2) of the Endangered Species Act, the BLM began consulting with the U.S. Fish and Wildlife Service and National Marine Fisheries Service early in the IAP/EIS process. The U.S. Fish and Wildlife Service and National Marine Fisheries Service provided input on issues, data collection and review, and alternatives development. The BLM is consulting with the U.S. Fish and Wildlife Service and National Marine Fisheries Service and developed biological assessments with each agency.

C.1.5 Consultation with Working Groups

NPR-A Working Group—The NPR-A Working Group was established in the 2013 IAP Record of Decision and includes city, tribal, and ANCSA corporation representatives of all North Slope communities. The NPR-A Working Group was established to provide meaningful, regular input by local communities to the management of the NPR-A. The BLM held teleconference meetings to consult with the NPR-A Working Group on the new IAP/EIS on the following dates:

- March 8 and 22, 2019
- April 18, 2019
- June 20, 2019
- August 19, 2019
- March 19, 2020

Western Arctic Caribou Herd Working Group—The Western Arctic Caribou Herd Working Group is a permanent organization of 20 stakeholders established in 1997 to ensure conservation of the Western Arctic caribou herd and the ecosystem on which it depends, and to maintain traditional and other uses for the benefit of all people now and into the future. The working group consists of subsistence users from communities within the range of the herd, other Alaska hunters, guides, transporters, conservationists, and reindeer herders. The BLM made presentations to the working group and answered questions about the project at the Western Arctic Caribou Herd Working Group meetings in Anchorage on December 13, 2018, and December 12, 2019, and spoke on the phone with the Chair of the working group's resource development committee on December 6, 2019, as the committee was developing its comments.

North Slope Subsistence Regional Advisory Council—The North Slope Subsistence Regional Advisory Council was established in 1980 pursuant to the Alaska National Interest Lands Conservation Act; it provides advice and recommendations to the Federal Subsistence Board on subsistence hunting, trapping, and fishing issues on federal public lands and waters on the North Slope. The council has 10 appointed members typically serving 3-year terms and representing eight rural communities. The BLM provided project information and answered questions telephonically with the North Slope Subsistence Regional Advisory Council on April 3, 2019; October 23, 2019; and April 1, 2020.

C.2 Consultation with Federally Recognized Tribes[1]

Location	Date	Tribal Government
Teleconference	February 13, 2019	Native Village of Nuiqsut
Teleconference	March 6, 2019	Native Village of Nuiqsut
Nuiqsut, Alaska	April 30, 2019	Native Village of Nuiqsut
Teleconference	June 18, 2019	Native Village of Nuiqsut
Teleconference	February 26, 2019	Iñupiat Community of the Arctic Slope
Teleconference	May 2, 2019	Iñupiat Community of the Arctic Slope
Utqiagvik, Alaska	December 16, 2019	Iñupiat Community of the Arctic Slope
Wainwright, Alaska	January 14, 2020	Native Village of Wainwright
Anaktuvuk Pass, Alaska	January 16, 2020	Naqsragmiut Tribal Council
Teleconference	January 13, 2020	Native Village of Nuiqsut
Teleconference	March 6, 2020	Native Village of Barrow

C.3 Public Meetings

Location	Date	Venue
Anchorage, Alaska	December 10, 2018	Campbell Creek Science Center
Atqasuk, Alaska	December 11, 2018	Atqasuk Community Center
Anaktuvuk Pass, Alaska	December 12, 2018	Anaktuvuk Pass Community Center
Fairbanks, Alaska	December 13, 2018	Morris Thompson Cultural and Visitor Center
Nuiqsuit, Alaska	January 05, 2019	Nuiqsut Community Center
Utqiagvik, Alaska	January 04, 2019	Iñupiat Heritage Center
Wainwright, Alaska	January 09, 2019	Wainwright Community Center
Point Lay, Alaska	January 10, 2019	Point Lay Community Center
Point Lay, Alaska	December 10, 2019	Point Lay Community Center
Anchorage, Alaska	December 11, 2019	Z.J. Loussac Public Library
Utqiagvik, Alaska	December 16, 2019	Iñupiat Heritage Center
Atqasuk, Alaska	December 17, 2018	Atqasuk Community Center
Fairbanks, Alaska	December 18, 2019	Morris Thompson Cultural and Visitor Center
Nuiqsut, Alaska	January 8, 2020	Nuiqsut Trapper School
Wainwright, Alaska	January 14, 2020	Wainwright Community Center
Anaktuvuk Pass, Alaska	January 15, 2020	Anaktuvuk Pass Community Center

[1]Some of the consultations listed in this table were official government-to-government consultation, and others were informal consultation.

C.4 ANCSA Corporation Consultation

Corporation	Date
Arctic Slope Regional Corporation	Teleconference: April 9, 2019
Kuukpik Corporation	In Person: March 7, April 12, May 1, 2019, and March 13, 2020
Arctic Slope Regional Corporation	In Person: February 20, 2020
Atqasuk Corporation	Teleconference: March 6, 2020
Wainwright Steering Committee	Teleconference: March 10 and April 21, 2020
Olgoonik Corporation	Teleconference: April 3, 2020

C.5 Inclusion of Traditional Knowledge

Traditional knowledge is critical in assessing impacts on rural communities, particularly with regard to their observations and information concerning subsistence practices and cultural concerns. Throughout the National Environmental Policy Act process, testimony was provided and traditional knowledge was shared in a variety of forums, such as public meetings and government-to-government and ANCSA consultations. A report was compiled of available traditional knowledge that had been documented in the six North Slope communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright since 1976 and as relevant to the NPR-A. The BLM took into consideration traditional knowledge when developing the alternatives and incorporated it into the resource sections.

C.6 List of Preparers

Preparer	Name	Role/Responsibility
BLM Interdisciplinary Team	Stephanie Rice	Project Manager, Principal-in-Charge, Facilitator, Public Involvement Lead, Human Environment and Special Designations Lead, Comment Analysis Lead, Decision File/Administrative Record Lead, Special Areas
	Serena Sweet	Assistant Project Manager, Petroleum Lead Resources and Spills Lead
	Cindy Hamfler	GIS
	Sarah Lamar	Renewable Resources Lead
	Stacey Fritz	Socioeconomics Lead, Subsistence Uses and Resources, Sociocultural Systems, Environmental Justice, Economy
	Zach Lyons	Nonrenewable Resources Lead, Physiography, Geology and Minerals, Petroleum Resources, Sand and Gravel Resources
	Vanessa Rathbun	Technical Writer and Editor, Word Processing/508 Compliance
	Craig Nicholls	Climate and Meteorology, Air Quality
	Alan Peck	Climate and Meteorology, Air Quality, Acoustic Environment
	Bob King	Paleontological Resources, Cultural Resources
	Joe Keeney	Paleontological Resources, Cultural Resources
	Eric Geisler	Soil Resources
	Matt Whitman	Water Resources and Fish and Aquatic Species
	Melody Debenham	Solid and Hazardous Waste
	Scott Guyer	Vegetation, Wetlands, and Floodplains
	Thomas St. Clair	Wildland Fire
	Debbie Nigro	Birds
	Tim Vosburgh	Terrestrial Mammals

Preparer	Name	Role/Responsibility
BLM Interdisciplinary Team *(continued)*	Casey Burns	Marine Mammals
	Donna Wixon	Landownership and Uses, Recreation, Wild and Scenic Rivers, Wilderness Characteristics, Visual Resources, Transportation, Renewable Energy
	Lonnie Bryant	Landownership and Uses, Transportation
	Sarah Yoder	Public Health and Safety
	Jeff Bruno	Public Health and Safety
Environmental Management and Planning Solutions, Inc. (EMPSi)	Chad Ricklefs, AICP	Project Manager
	Katie Patterson, JD	Assistant Project Manager, Geology and Minerals
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Appendix D
Laws and Regulations

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
AAC	Alaska Administrative Code
AS	Alaska Statute
BLM	Bureau of Land Management
CAA	Clean Air Act of 1963
CFR	Code of Federal Regulations
CWA	Clean Water Act of 1972
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
IAP	integrated activity plan
MMPA	Marine Mammal Protection Act of 1972
NSB	North Slope Borough
ROW	right-of-way
SHPO	State Historic Preservation Office
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service

Appendix D. Laws and Regulations

Requirements of federal, state, and local laws and regulations, and policies associated with future development in the National Petroleum Reserve in Alaska are provided below.

D.1 International Agreements

D.1.1 Agreement on the Conservation of Polar Bears (Range States Agreement)

This is an agreement between the governments of Canada, Denmark, Norway, the former Union of Soviet Socialist Republics, and the United States (U.S.). It recognizes the responsibilities of circumpolar countries for coordinating actions to protect polar bears. The agreement prohibits hunting, killing, and capturing polar bears except by local people under traditional rights or for bona fide scientific and conservation purposes, preventing serious disturbance to the management of other living resources. This multilateral agreement also commits each associated country to adhere to sound conservation practices by protecting the ecosystem of polar bears. Special attention is given to denning areas, feeding sites, and migration corridors, based on best available science through coordinated research. The agreement was signed by the U.S. on November 15, 1973, in Oslo, Norway; Congress ratified it on September 30, 1976, and it went into force in this country on November 1, 1976.

D.1.2 Inuvialuit-Iñupiat Polar Bear Management Agreement

Signed in 1988 and reaffirmed in 2000 by the Inuvialuit Game Council and the North Slope Borough (NSB) Fish and Game Management Committee, the Inuvialuit-Iñupiat Polar Bear Management Agreement is a voluntary user-to-user agreement between Inuvialuit hunters in Canada and Iñupiaq hunters in Alaska. It provides for annual quotas and hunting seasons, protects bears in dens or during den construction, and protects females accompanied by cubs-of-the-year and yearlings. It allows for the collection of information and specimens to monitor harvest composition and provides for annual meetings to exchange information on the harvest, research, and management. The Inuvialuit-Iñupiat Polar Bear Management Agreement also establishes a joint commission to implement it and a technical advisory committee, consisting of biologists from agencies in the U.S. and Canada involved in research and management. Their function is to collect and evaluate scientific data and make recommendations to the joint commission.

D.2 Federal Laws and Regulations and Policies

The following summarizes federal laws and regulations, and policies relevant to the oil and gas leasing program in the National Petroleum Reserve in Alaska. Some obligations would be the applicant's responsibility, and others would be required of federal agencies before they grant authorizations to oil and gas companies.

The Barrow Gas Field Transfer Act of 1984 (Public Law 98-366) authorized actions under an agreement between the NSB and the U.S. Secretary of the Interior. Part of the act authorizes the secretary to grant rights-of-way (ROWs) to the NSB so it can provide energy supplies to villages on the North Slope.

D.2.1 Bureau of Land Management

- The National Environmental Policy Act of 1969 sets policy and provides the means by which the federal government, including the Bureau of Land Management (BLM) and the federal cooperating agencies, examines major federal actions that may have significant impacts on the environment.

Examples are the oil and gas leasing and development contemplated in this environmental impact statement (42 United States Code [U.S.C.U.S.C.] 4321 et seq.).

- Under the Federal Land Policy and Management Act of 1976 (43 U.S.C.U.S.C. 1701 et seq.), the Secretary of the Interior has broad authority to regulate the use, occupancy, and development of public lands and to take whatever action is required to prevent unnecessary or undue degradation of public lands (43 U.S.C.U.S.C. 1732).
- Section 28 of the Mineral Leasing Act of 1920 (30 U.S.C. 185; 43 Code of Federal Regulations [CFR] 2880) provides the BLM with the authority to issue ROW grants for oil and natural gas pipelines and related facilities not authorized by appropriate leases.
- Under the Naval Petroleum Reserves Production Act of 1976, the BLM issues ROW grants and temporary use permits for constructing, operating, and maintaining pipelines, production facilities, and facilities related to them (42 U.S.C. 6501).
- Section 810 of the Alaska National Interest Lands Conservation Act (16 U.S.C. 3101) establishes procedures for federal land management agencies to evaluate the effect of federal actions on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes (16 U.S.C. 3120).
- The BLM issues geophysical permits to conduct seismic activities, as described in 43 CFR 3152, under authority of the Mineral Leasing Act of 1920, Alaska National Interest Lands Conservation Act of 1980 (16 U.S.C. 3101), Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.), Naval Petroleum Reserves Production Act of 1976, and Department of the Interior Appropriations Act, Fiscal Year 1981.
- Under the authority of the Naval Petroleum Reserves Production Act of 1976 (42 U.S.C. 6501–6508) and other federal laws for development and production of federal leases, the BLM reviews, denies, approves, or approves with appropriate modifications and conditions applications for permits to drill (including drilling plans and surface-use plans of operations) and subsequent well operations (43 CFR 3160) for development and production on federal leases.
- As described in 43 CFR 3130 and 3180, under the Mineral Leasing Act of 1920 (30 U.S.C. 181), Federal Oil and Gas Royalty Management Act of 1982 (43 U.S.C. 1701), Naval Petroleum Reserves Production Act of 1976, Department of the Interior Appropriations Act, Fiscal Year 1981 (Public Law 96-514), the BLM approves lease administration requirements, including unit agreements and plans of development, drilling agreements, and participating area determinations for exploring for and developing oil and gas leases.
- In accordance with Section 106 of the National Historic Preservation Act of 1966, the BLM is consulting with the Alaska State Historic Preservation Office (SHPO) to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places. Formal consultations with the SHPO may be required when individual projects are implemented. The SHPO declined to consult with the BLM on the National Petroleum Reserve in Alaska Integrated Activity Plan (IAP)/Environmental Impact Statement (EIS. The SHPO acknowledged that, as a land use plan, the National Petroleum Reserve in Alaska IAP/EIS is an administrative action without the potential to affect historic properties. Section 106 of the National Historic Preservation Act (54 U.S.C. 300301 et seq.) and its implementing regulations (36 CFR 800) require the BLM to consider the effects of federal undertakings on historic properties. Other relevant federal cultural resource protection laws that the BLM is charged with upholding are the

Antiquities Act of 1906 (54 U.S.C. 320301 et seq.), the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996), Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa et seq.), the Abandoned Shipwreck Act of 1987 (43 U.S.C. 2101 et seq.), and Executive Order 13007 (Indian Sacred Sites). The Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001–3013) requires the BLM to plan for and facilitate the return of human remains, funerary and sacred objects, and objects of cultural patrimony to lineal descendants and culturally affiliated Alaska Native tribes.

- The BLM consults with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service regarding the effects of its actions on threatened and endangered species and designated critical habitat.
- The BLM conducts Executive Order 13175 tribal consultation and consultation under the Alaska Native Claims Settlement Act of 1971.
- Under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, the BLM consults with the National Marine Fisheries Service regarding authorized, funded, or undertaken actions that may adversely affect essential fish habitat.
- The BLM issues material sale permits under the Materials Act of 1947 and the Naval Petroleum Reserves Production Act of 1976.

D.2.2 U.S. Fish and Wildlife Service

- The USFWS Mitigation Policy of January 23, 1981 (reinstated via 2016 policy withdrawal effective July 30, 2018) provides direction on how to develop mitigation recommendations to offset the impacts of development on species or their habitats.
- The Endangered Species Act of 1973 states that all federal agencies, in consultation with and with the assistance of the Secretary of the Interior or Commerce, shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species. Furthermore, an agency's action shall not destroy or adversely modify the habitat of such species that the secretary determines to be critical. Section 9 (16 U.S.C. 1538) of the Endangered Species Act identifies prohibited acts related to endangered species and prohibits all persons, including federal, state, and local government employees, from taking listed species of fish and wildlife, except as specified under provisions for exemption (16 U.S.C. 1535(g)(2) and 1539). Generally, the USFWS manages land and freshwater species, while the National Marine Fisheries Service manages marine species, including anadromous salmon; however, the USFWS is responsible for some marine animals, such as nesting sea turtles, walruses, polar bears, sea otters, and manatees.
- All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA; 16 U.S.C. 1361 et seq.). The National Marine Fisheries Service and the USFWS share jurisdiction for the MMPA, depending on the species being considered. Under the MMPA, taking marine mammals without a permit or exception is prohibited. Under the MMPA, "take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The MMPA defines harassment as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]." Under Section 101(a)(5)(D) of the MMPA, the USFWS may

issue a letter of authorization for incidental take, for up to 1 year, of small numbers of marine mammals, where the take would be limited to harassment (Incidental Harassment Authorization).

- The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter any migratory bird, or the parts, nests, or eggs of such a bird, except under the terms of a valid permit issued under federal regulations. The migratory bird species protected by the act are listed in 50 CFR 10.13.
- The Bald and Golden Eagle Protection Act of 1940 prohibits taking eagles, including their parts, nests, or eggs. If a project may result in take, and after avoidance and minimization measures are established, the USFWS may issue an eagle take permit.
- Under the Fish and Wildlife Coordination Act of 1934, the USFWS provides consultation on impacts on fish and wildlife resources.

D.2.3 Environmental Protection Agency

The U.S. Environmental Protection Agency's (EPA) authority to regulate oil and gas development is contained in the Clean Water Act of 1972 (CWA; 33 U.S.C. 1251 et seq.), the Clean Air Act of 1963 (CAA; 42 U.S.C. 7401 et seq.), and the Safe Drinking Water Act of 1974 (42 U.S.C. 300f et seq.). These authorities are discussed below.

- Under Section 402 of the CWA (33 U.S.C. 1342), the EPA has delegated authority to the State of Alaska to issue permits for discharging pollutants from a point source into Waters of the U.S. for facilities, including those for oil and gas, operating within the State's jurisdiction. Point-source discharges that require an Alaska Pollutant Discharge Elimination System permit include sanitary and domestic wastewater, gravel pit and construction dewatering, hydrostatic test water, and stormwater discharges (40 CFR 122).
- The EPA co-administers the CWA Section 404 program with the U.S. Army Corps of Engineers (USACE). The EPA develops and interprets policy, guidance, and the Section 404(b)(1) guidelines, which are the environmental criteria used in evaluating permit applications. The EPA also determines the scope of geographic jurisdiction and the applicability of statutory exemptions to the permit requirements. It approves and oversees state and tribal assumption of Section 404 permitting authority, reviews permit applications for compliance with the guidelines, and provides comments to the USACE. The EPA can elevate specific permit cases or policy issues pursuant to Section 404(q), under which it has the authority to prohibit, deny, or restrict the use of any defined area as a disposal site. Lastly, the EPA has independent authority to enforce Section 404 provisions.
- Under the Safe Drinking Water Act of 1974 (42 U.S.C. 300f et seq.), the EPA's responsibilities are to manage the underground injection control program and the direct implementation of Class I and Class V injection wells in Alaska. These wells are for injecting nonhazardous and hazardous waste through a permitting process for fluids that are recovered from down hole. The injection wells also are for municipal waste, stormwater, and other fluids that do not come up from down hole (40 CFR 124A, 144, and 146). The EPA oversees the Class II program delegated to the State of Alaska and managed by the Alaska Oil and Gas Conservation Commission; this Class II program includes Class II enhanced oil recovery, storage, and disposal wells that may receive nonhazardous produced fluids originating from down hole, including muds and cuttings (40 CFR 147). The EPA issues an underground injection control Class 1 industrial well permit under the Safe Drinking Water Act of

1974 (42 U.S.C. 300f et seq. and 40 CFR 144 and 146) for underground injection of Class I (industrial) waste materials.

- Under Section 311 of the CWA, as amended (33 U.S.C. 1321; 40 CFR 112), the EPA requires a "spill prevention containment and countermeasure plan" for storing over 660 gallons of fuel in a single container or over 1,320 gallons in aggregate aboveground tanks.
- Under the CWA, as amended (Oil Pollution Act [33 U.S.C. 40] and Facility Response Plan Rule [40 CFR 112.20–112.21], the EPA requires a facility response plan to identify and ensure the availability of sufficient response resources for the worst case discharge of oil to the maximum extent practicable, ". . . generally for facilities that transfer over water to or from vessels, and maintaining a capacity greater than 42,000 gallons, or any facility with a capacity of over one million gallons."
- Under Sections 165 (42 U.S.C. 7475) and 502 of the CAA (42 U.S.C. 7661a), the State of Alaska is authorized to issue air quality permits for facilities operating within State jurisdiction for the Title V operating permit (40 CFR 70) and the "prevention of significant deterioration" permit (40 CFR 52.21) to address air pollution emissions. The EPA oversees the State's program.
- Under Section 309 of the CAA (42 U.S.C. 7609), the EPA requires a review and evaluation of the draft and final environmental impact statements for compliance with the Council on Environmental Quality guidelines.
- Under Sections 301–304, 311, and 312 (42 U.S.C. 11001), the EPA requires that states establish emergency planning, emergency release notification, community right-to-know reporting, and toxic chemical release inventory.
- The EPA retains oversight authority over the Alaska Pollutant Discharge Elimination System program; however, to address air pollutant emissions, it delegates authority to the Alaska Department of Environmental Conservation to issue air quality permits for facilities operating within State jurisdiction. This includes a Title V operating permit and a prevention of significant deterioration permit under the CAA, as amended (42 U.S.C. 7401 et seq.).

D.2.4 National Oceanic and Atmospheric Administration Fisheries

The National Oceanic and Atmospheric Administration is responsible for the stewardship of national marine resources. The agency conserves and manages fisheries to promote sustainability and to prevent the lost economic potential associated with overfishing, declining species, and degraded habitats. It provides consultation under the following:

- Endangered Species Act of 1973, Section 7(a)(2), on the effects on threatened or endangered species
- Fish and Wildlife Coordination Act on the effects on fish and wildlife resources
- MMPA on the effects on marine mammals; it issues incidental harassment authorization under the MMPA for incidental takes of protected bowhead whales and ringed seals.
- Magnuson-Stevens Fishery Conservation and Management Act of 1976 for effects on essential fish habitat; the act requires federal agencies to consult with the Secretary of Commerce on any action authorized, funded, or undertaken or proposed to be authorized, funded, or undertaken by such agency that may adversely affect essential fish habitat identified under the act.

D.2.5 U.S. Army Corps of Engineers

The USACE has the authority to issue or deny permits for placing dredge or fill material in the Waters of the U.S., including wetlands, and for work or structures in, on, over, or under navigable Waters of the United States. These USACE authorities are set forth as follows:

- Under Section 404 of the CWA (33 U.S.C. 1251 et seq.), the USACE regulates discharges of dredge and fill material in Waters of the U.S., including wetlands.
- Under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), the USACE has regulatory authority for work and structures performed in, on, over, or under navigable Waters of the United States.
- Under Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (33 U.S.C. 1413), the USACE issues Section 103 ocean dumping permits for transporting dredged material for ocean disposal.

D.2.6 Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management provided subject matter expertise in drafting and reviewing this IAP/EIS as part of the BLM interdisciplinary team. The Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska, established under Executive Order 13580, adopted the concept of integrated Arctic management to ensure that decisions on development and conservation made in the Arctic are driven by science, stakeholder engagement, and government coordination.

D.3 Executive Orders

In addition to the statutory authorities described above, a number of executive orders may apply, as follows: Executive Orders 13783 (promoting energy independence and economic growth), 11988 (floodplain management), 11990 (protection of wetlands), 13158 (marine protected areas), 12898 (environmental justice), 13007 (Indian sacred sites), 13175 (tribal consultation), and 13112 (invasive species control).

D.4 State of Alaska

The State issues several permits. The Alaska Department of Natural Resources issues permits for temporary water use and water rights, permits for cultural resource surveys, concurrence on the effects on cultural resources evaluated under Section 106, and other authorizations for activities associated with oil and gas development. The Alaska Department of Fish and Game issues fish habitat permits. The Alaska Department of Environmental Conservation issues prevention of significant deterioration and other air quality permits as part of the implementation plans. The Alaska Department of Environmental Conservation is responsible for issuing several permits and plan approvals for oil and gas exploration and development, including the storage and transport of oil and cleanup of oil spills. The Alaska Oil and Gas Conservation Commission issues drilling permits and approves production, injection, and disposal plans for exploration and development.

Additional State authorities are presented below.

D.4.1 Alaska Department of Natural Resources

- Issues a material sales contract for mining and purchase of gravel from state lands under Alaska Statute (AS) 38.05.850 and 11 Alaska Administrative Code (AAC) 71.070 and 71.075
- Issues ROW and land use permits for use of State land, ice road construction on State land, and State freshwater bodies under AS 38.05.850

- Issues “temporary water use and water rights” permits under AS 46.15 for water use necessary for construction and operations
- Issues pipeline ROW leases for pipeline construction and operation across State lands under AS 38.35.020
- Issues Alaska cultural resource permits for surveys under the Alaska Historic Preservation Act (AS 41.35.080)
- Adjudicates instream flow reservations and other applications for reserved water rights under AS 46.15.145, Reservation of Water; permissible instream uses are the protection of fish and wildlife habitat, migration, and propagation; recreation and parks; navigation and transportation; and sanitation and water quality.
- The Office of History and Archaeology identifies and protects historic properties in Alaska and is led by the SHPO. Section 106 of the National Historic Preservation Act of 1966 (54 U.S.C. 300301 et seq.) and its implementing regulations (36 CFR 800) require federal agencies to consider the effects of federal undertakings on properties listed on, or eligible for listing on, the National Register of Historic Places. It requires federal agencies to identify cultural sites that may be affected and determines their eligibility to be listed. This consultation is done through the SHPO, who evaluates assessments and issues concurrences with findings on federal lands under Section 106 and on State lands under the Alaska Historic Preservation Act (AS 41.35.010–41.35.240).

D.4.2 Alaska Department of Environmental Conservation

- Issues an Alaska Pollutant Discharge Elimination System wastewater discharge permit for wastewater disposal into all State waters under a transfer of authority from the EPA National Pollutant Discharge Elimination System Program under Section 402 of the CWA, as amended (33 U.S.C. 1342; AS 46.03.020, 46.03.100, 46.03.110, 46.03.120, and 46.03.710; 18 AAC 15, 70, and 72.500). These permits may include a mixing zone approval where appropriate. In addition to developing, issuing, modifying, and renewing permits, the Alaska Pollutant Discharge Elimination System program includes the Storm Water Program, Compliance and Enforcement, Federal Facilities, and the Pretreatment Program.
- Issues a certificate of reasonable assurance/Alaska Pollutant Discharge Elimination System and mixing zone approval for wastewater disposal into all State waters for permits issued by the USACE under Sections 402 and 404 of the CWA; these permits may include discharge of dredge and fill material into Waters of the United States.
- Issues a certificate of reasonable assurance under Section 401 of the CWA (401 Certification), which is required for validity of the USACE Section 404 permit.
- Issues a Class I well wastewater disposal permit for underground injection of non-domestic wastewater under AS 46.03.020, 46.03.050, and 46.03.100.
- Reviews and approves all public water systems, including plans, monitoring programs, and operator certifications, under AS 46.03.020, 46.03.050, 46.03.070, and 46.03.720 (18 AAC 80.005).
- Approves domestic wastewater collection, treatment, and disposal plans for domestic wastewaters (18 AAC 72).
- Approves financial responsibility for cleaning up oil spills (18 AAC 75).
- Reviews and approves the oil discharge prevention and contingency plan under the Oil Pollution Act of 1990 and the certificate of financial responsibility for storage or transport of oil under AS

46.04.030 and 18 AAC 75. The State review applies to oil exploration and production facilities, crude oil pipelines, oil terminals, tank vessels and barges, and certain non-tank vessels.

- Issues Title V operating permits and prevention of significant deterioration permits under CAA Amendments (Title V) for air pollutant emissions from construction and operation (18 AAC 50).
- Issues Alaska Pollutant Discharge Elimination System permits under Section 402, Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. 1342) for discharges into Waters of the United States. The EPA delegated full program authorization in November 2012.
- Issues solid waste disposal permits for State lands under AS 46.03.010, 46.03.020, 46.03.100, and 46.03.110; AS 46.06.080; and 18 AAC 60.005; and 200.
- Reviews and approves solid waste processing and temporary storage facilities plans for handling and temporarily storing solid waste on federal and State lands under AS 46.03.005, 46.03.010, and 46.03.020, and 18 AAC 60.430
- Approves the siting of hazardous waste management facilities

D.4.3 Alaska Department of Fish and Game

- The Fishway Act (AS 16.05.841) deals exclusively with fish passage; it applies to streams with documented resident fish use and without documented use by anadromous fish.
- The Anadromous Fish Act (AS 16.05.871) applies to streams specified in the Anadromous Waters Catalog as important for the spawning, rearing, or migration of anadromous fishes; AS 16.05.871 is a broader authority than AS 16.05.841 and extends to anadromous fish habitat.
- Under AS 16.05.841 and AS 16.05.871, the agency issues fish habitat permits for activities in streams used by fish that the agency determines could represent impediments to fish passage or for traveling in, excavating, or culverting anadromous fish streams.
- Issues public safety permits for nonlethal hazing of wild animals that are creating a nuisance or a threat to public safety.
- Evaluates potential impacts on fish, wildlife, and fish and wildlife users and presents any related recommendations to the Alaska Department of Natural Resources or to federal permitting agencies via the Fish and Wildlife Coordination Act.

D.4.4 Alaska Oil and Gas Conservation Commission

- Issues permits to drill under 20 AAC 25.05
- Issues approval for annular disposal of drilling waste (20 AAC 25.080)
- Authorizes plugging, abandonment, and location clearance (20 AAC 25.105–25.172)
- Authorizes production practices (20 AAC 25.200–25.245)
- Authorizes Class II waste disposal and storage (20 AAC 25.252)
- Approves workover operations (20 AAC 25.280)
- Requires information and documentation as requested by the commissioner (20 AAC 25.300–25.320)
- Authorizes enhanced recovery operations under 20 AAC 25.402–460

D.4.5 Alaska Department of Public Safety

The State Fire Marshall within the Department of Public Safety reviews and approves plans for compliance with the fire and life safety regulations at 13 AAC 50.025..

D.5 NORTH SLOPE BOROUGH

The NSB, as a Home Rule Borough, issues development permits and other authorizations for oil and gas activities under the terms of its ordinances (NSB Municipal Code Title 19). The Iñupiat History, Language, and Culture Division is responsible for traditional land use inventory clearance.

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Appendix E

Final Alaska National Interest Lands Conservation Act Section 810 Evaluation of Subsistence Impacts

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MAPS

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
ANILCA	Alaska National Interest Lands Conservation Act
BLM	Bureau of Land Management
BMP	Best Management Practices
CAH	Central Arctic Caribou Herd
GMT	Greater Mooses Tooth
IAP/EIS	Integrated Activity Plan/Environmental Impact Statement
NPR-A	National Petroleum Reserve in Alaska
NSO	No Surface Occupancy
ROP	Required Operating Procedures
TCH	Teshekpuk Caribou Herd
U.S.C.	United States Code
WAH	Western Arctic Caribou Herd

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Appendix E. Final Alaska National Interest Lands Conservation Act Section 810 Evaluation of Subsistence Impacts

This evaluation of subsistence impacts is for the National Petroleum Reserve-Alaska (NPR-A) Integrated Activity Plan/Environmental Impact Statement (IAP/EIS). The Bureau of Land Management (BLM) has developed the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed development of a revised IAP that "strikes an appropriate balance of promoting development while protecting surface resources." The NPR-A IAP/EIS considers a range of alternatives that makes areas available for leasing, including areas not currently open to leasing, examines current special area boundaries, and considers new or revised lease stipulations and required operating procedures (ROPs; referred to as best management practices [BMPs] in the 2012 IAP/EIS).

In addition to the no action alternative (Alternative A), the NPR-A IAP/EIS considers four action alternatives (Alternatives B, C, D, and E), all of which differ in the areas available for leasing and infrastructure, the lease stipulations and required operating procedures that would apply to on-the-ground activities, and the suitable rivers recommended for Wild and Scenic River designation. All action alternatives would remove the Colville River Special Area from the BLM's management plan for the NPR-A. Only under Alternative B would all 12 eligible rivers in the southwestern portion of the NPR-A be found suitable and recommended for inclusion in the National Wild and Scenic Rivers System to protect their free-flowing condition, water quality, and outstandingly remarkable values. Alternative A represents continued implementation of the current IAP adopted in the February 2013 record of decision. Under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface estate would be available for oil and gas leasing, including some lands closest to existing leases centered on the Greater Mooses Tooth and Bear Tooth units and Umiat. Lands near Teshekpuk Lake would continue to be unavailable for oil and gas leasing. New infrastructure would be prohibited on 8.3 million acres. Of the four action alternatives, Alternative B would make available the fewest acres for oil and gas leasing and infrastructure development. Compared with Alternative A, Alternative B would close areas closer to Utqiagvik, Atqasuk, and Nuiqsut to oil and gas leasing and would defer leasing in the northeastern portion of the NPR-A for 10 years. Alternative C would make more areas available for oil and gas leasing and infrastructure development than Alternatives A and B, opening to leasing additional lands in the Teshekpuk Lake Special Area and in the Utukok River Uplands Special Area. Alternatives D and E would make the greatest number of acres available for oil and gas leasing and infrastructure development, including a larger area surrounding Teshekpuk Lake.

Chapter 3, *Affected Environment and Environmental Consequences*, of the NPR-A IAP/EIS describes the current environmental condition of the planning area and potential effects of the alternative management scenarios on the physical, biological, and socioeconomic environment. In particular, Section 3.4.3, *Subsistence Uses and Resources*, addresses the affected environment and environmental consequences for subsistence. Other relevant sections include Section 3.3.3, *Fish*, Section 3.3.4, *Birds*, Section 3.3.5, *Terrestrial Mammals*, Section 3.4.4, *Sociocultural Systems*, Section 3.4.11, *Economy*, and Section 3.4.12, *Public Health*. This evaluation uses that information to assess potential impacts on subsistence uses and needs pursuant to Section 810(a) of the Alaska National Interest Lands Conservation Act (ANILCA).

E.1 Subsistence Evaluation Factors

Section 810(a) of ANILCA, 16 United States Code (U.S.C) 3120(a), requires that an evaluation of subsistence uses and needs must be completed for any federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy or disposition of public lands." Most of the NPR-A is on BLM-managed public lands except for Alaska Native lands near the four communities within the NPR-A (Wainwright, Atqasuk, Utqiagvik, and Nuiqsut) and Native allotments that are in various locations throughout the NPR-A (particularly along key river drainages). Thus, an evaluation of potential impacts on subsistence uses and needs under ANILCA Section 810(a) must be completed for the NPR-A IAP/EIS. All impacts on subsistence uses and needs are evaluated herein regardless of land status within the planning area.

ANILCA requires that this evaluation include findings on three specific issues:

1. The effect of use, occupancy, or disposition on subsistence uses and needs
2. The availability of other lands for the purposes sought to be achieved
3. Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes (16 U.S.C. Section 3120(a))

Following BLM Alaska guidance (BLM IM No. AK-2011-008), three factors are considered when determining if a significant restriction of subsistence uses and needs may result from the proposed action, alternatives, or cumulatively:

1. A reduction in the abundance of harvestable resources used for subsistence purposes. Forces that might cause a reduction include adverse impacts on habitat, direct impacts on the resource, increased harvest, and increased competition from non-subsistence harvesters.
2. A reduction in the availability of resources used for subsistence purposes caused by an alteration in their distribution, migration, or location.
3. A limitation on the access of subsistence users to harvestable resources. Such an evaluation includes only physical and legal barriers.

NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Affected Environment*, and Appendix T, *Subsistence Use and Resources*, provide information on areas and resources important for subsistence use, and the degree of dependence of the six primary subsistence study communities (Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright) on different subsistence resources. The NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*, provides data on subsistence resource availability and limitations that each alternative would place on access and is used to determine whether the alternatives may cause a significant restriction to subsistence uses.

A finding that the proposed action may significantly restrict subsistence uses imposes requirements to notify the State of Alaska and appropriate regional and local subsistence committees, hold hearings in affected communities, and make the following determinations before BLM can authorize the use of public lands:

- Such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the use of the public lands.
- The proposed activity would involve the minimal amount of public lands necessary to accomplish the purposes of the use, occupancy, or other disposition.
- Reasonable steps would be taken to minimize adverse effects upon subsistence uses and resources resulting from such actions (16 U.S.C. 3120(a)).

A proposed action or alternative would be considered to significantly restrict subsistence uses if, after consideration of stipulations or protection measures (e.g., lease stipulations and BMPs or ROPs) included as a part of each alternative, it can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources. Substantial reductions in the opportunity to continue subsistence uses generally are caused by large reductions in resource abundance, a major redistribution of resources, extensive interference with access, or major increases in the use of those resources by non-subsistence users (BLM IM AK-2011-008).

As noted above, this ANILCA Section 810 evaluation relies primarily on the information contained in the NPR-A IAP/EIS. When analyzing the effects of the alternatives, all of the six primary subsistence study communities are given equal attention, as all of these communities have use areas overlapping the NPR-A and could be affected to varying degrees depending on the alternative. Four communities are within the NPR-A (Atqasuk, Nuiqsut, Utqiagvik, and Wainwright), and these communities would be most likely to experience direct impacts of oil and gas or infrastructure development within the NPR-A (**Map E-1**).

Point Lay has use areas overlapping the western portion of the NPR-A. While Anaktuvuk Pass has peripheral uses of the NPR-A in its southern and southeastern portions, the community of Anaktuvuk Pass has a particularly high reliance on caribou that migrate from areas of high development potential into traditional harvesting areas and are therefore included as a primary study community. In addition to the primary study communities, the NPR-A IAP/EIS addresses potential impacts on seven communities that have peripheral uses of the NPR-A (Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak) and indirect and cumulative impacts on the 42 communities that harvest caribou from the Western Arctic Caribou Herd (WAH) and/or the Teshekpuk Caribou Herd (TCH), the primary caribou herds that use the NPR-A (**Map E-1**).

In addition to ANILCA, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 *Federal Register* 7629; February 16, 1994) calls for an analysis of the effects of federal actions on minority populations and low-income populations with regard to subsistence. Specifically, environmental justice is:

> *The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.*

Regarding the subsistence consumption of fish and wildlife, Section 4-4 of the order requires federal agencies to collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish or wildlife for subsistence, and to communicate to the public any risks associated with those consumption patterns. To this end, the alternatives subsistence analyses, located in Section 3.4.3 of the NPR-A IAP/EIS, have been reviewed and found to comply with Executive Order 12898.

E.2 ANILCA Section 810(a) Evaluations and Findings for All Alternatives and the Cumulative Case

Evaluations and findings for Alternatives A, B, C, D, and E and the cumulative case are presented individually in the following sections. The NPR-A IAP/EIS uses the term ROPs to replace the term BMPs used in the 2012 NPR-A IAP/EIS. Under Alternative A (the no action alternative), the BMPs and lease stipulations from the 2012 NPR-A IAP/EIS would remain in effect, as adopted in the current IAP February 2013 record of decision.

Under Alternatives B through E, new ROPs and lease stipulations would be established. These ROPs and lease stipulations are listed in the NPR-A IAP/EIS, Table 2-1. Additional protections for biologically sensitive areas are listed in Table 2-2 and would apply differently under the four action alternatives. The mitigating effects of these ROPs, lease stipulations, and additional protections are accounted for in the following evaluations and findings.

In the NPR-A IAP/EIS, the BLM analyzed potential direct impacts on subsistence uses and resources based on the percentage of documented subsistence use areas for each community that are open to oil and gas leasing and infrastructure development. In addition, this evaluation considers this information in the context of whether potentially affected subsistence use areas are in areas of low, medium, or high development potential (**Map E-1**) and whether subsistence resources of high material and cultural importance would be affected; this information is provided under the individual alternatives discussions. The NPR-A IAP/EIS analyzes impacts based on the potential for direct and indirect impacts resulting from activities expected to occur under the reasonably foreseeable development scenario (NPR-A IAP/EIS, Appendix B, *Reasonably Foreseeable Development Scenario*). Future analyses for specific on-the-ground activities would occur with site-specific scenarios, and these analyses would determine how and to what level subsistence uses would be affected based on specific infrastructure design, placement, and operational details.

E.2.1 Evaluation and Finding for Alternative A (No Action Alternative)

Alternative A of the NPR-A IAP/EIS is composed of decisions established in the 2013 record of decision for the 2012 NPR-A IAP/EIS. Under Alternative A, the BLM would continue to implement existing management practices in the NPR-A. Under this alternative, the areas open to oil and gas leasing and infrastructure, management of NPR-A lands and rivers, and BMPs and lease stipulations would remain the same. Under Alternative A, 34,000 acres are closed to fluid mineral leasing but have valid existing leases, and 729,000 acres that are subject to no surface occupancy (NSO) also have valid existing leases. Where there are valid existing leases, activities that are currently allowed pursuant to the 2013 record of decision would continue. If the existing leases are developed, the likelihood of potential impacts on the study communities would increase (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

Under Alternative A, management of the NPR-A would continue as previously approved under the February 2013 NPR-A IAP record of decision. Currently proposed projects such as Greater Mooses Tooth Two (GMT2) (under construction) and Willow (undergoing the National Environmental Policy Act process) would proceed, and reasonably foreseeable projects such as development at Umiat and additional satellite developments using the Alpine and Willow central processing facilities are expected to occur (NPRA IAP/EIS, Appendix B**,** *Reasonably Foreseeable Development Scenario*).

In addition to oil and gas leasing, continuation of the existing management plan under Alternative A would permit or restrict other activities such as seismic surveys, gravel mining, and infrastructure development (e.g., roads and pipelines) in certain areas. Thus, the analysis is of potential direct and indirect impacts on subsistence resource abundance, resource availability, and harvester access resulting from on-the-ground post-leasing activities, other oil and gas activities not associated with leasing (e.g., seismic surveys), mining, and infrastructure development within the NPR-A. Actions that may impact subsistence uses include noise, traffic, and human activity, infrastructure, contamination, and legal or regulatory barriers. Other impacts pertaining to changes in income, revenue, employment rates, and general development and culture are addressed in the NPR-A IAP/EIS but do not pertain to changes in resource abundance, resource availability, or harvester access and are not analyzed here in accordance with BLM guidance (BLM IM No. AK-2011-008).

National Petroleum Reserve-Alaska EIS Subsistence Study Communities

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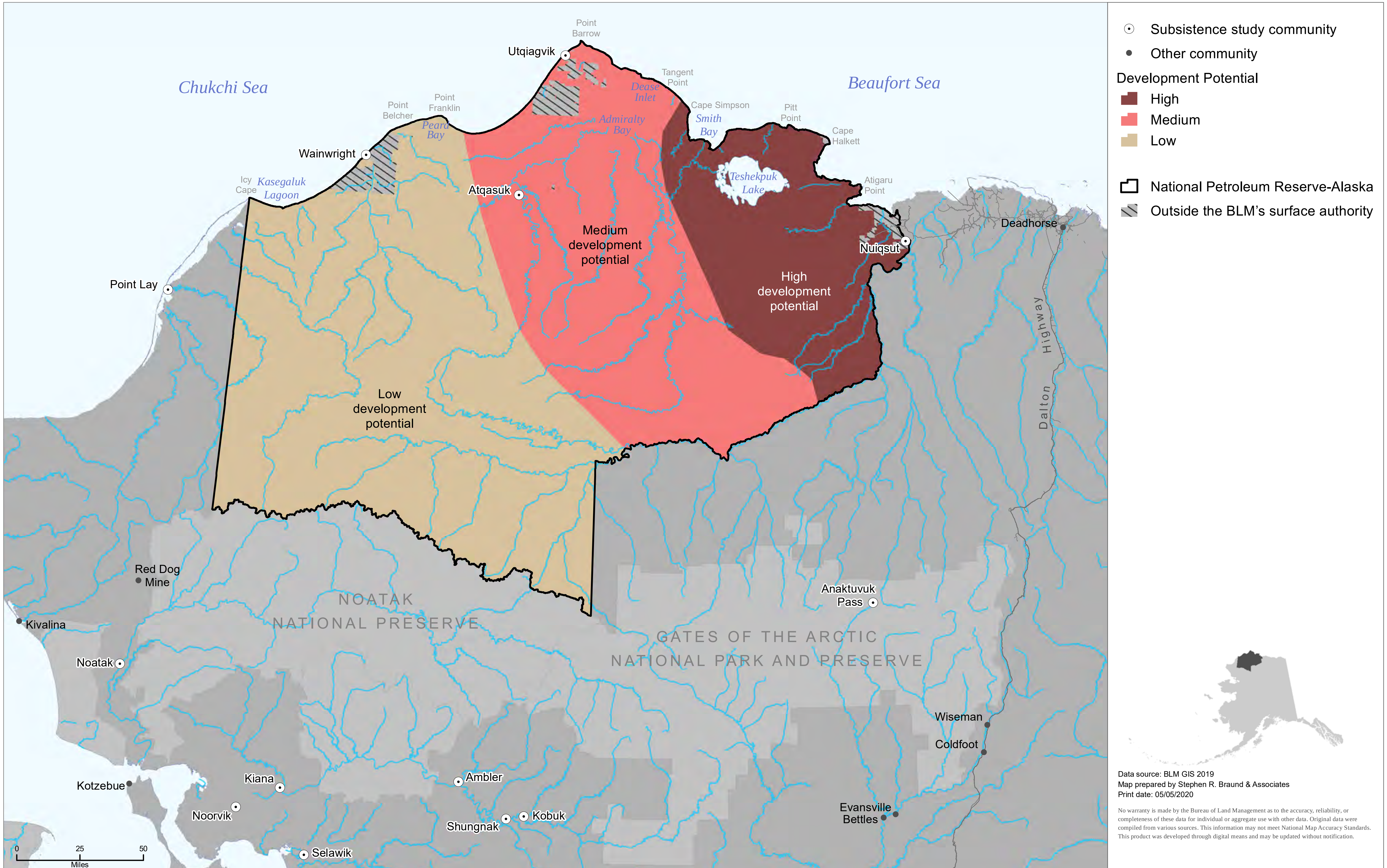

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Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Under Alternative A, approximately 52 percent of NPR-A lands would be available for oil and gas leasing and infrastructure development, with large portions of land protected for surface resources. Lands in the northeast and southwest portions of the NPR-A, including those around Teshekpuk Lake and around the Utukok River Uplands, key habitat areas for the WAH and TCH, would continue to be closed to oil and gas leasing and infrastructure development.

The NPR-A (**Map E-1**) and its drainages are heavily used by the six primary study communities presented in the NPR-A IAP/EIS for hunting and harvesting of large land mammals, small land mammals, salmon and non-salmon fish, migratory and upland game birds, and vegetation (see **Maps E-2** through **E-7**). Marine mammals and fish (including salmon and non-salmon fish) are also harvested offshore from the NPR-A in coastal and nearshore areas. As presented in NPR-A IAP/EIS, Appendix A, large land mammals, salmon and non-salmon fish, vegetation, marine mammals, and migratory birds are all resources of high material and cultural importance to one or more of the six primary study communities. Thus, this evaluation focuses on potential impacts on subsistence uses of all of the above resources for the six primary study communities. In addition, this evaluation addresses impacts on communities who have peripheral uses of the NPR-A and communities who harvest from the TCH and WAH, the two primary herds that use the NPR-A.

Impacts on resource availability and harvester access would be most likely to occur for communities that have regular use of NPR-A lands (e.g., Atqasuk, Point Lay, Nuiqsut, Utqiagvik, and Wainwright), and even more likely for communities who have use areas overlapping areas of high development potential where development is most likely (e.g., Nuiqsut; see **Tables E-1** through **E-4**). Impacts on resource abundance would affect all subsistence users of the TCH and/or WAH either through decreased resource availability or through changes in harvest restrictions in response to reduced herd populations. Thus, impacts on subsistence resource abundance, particularly for the WAH, which has a broader user base than the TCH, would extend well beyond the NPR-A. Under Alternative A, Atqasuk would have the greatest percentage of their use areas open to oil and gas leasing, followed by Utqiagvik, Wainwright, Nuiqsut, Point Lay, and Anaktuvuk Pass (see **Table E-1**). A majority of use areas for Utqiagvik, Wainwright, Atqasuk, and Point Lay are in areas of low to medium development potential (**Maps E-2** through **E-7**) and thus the likelihood of oil and gas development occurring within those communities' subsistence areas is lower than for Nuiqsut. In the case of Atqasuk, use areas for large land mammals and small land mammals overlap with areas of high development potential and so this community could also experience direct impacts on resource availability and access but on the periphery of their hunting area (**Table E-1**; **Map E-3**). Large land mammals are a resource of high importance for the community of Atqasuk (NPR-A IAP/EIS, Appendix T, Table T-4, *Harvest Characteristics of Atqasuk*). Oil and gas exploration would likely continue in areas of medium development potential that are open to oil and gas leasing, including in currently leased areas directly to the east and southeast of Atqasuk, presenting potential temporary conflicts with subsistence users (Appendix B, *Reasonably Foreseeable Development Scenario*). Although exploration is likely and development is possible in areas of medium development potential, only areas of high development potential are considered likely targets for development at this time (Appendix B).

Nuiqsut is currently the community most directly affected by oil and gas development on the North Slope. Lands of high development potential to the west, southwest, and south of Nuiqsut would remain open to oil and gas leasing under Alternative A, and these lands are used for subsistence harvesting of multiple resources, including resources of high material and cultural importance (see **Tables E-1** and **E-2**, **Map E-4**, NPR-A

Table E-1
Percentage of NPR-A Subsistence Use Areas Closed and Open to Fluid Mineral Leasing

Community	Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Percent of Total Use Areas in NPR-A
	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	
Anaktuvuk Pass	3	<1	3	<1	0	4	0	4	0	4	4
Atqasuk	25	71	36	60	4	92	1	94	1	95	100
Utqiagvik	28	33	30	30	15	45	11	49	11	49	62
Nuiqsut	14	26	16	24	5	35	0	40	0	40	41
Point Lay	29	10	32	7	27	12	27	12	27	12	40
Wainwright	36	29	39	26	24	41	24	41	24	41	66

Source: See NPR-A IAP/EIS, Table T-2, Data Sources
"Open" lands include any lands open to leasing, including those subject to no surface occupancy, controlled surface use, timing limitations, best management practices, and standard terms and conditions.

IAP/EIS, Appendix T, Table T-5, *Harvest Characteristics of Nuiqsut*). Therefore, direct impacts on harvester access would continue to grow for the community of Nuiqsut as oil and gas development expands into this area.

Utqiagvik subsistence use areas extend to the southeast of the community into areas of high development potential (**Map E-6**), with the greatest number of overlapping use areas near the mouth of Teshekpuk Lake, which would remain closed to oil and gas development under Alternative A, and south of Teshekpuk Lake surrounding the Price and Ikpikpuk rivers, which would remain open to oil and gas development (NPR-A IAP/EIS, Appendix A). Utqiagvik use areas for land mammals (high resource importance), non-salmon fish (high resource importance), and birds overlap areas of high development potential open to oil and gas leasing under Alternative A.

A large area of land surrounding Atqasuk and representing a substantial portion of their traditional use area would remain open to oil and gas leasing under Alternative A (**Map E-3**). Most of the area overlapping Atqasuk subsistence use areas would be in areas of medium development potential. While the potential for direct impacts would be less than for Nuiqsut, exploration would likely continue to occur in these areas, causing temporary impacts on subsistence users. A small portion of Atqasuk use areas for large and small land mammals would also overlap areas of high development potential (**Table E-2**, **Map E-3**). Oil and gas leasing and development within medium development potential areas could affect harvester access, resource availability, and resource abundance for Atqasuk and could lead to a situation similar to that seen in Nuiqsut where the community is boxed in by development. Although exploration is likely and development is possible in medium development potential areas, only high development potential areas are considered likely targets for development at this time (Appendix B).

Anaktuvuk Pass Subsistence Use Areas, All Studies

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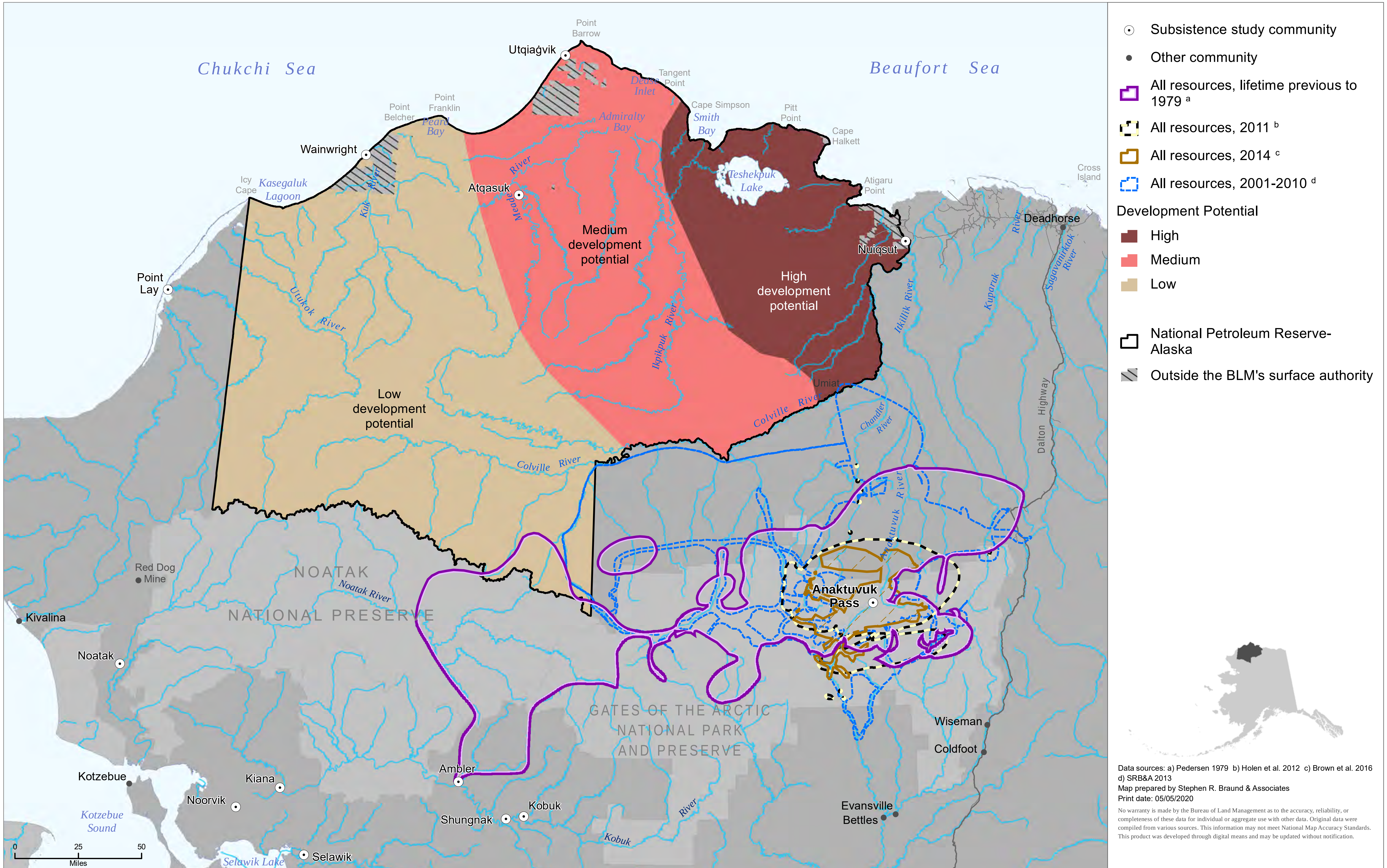

Atqasuk Subsistence Use Areas, All Studies

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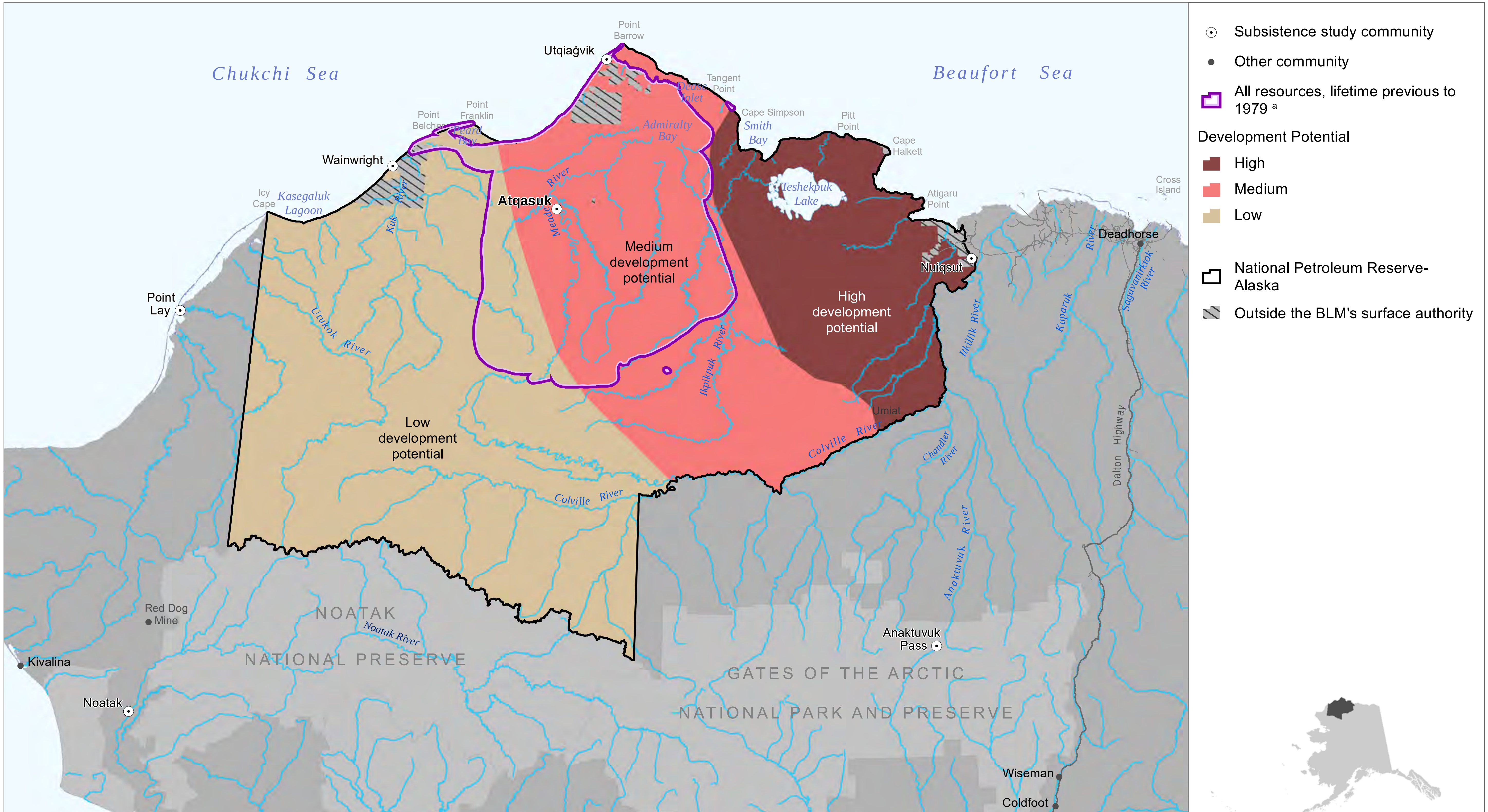

Data source: a) Pedersen 1979
Map prepared by Stephen R. Braund & Associates
Print date: 05/14/2020

Nuiqsut Subsistence Use Areas, All Studies

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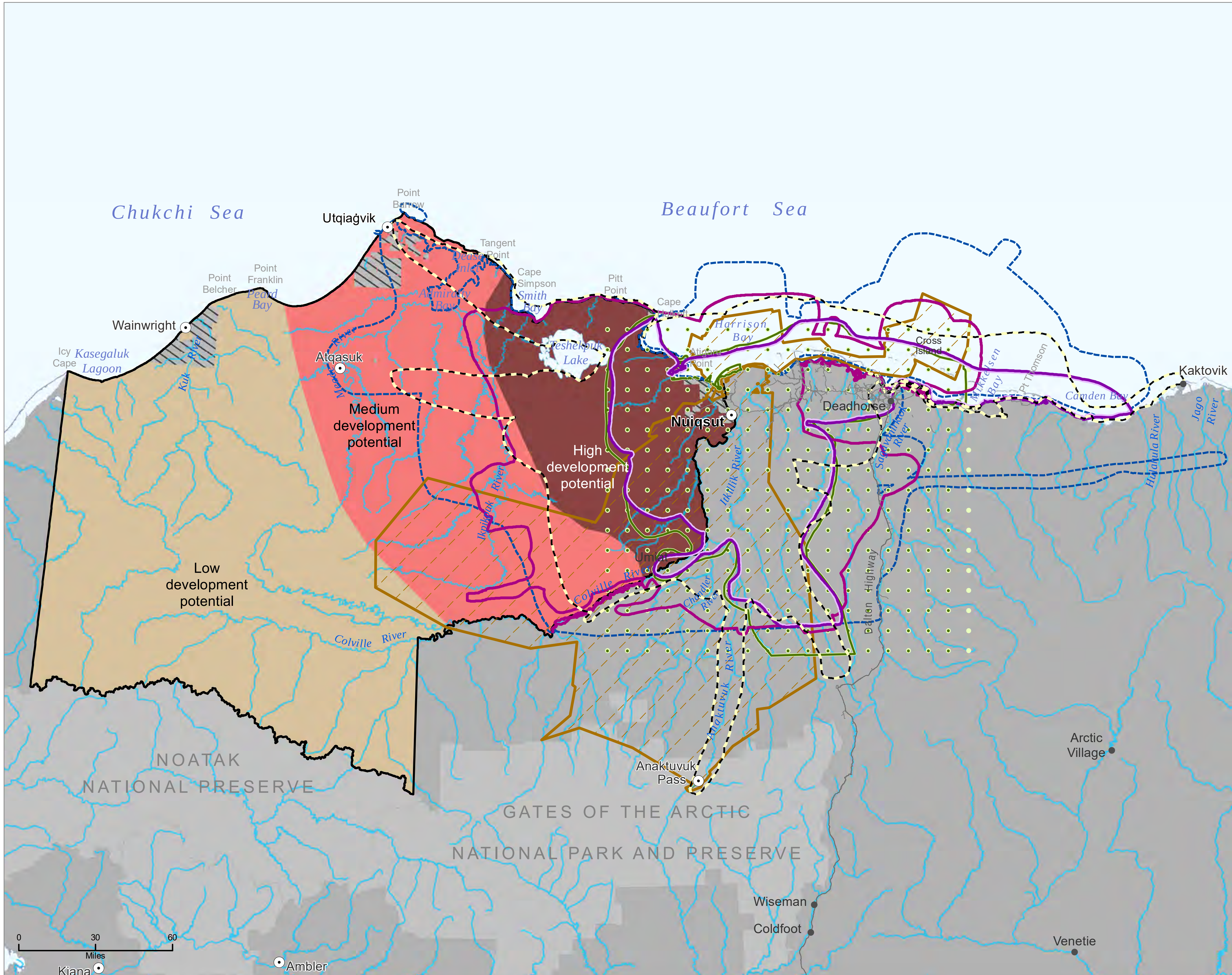


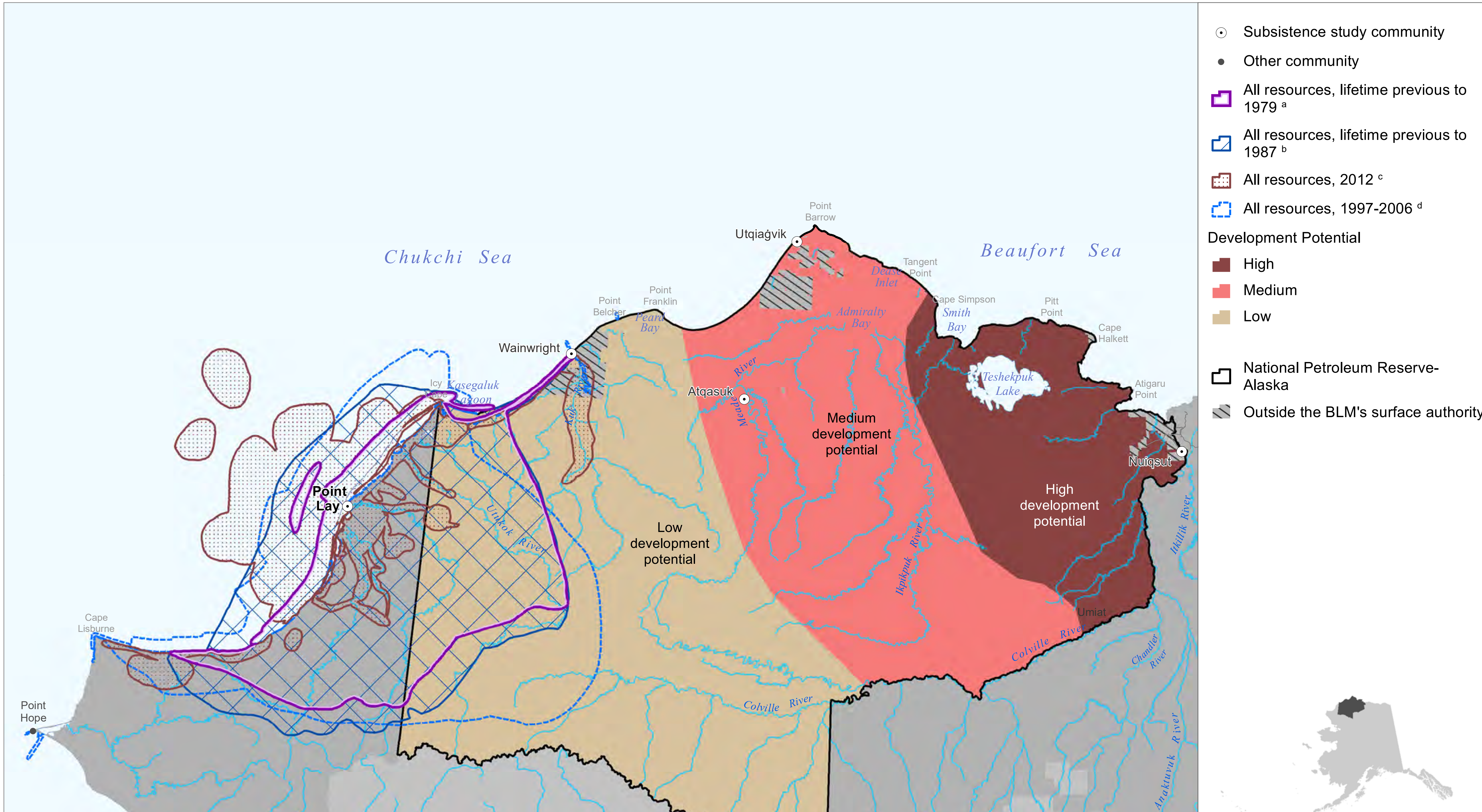
- Subsistence study community
- Other community
- All resources, early 1970s [a]
- All resources, lifetime previous to 1979 [b]
- All resources, 1973-1986 [c]
- All resources, 1994-2003 [d]
- All resources, 2014 [e]
- All resources, 1995-2006 [f]

Development Potential

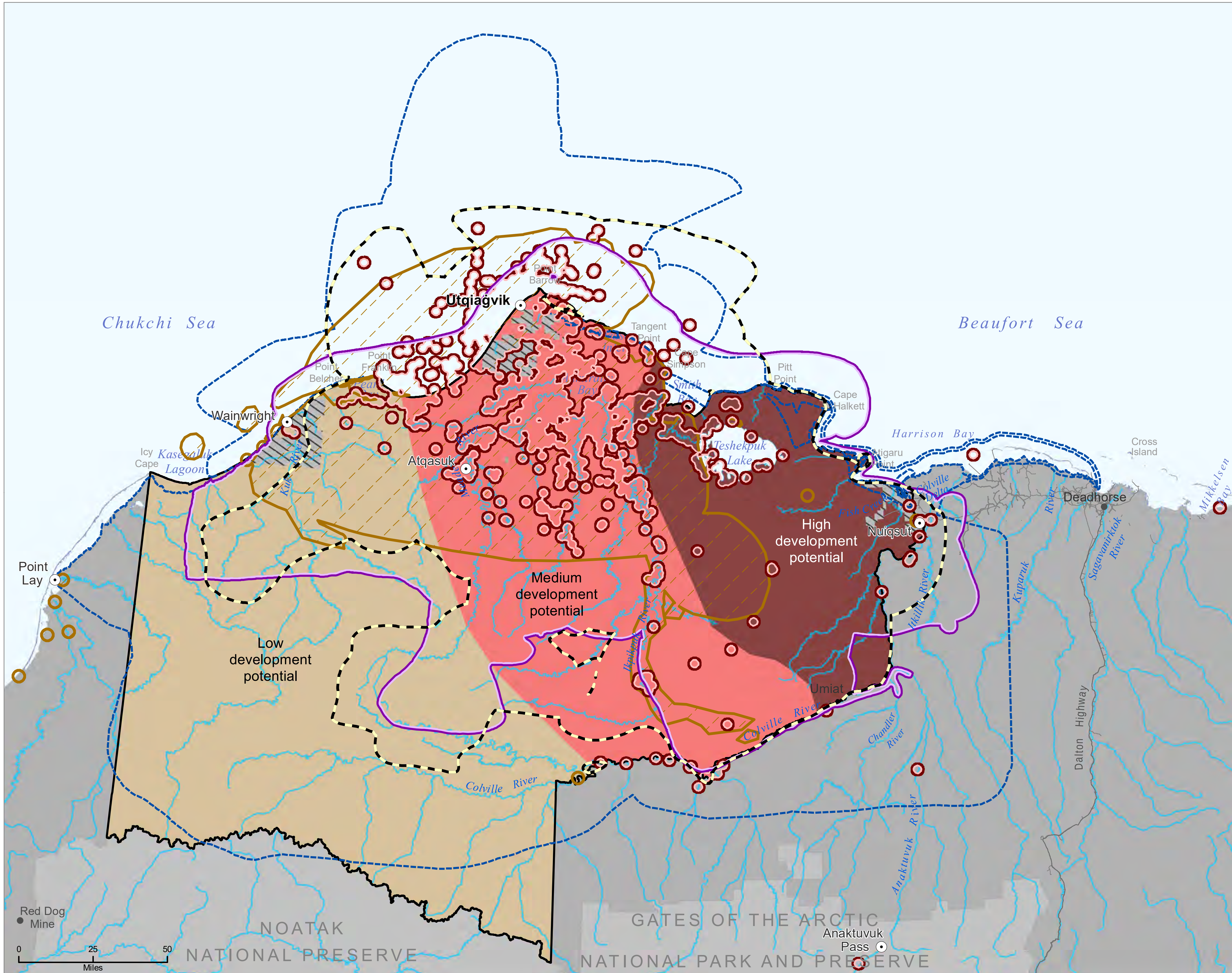
- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Brown 1979 b) Pedersen 1979 c) Pedersen 1986 d) BLM 2004 e) Brown et al. 2016 f) SRB&A 2010a
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020



Data sources: a) Pedersen 1979 b) Impact Assessment Inc. 1989 c) Braem et al. 2017 d) SRB&A 2014b
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020



Subsistence study community
Other Community
All resources, lifetime Previous to 1979 [a]
All resource harvest sites buffered, 1987-1989 [b]
All resources, 1987-1989 [c]
All resources, 2014 [d]
All resources, 1997-2006 [e]

Development Potential
High
Medium
Low

National Petroleum Reserve-Alaska
Outside the BLM's surface authority

Data sources: a) Pedersen 1979 b) SRB&A and ISER 1989 c) SRB&A Unpublished d) Brown et al. 2016 e) SRB&A 2010a
Map prepared by Stephen R. Braund & Associates
Print date: 05/05/2020

Wainwright Subsistence Use Areas, All Studies

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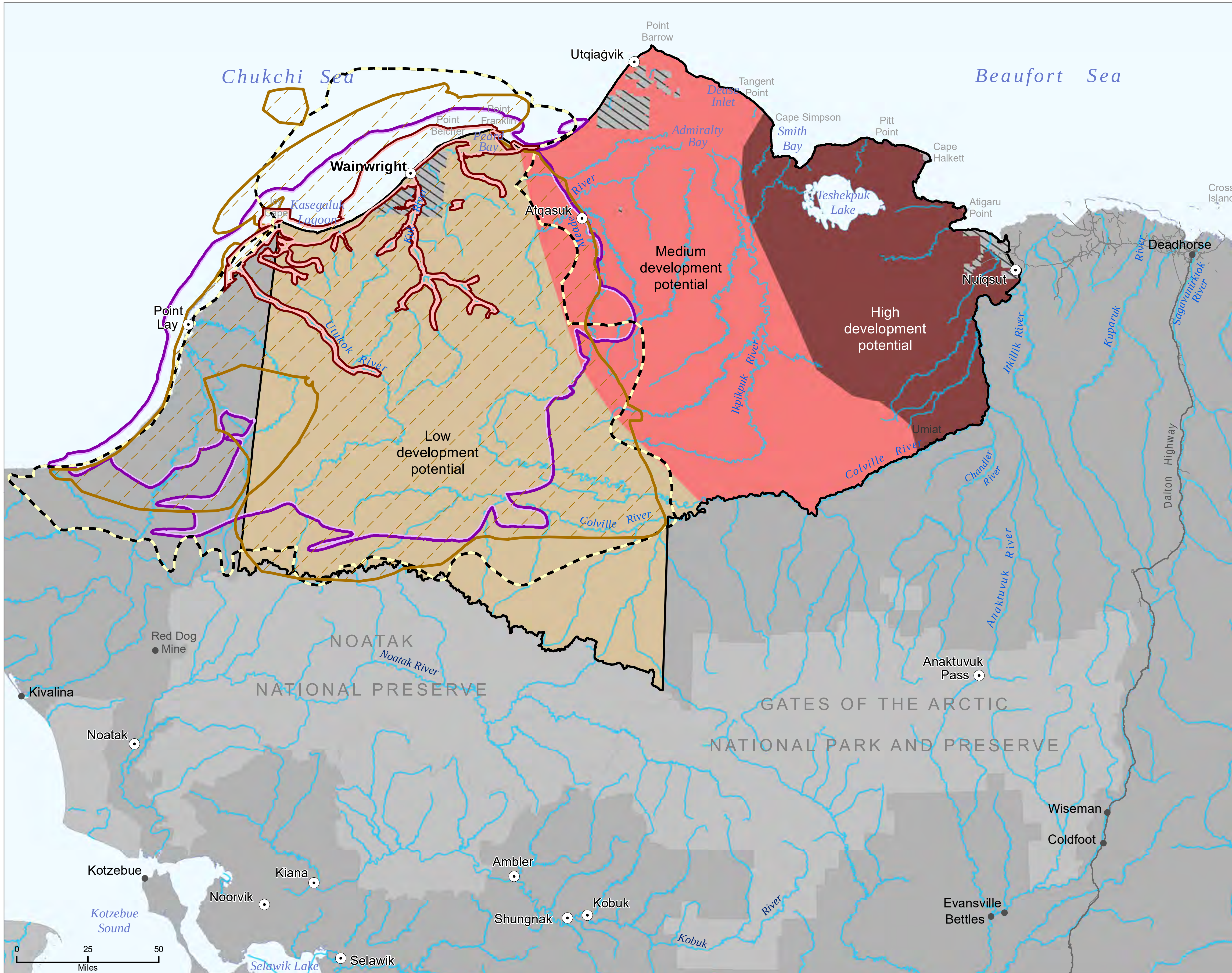

- Subsistence study community
- Other community
- All resources, lifetime previous to 1979 [a]
- All resources, 1987-1989 [b]
- All resources, lifetime previous to 1982 [c]
- All resources, 1998-2007 [d]

Development Potential

- High
- Medium
- Low

- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Pedersen 1979 b) SRB&A Unpublished c) Nelson 1981 d) Wainwright Traditional Council and The Nature Conservancy 2008

Map prepared by Stephen R. Braund & Associates

Print date: 05/05/2020

Table E-2
Subsistence Use Areas Crossing Areas Open to Fluid Mineral Leasing, Alternative A

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	ND	N	M	See "Non-Salmon Fish"
Non-Salmon Fish	N	M[2]	H	L	H	M[2]
Marine Mammals	ND	M	H	N	M	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	N
Vegetation	N	M	H	N	M	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

While nearly 30 percent of Wainwright lands would remain open to oil and gas leasing, most of these lands would be in an area of low to medium development potential (**Tables E-1** and **E-2**); the area immediately around Wainwright and along the Kuk River, a key subsistence harvesting area for the community, would remain closed to oil and gas leasing (**Map E-7**). A small percentage of Point Lay and Anaktuvuk Pass use areas would remain open to oil and gas leasing under Alternative A (**Table E-1**). While Anaktuvuk Pass large and small land mammal use areas would overlap areas of high development potential (**Table E-2**), these use areas represent a small proportion of the overall use areas for that community and impacts on access would be relatively unlikely (**Map E-2**).

Under Alternative A, new infrastructure would be prohibited directly around Teshekpuk Lake and in the southwest portion of the NPR-A near the Utukok River uplands, although exceptions would be made for essential pipeline crossings, roads, or essential coastal infrastructure. In the case of the primary study communities, Atqasuk would continue to have the greatest percentage of their use area open to new infrastructure (65 percent), followed by Utqiagvik (30 percent), Nuiqsut (27 percent), Wainwright (23 percent), and Point Lay (8 percent; **Table E-3**). Anaktuvuk Pass would have less than 1 percent of subsistence use areas open to infrastructure development in the NPR-A. Under the reasonably foreseeable development scenario, Alternative A is expected to result in between 20 (low development scenario) and 128 (high development scenario) miles of gravel roads. New infrastructure could impact access to use areas for Atqasuk, Utqiagvik, Nuiqsut, Point Lay, and Wainwright due to direct overlap with use areas (**Maps E-3** through **E-7**). Oil and gas infrastructure is most likely to occur in high development potential areas, which is primarily used by subsistence hunters in the community of Nuiqsut. Under Alternative A, there is no requirement that subsistence users be allowed to use industrial roads. Additionally, roads may be unavailable for use during the construction phase, which could last between 1 and 7 years, depending on the size of the development.

Table E-3
Percentage of NPR-A Subsistence Use Areas Closed and Open to Infrastructure

Community	Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Percent of Total Use Areas in NPR-A
	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open	
Anaktuvuk Pass	4%	<1%	4%	<1%	<1%	3%	<1%	3%	3%	<1%	4%
Atqasuk	27%	65%	47%	45%	25%	68%	25%	68%	23%	69%	100%
Utqiagvik	30%	30%	38%	22%	24%	35%	23%	37%	24%	36%	62%
Nuiqsut	12%	27%	22%	17%	12%	27%	11%	29%	11%	29%	41%
Point Lay	31%	8%	33%	6%	30%	8%	30%	8%	30%	8%	40%
Wainwright	41%	23%	45%	20%	32%	32%	31%	32%	33%	32%	66%

Source: See NPR-A IAP/EIS, Appendix T, Subsistence Use and Resources, Table T-2, Subsistence Data Sources
[1] "Open" lands include any lands available for new subsistence infrastructure. Lands which are unavailable for new infrastructure except for essential pipeline crossings, roads, or coastal infrastructure are not considered "Open."

While oil and gas infrastructure is most likely to occur within areas of high development potential, other non-oil and gas infrastructure could occur elsewhere within the NPR-A, affecting subsistence use areas for other communities. Under Alternative A, all six primary study communities could potentially have infrastructure overlap subsistence use areas for key resources, though only a minimal area would be open to infrastructure for Anaktuvuk Pass. Nuiqsut, Utqiagvik, Atqasuk, Point Lay, and Wainwright (limited overlap for most resources) have subsistence use areas for multiple resources overlapping areas open to new infrastructure, thus increasing the likelihood of infrastructure related impacts on those communities (**Table E-4**).

Table E-4
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative A

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X	N	X[1]	X[1]	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X[1]
Bird Eggs	ND	ND	N	N	X	X[1]
Marine Invertebrates	ND	ND	ND	ND	X[1]	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Subsistence Resource Abundance

The NPR-A is used by the six primary study communities to harvest various species of terrestrial mammals, fish, birds, marine mammals, and vegetation. Large land mammals and non-salmon fish are resources of high importance among all six primary study communities, and both resources occur and are harvested throughout the NPR-A. Additional resources of high importance for most of the six primary study communities are migratory birds and marine mammals. The NPR-A contains key nesting habitat for migratory birds, and marine mammal habitat for seals, bowhead whales, and walrus, all key subsistence species, occurs offshore from the NPR-A. In all cases, the likelihood of oil and gas and infrastructure development within the NPR-A affecting resource abundance would depend on the location, magnitude, and nature of future development. Conclusions regarding potential impacts on resource abundance are based on the reasonably foreseeable development scenario (NPR-A IAP/EIS, Appendix B, *Reasonably Foreseeable Development Scenario*), the likelihood of oil and gas development within key habitat areas, and the likelihood of a large-scale oil spill occurring in key habitat areas.

Primary large land mammal resources harvested within the NPR-A include caribou, moose, and to a lesser extent, Dall sheep and bear. As noted above, the WAH and TCH are the primary caribou herds that occur in the NPR-A, with seasonal migrations occurring through the area during the spring and fall, and key calving grounds for both herds in the Utukok River uplands (WAH) and around Teshekpuk Lake (TCH; NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals, Affected Environment*). Impacts on caribou populations could occur through direct mortality or through decreased calf survival resulting from impacts on calving grounds or to the behavior of maternal caribou. Injuries and mortality of caribou and other resources resulting from vehicle collisions along industry and other roads in the NPR-A may occur but are not expected to have population-level effects (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals, Direct and Indirect Impacts*).

Future oil and gas infrastructure in the planning area, particularly in the TCH calving grounds near Teshekpuk Lake and WAH calving grounds in the Utukok River uplands, could cause a shift in calving distribution during some years, which would likely reduce calf survival and halt herd growth. To the extent that calving grounds are disturbed by oil and gas development, WAH and TCH calf survival and herd numbers could be reduced. An overall reduction in the WAH or TCH could affect harvest success among the Iñupiat on the North Slope as well as other study communities located within the range of these herds. In the case of Alternative A, most high-density calving grounds surrounding Teshekpuk Lake and the Utukok River uplands would remain closed to oil and gas leasing and infrastructure development. TCH caribou would have a somewhat higher potential than the WAH for exposure to infrastructure development within their calving grounds under Alternative A. Infrastructure within TCH calving grounds would likely result in displacement of calving caribou; however, the magnitude of displacement would depend on the size and nature of oil and gas and infrastructure development. Certain infrastructure, such as pipelines to transport oil and gas from offshore leases, would still be permitted in areas closed to leasing and development and could contribute to habitat fragmentation but are not expected to affect access to mosquito relief habitat for the TCH.

Moose occur throughout the NPR-A but particularly along the Colville River drainage where residents typically hunt them during the late summer and fall months. While ground traffic along project roads may result in individual injuries or mortalities to moose, these mortalities are not expected to have population level effects. In addition, because permanent oil and gas facilities would be prohibited within certain distances of major rivers, the likelihood of direct impacts on moose, which prefer riparian habitat, would be low. The NPR-A is heavily used by North Slope hunters for furbearer (e.g., wolf and wolverine) hunting and trapping. While furbearers and small land mammals do not contribute a large amount in terms of subsistence foods, furbearer hunting and trapping is a specialized activity that has cultural importance. While wolf and wolverine would likely be displaced by infrastructure and human activity and some individual mortalities of wolverine may occur, overall population levels are not expected to be affected by future developments. Thus, the abundance of wolf and wolverine available for subsistence use would likely not be impacted under Alternative A (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

North Slope residents harvest non-salmon fish in rivers and streams throughout the NPR-A, with key drainages being the Colville, Fish, Chipp, Ikpikpuk, Meade, Inaru, Kuk, Kokolik, and Utukok rivers. Key subsistence non-salmon fish species among the study communities include broad and humpback whitefish, Arctic and least cisco, Dolly Varden, Arctic grayling, smelt, and burbot. Depending on the location and magnitude of development within the NPR-A, impacts on fish abundance could occur within individual harvesting drainages for the NPR-A communities; however, most impacts on fish abundance are not expected to extend throughout the NPR-A unless a large-scale contamination event occurred. Oil and gas and infrastructure development could affect fish habitat by reducing fish passage, degrading water quality (e.g., increased turbidity from dust and gravel spray or road and pad construction activities), and reducing water quantity (NPR-A IAP/EIS, Section 3.3.3, *Fish*). ROP E-6 (BMPs E-6 and E-15 under Alternative A) would mitigate impacts on fish passage by requiring that all crossings be designed to allow for fish passage. Under Alternative A, most rivers and streams in areas open to oil and gas leasing would be subject to NSO. Habitat loss and degradation could displace or cause individual mortalities of these resources, but these changes are not expected to cause population-level effects across the NPR-A. A large oil spill would have serious adverse effects on aquatic habitats; however, such large-scale spills within major waterbodies are not expected to occur (NPR-A IAP/EIS, Section 3.3.3, *Fish*).

Migratory birds are another resource heavily hunted within the NPR-A and of high importance to most North Slope communities. Key migratory bird species include white-fronted geese, black brant, snow geese, Canada geese, and eiders (although primarily in coastal and nearshore areas). Habitat loss and degradation could displace or cause individual mortalities of migratory birds, but population-level effects are not expected. While unlikely, large spills on land could affect waterfowl nesting and feeding areas and cause mortality to large numbers of individual birds, affecting their availability to harvesters across the NPR-A and in other regions (e.g., south of the planning area; NPR-A IAP/EIS, Section 3.3.4, *Birds*).

Other resources harvested within or offshore from the NPR-A include vegetation, primarily along key waterways, and marine mammals. Vegetation harvesting areas could be affected by spills and contamination along roads, waterways, and in coastal areas. Dust deposition along roads would affect the abundance of vegetation within a certain distance from road corridors and may result in the loss of individual berry or plant harvesting patches. Residents would likely use alternate harvesting areas in these cases. Invasive nonnative plants could be transported into the planning area along roads and could reduce availability of native species of plants and berries in those areas. Large-scale oil spills in open water associated with vessel or barge traffic, particularly during the summer months, could have negative effects on large numbers of marine mammals, thus affecting the availability of these resources to Nuiqsut, Utqiagvik, Point Lay, and Wainwright residents. However, the likelihood of a large-scale spill occurring is small (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*).

Subsistence Resource Availability

Impacts on wildlife and vegetation resources related to habitat loss and disturbance are discussed in Section 3.3.1 and Sections 3.3.3 through 3.3.6 of the NPR-A IAP/EIS. The NPR-A includes primary calving, wintering, and migratory grounds for the WAH and TCH. The NPR-A also includes key habitat for other terrestrial mammals (moose, wolf/wolverine), fish, and migratory birds, and is offshore from key marine mammal migratory and feeding grounds. North Slope residents harvest vegetation such as berries and greens in various locations throughout the NPR-A but particularly along river corridors and coastal areas. Impacts on resource availability may occur as a result of noise, traffic, and human activity, infrastructure, and contamination. Communities that are most likely to experience impacts on resource availability are those with a greater percentage of use areas overlapped by areas open to oil and gas leasing and infrastructure development (see **Tables E-1** and **E-2**), particularly in areas of high development potential (see **Tables E-3** and **E-4**). Under Alternative A, Nuiqsut and Utqiagvik have the highest number of subsistence use areas overlapping areas of high development potential open to oil and gas and infrastructure development (**Tables E-3** and **E-4**). Atqasuk has a higher percentage of subsistence use areas overlapped, but most subsistence use areas (with the exception of Atqasuk large land mammals and small land mammals, which overlap minimally with areas of high development potential) are in areas of low to medium development potential (see **Tables E-1** and **E-2**). The peripheral study communities of Ambler, Kiana, Kobuk, Noatak, Noorvik, Selawik, and Shungnak all have lifetime subsistence use areas documented on the periphery of the NPR-A; however, in all cases more recent mapped data indicate that use areas do not extend to the NPR-A. Thus, any impacts on these communities would likely be indirect and affect resources that occur in and migrate through the NPR-A and are harvested elsewhere (e.g., caribou and migratory birds).

Noise, Traffic, and Human Activity

Noise, traffic, and human activity associated with post-leasing oil and gas activities and infrastructure development would result from construction, gravel mining, air, vessel, and ground traffic, seismic activity, drilling, and human presence. While oil and gas development is a major source of air traffic on the North Slope, other sources of air traffic include scientific and agency research, recreational uses, and commercial flights. Impacts on resource availability resulting from noise, traffic, and human activity are discussed in NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts.* Noise and traffic associated with oil and gas activities in the NPR-A could potentially affect the availability of resources, such as caribou, marine mammals, furbearers, small land mammals, fish, and migratory birds. Most impacts related to noise and traffic would be local, occurring in areas where subsistence use areas overlap with noise and traffic-generating activities. However, certain impacts, particularly those related to caribou migration, could extend outside the NPR-A and would be regional. Even small changes in resource migration or distribution from a biological perspective can have larger impacts on subsistence users if resources are not in traditional use areas at expected times of the year. According to traditional knowledge of North Slope Iñupiat, furbearers, caribou, and marine mammals are particularly sensitive to noise and human activity (SRB&A 2018a, 2009).

Potential impacts on the availability of land mammals include displacement of wildlife from areas of heavy oil and gas activity; diversion of wildlife, particularly caribou, from their usual migratory routes; and skittish behavior that results in reduced harvest opportunities (SRB&A 2018a). Until recently, air traffic, particularly helicopter traffic, has been the most commonly reported impact on caribou hunting to the Nuiqsut Caribou Subsistence Monitoring Project (SRB&A 2018a, CPAI 2018, SRB&A 2019a). Residents from Nuiqsut and other North Slope communities (SRB&A 2018a, 2009) note that air traffic can cause skittish behavior in caribou, either causing them to stay inland from riversides or diverting them from their usual migration and crossing routes; such impacts could occur for NPR-A harvesters as they travel along the coast or rivers by boat or inland by snowmachine looking for caribou. Observed behavioral responses include caribou "scattering" rather than remaining in groups where they are easier to hunt, acting skittish, and deflecting away from the source of noise or away from riversides (where hunters wait for them) (SRB&A 2010b, 2011, 2012, 2013, 2014a, 2015, 2016, 2017a, 2018a). Hunters have frequently recounted experiences where a potentially successful harvest was disrupted by air traffic overhead, with caribou diverting to locations too far from riversides for hunters to access. Data show a potential decrease in hunting success among Nuiqsut hunters, despite the fact that overall harvest numbers for the community of Nuiqsut have remained stable. This includes a greater percentage of households reporting unsuccessful harvests over time and a higher average number of trips taken per caribou harvested (SRB&A 2019b). ROP F-4 (BMP F-1 under Alternative A) places restrictions on the timing, location, and altitude of aircraft, in addition to requiring consultation with subsistence users.

In addition to air traffic, roads and road traffic can cause behavioral and migratory changes in caribou and other land mammal resources that can affect hunting success (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*, *Direct and Indirect Impacts*). Deflections or delays of caribou movement from roads and associated ground traffic and human activity have been documented both by active harvesters (SRB&A 2010b, 2011, 2012, 2013, 2015, 2014a, 2016, 2017a, 2018a) and during behavioral studies on caribou (Wilson, Parrett, Joly, and Dau 2016). Impacts from roads are particularly high during times of high levels of ground traffic (i.e., more than 15 trips per hour). Impacts from air and ground traffic would be greatest during the peak caribou hunting season which, for most communities in the NPR-A, occurs throughout the summer and fall (June through October) (SRB&A 2010a, 2014b, 2018a). Under all alternatives, ROP K-9 would place restrictions on ground traffic within the TCH Habitat Area, including speed limits of 15 miles per hour when caribou are within 0.5 miles of the road and temporarily stopping traffic to prevent displacement of calving caribou.

Other potential sources of impacts on caribou availability include construction noise (including noise associated with sand and gravel mining), seismic activity, drilling noise, and general human activity, which could cause avoidance behavior or skittishness in caribou within hunting areas. Winter seismic exploration has the potential to displace caribou, which could affect winter harvests of caribou; this would be particularly likely for TCH caribou, many of which remain in the NPR-A year-round (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

The WAH and TCH routinely occur in the NPR-A throughout the spring calving and summer insect seasons (May through August), with the WAH calving primarily in the Utukok River uplands in the southwestern portion of the NPR-A and the TCH calving near Teshekpuk Lake in the northeastern portion of the NPR-A. The WAH generally winters to the south of the NPR-A following the fall migration, while much of the TCH remains in the NPR-A throughout the winter with some heading south into the Brooks Range. Thus, impacts on caribou resource availability could occur for most NPR-A subsistence hunters. According to NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*, WAH caribou may be more sensitive to air and noise traffic than the TCH, which has had more exposure to development activities; however, both herds have had less exposure to development and infrastructure than other Alaskan caribou herds such as the Central Arctic Herd (CAH).

Other land mammal hunting activities that could be affected by noise, traffic, and human activity include moose hunting and furbearer hunting and trapping. Moose hunters have reported similar impacts as those described for caribou hunting as a result of noise and traffic; however, these impacts would likely occur on a more localized, individual level rather than diverting movement or causing larger-scale changes in distribution. In addition to large land mammals, furbearers, such as wolf and wolverine, have been reported to avoid areas of heavy traffic, drilling noise, seismic testing, and other activity. Seismic activity may occur throughout the NPR-A in areas open or closed to oil and gas leasing, although it is less likely to occur in areas closed to leasing. Impacts on moose hunting would likely peak in the fall, while impacts on wolf and wolverine hunting would be highest in winter. Because oil and gas development and infrastructure would be limited at various distances from rivers, where most residents hunt them, impacts on moose hunting would be less likely.

In addition to air and ground traffic, barging and shipping traffic associated with oil and gas development activities within the NPR-A could affect the availability of marine resources such as seals, bowhead whales, and walrus. Impacts on marine mammals from noise and traffic have been reported by whaling crews and marine mammal hunters in Nuiqsut, Wainwright, and Utqiagvik (SRB&A 2009, 2017b) and documented through western science (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). Vessel and air traffic in offshore areas could cause skittish behavior and affect marine mammal distribution in hunting areas for Utqiagvik and Wainwright and to the west of primary seal hunting grounds in Harrison Bay for Nuiqsut (Nuiqsut whaling occurs farther to the east of the NPR-A at Cross Island). Oil and gas development within the NPR-A would likely require barge and vessel traffic and potential construction of barge landings or module transfer islands to support onshore development. Conflict Avoidance Agreements between industry and the Alaska Eskimo Whaling Commission are generally considered an effective measure by whaling crews, industry, and agencies for minimizing impacts on whaling. However, not all vessel traffic, such as that from barging not associated with oil and gas development, is subject to these agreements, so impacts from shipping and marine traffic associated with other NPR-A activities such as infrastructure development could occur even with an agreement in place. Increased noise and activity associated with oil and gas development and exploration could result in large stampedes of walrus, which have increased in density in Chukchi Sea nearshore waters and barrier islands in recent years, resulting in walrus injury or mortality (see NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). Various ROPs would place restrictions on marine vessel traffic when in the vicinity of marine mammals or key marine mammal habitat (ROPs K-4, K-5, H-1, and H-4).

Other sources of impacts on marine mammals include air and ground traffic and seismic activity in coastal and nearshore areas, and noise from construction and operation of nearshore facilities such as saltwater treatment plants and module transfer islands (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). Seal hunting commonly occurs in nearshore areas both during the open water and winter seasons; noise and traffic in those areas would likely result in temporary displacement of seals and could affect harvester success in those areas. Some seals would likely habituate to industrial noise and vessel traffic. Overall, because the majority of development would be land-based and because of the existence of Conflict Avoidance Agreements to reduce impacts associated with barging, impacts on resource availability may occur in isolated instances for individual hunters but are not expected to occur on a large scale.

Noise and traffic associated with future oil and gas development or infrastructure development could also disturb other subsistence resources, such as birds and fish, and could cause temporary reductions in harvesting success for NPR-A harvesters; however, most displacement would be temporary and would not result in large-scale changes in distribution (NPR-A IAP EIS Sections 3.3.3, *Fish* and Section 3.3.4, *Birds*). Birds may be displaced from or avoid areas of heavy traffic and noise. If construction, heavy air traffic, or ice roads and associated traffic occur in commonly used geese hunting areas during the spring or summer months, then NPR-A residents could experience decreased hunting success during the affected hunting season(s) (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources*). However, routine operational activities (e.g., road and air traffic) are not expected to result in large-scale distribution changes or disturbances to birds (NPR-A IAP/EIS, Section 3.3.4, *Birds*). For geese, responses to human presence and foot traffic are stronger than responses to air and ground traffic, although close approaches by helicopters and aircraft landings also cause flushing reactions in nesting geese (NPR-A IAP/EIS, Section 3.3.4, *Birds*). Marine vessel traffic associated with NPR-A development could result in disturbances of birds, such as eiders, in the nearshore marine environment; however, these impacts likely would be temporary and at a small scale.

Actions that could disturb or displace fish include seismic surveys, dredging and blasting, and pile driving for bridges and pipeline crossings. Fish may exhibit avoidance behaviors in the vicinity of noise generated by seismic surveys, vehicles, machinery, and marine vessels. Such impacts would be greatest during construction but could continue through the life of any development project (NPR-A IAP/EIS, Section 3.3.3, *Fish*). During winter, residents from Utqiagvik, Atqasuk, Nuiqsut, and Wainwright fish through the ice at riverine locations within the NPR-A. Depending on the location of seismic surveys, which could occur throughout the NPR-A in areas open and closed to oil and gas leasing, these individuals could experience decreased fishing success resulting from seismic activities (SRB&A 2009). Reduced catch rates resulting from the use of seismic air guns have been documented by Engas, Lokkeborg, and Soldal (1996) and Engas and Lokkeborg (2002). Impacts of vibroseis are believed to be minimal when strict seismic survey guidelines, such as those required under ROP 14, are followed (NPR-A IAP/EIS, Section 3.3.3, *Fish*).

The above impacts on resource availability may be considered minimal from a biological standpoint in that overall population levels or species distribution would not be affected; however, small changes in the behavior or distribution of a resource can have larger impacts on subsistence resource availability when resources are not present in traditional hunting areas at the expected times and in adequate abundance. Changes in resource availability may not occur to the extent that overall community harvest amounts are affected; however, subsistence users may experience decreased harvest success, which results in having to take more frequent or longer hunting trips or traveling farther in search of resources. Such changes could increase hunter risks to safety and contribute to social stress within communities, thus affecting community well-being and health.

While noise and traffic would be most likely to occur in areas of oil and gas development, other activities such as air and vessel traffic related to scientific research and recreation would also continue to occur under Alternative A throughout much of the NPR-A. These activities would also affect subsistence resource availability for NPR-A subsistence users. While most impacts on resource availability related to noise and traffic would be local in extent and would affect communities who have direct uses of the NPR-A, such as Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright, more widespread changes in migration or abundance resulting from noise and traffic and infrastructure (see discussion below) could cause planning area-wide or regional impacts extending throughout the NPR-A or outside the NPR-A to other communities, such as Anaktuvuk Pass and the peripheral and caribou study communities. Impacts on resource availability that extended to communities outside the NPR-A would be most likely to occur for terrestrial migratory resources such as caribou. Such large-scale impacts would be most likely to occur during times of particularly heavy construction or traffic activity, and the likelihood of herd-wide changes in resource availability would vary from year to year depending on planned development activities. Heavy construction noise and helicopter, plane, and ground traffic (along gravel roads) combined with impacts of infrastructure (see below) could affect the timing or location of WAH or TCH caribou arrival into subsistence harvesting areas south of the NPR-A during the fall and winter (e.g., to the 42 WAH/TCH study communities or the peripheral study communities) or into NPR-A community hunting areas during the summer. Reduced harvests of caribou by NPR-A communities could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed to doing.

Infrastructure

Potential infrastructure associated with NPR-A exploration and development includes roads (gravel and ice), gravel pads, runways, pipelines, bridges, facilities (e.g., camps and central processing facilities and community infrastructure), gravel mines, module transfer islands, and saltwater treatment plants. Infrastructure can affect resource availability through habitat loss/alteration, displacement, and obstruction or diversion of resources. While most infrastructure-related impacts would occur in the vicinity of infrastructure areas, impacts that result in the diversion of resources such as caribou or fish could have farther reaching impacts on resource availability. Large-scale effects on caribou migration, for example, could extend outside the NPR-A area and be regional.

Roads associated with oil and gas development in addition to community infrastructure projects (e.g., a road from Utqiagvik to Nuiqsut) would remove habitat but also pose as a linear barrier to movement for migratory resources such as caribou. The physical presence of roads in combination with road traffic can cause caribou and other mammals to exhibit avoidance or delayed or diverted crossing behaviors (see above, under *Noise, Traffic, and Human Activity*). Roads in calving areas also can displace calving caribou. A road, such as the one proposed north of Teshekpuk Lake, could displace maternal caribou during calving and affect access to TCH mosquito-relief habitat during the summer (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*). Studies on the North Slope show that caribou distribution, especially cows with calves, changes around transportation corridors, and that some caribou are influenced in their movement by the presence of roads (NRC 2003). Pipelines, particularly those placed near roads, may also displace or deflect caribou. Displacement of CAH caribou has been observed at existing North Slope oil fields, with decreased use occurring up to 5 kilometers, 2 kilometers, and 1 kilometer of infrastructure during calving, post-calving, and mosquito seasons, respectively. Similar displacement levels would be expected in the NPR-A, although the potential for hunting activity along road corridors and the relatively lower habituation of the WAH and TCH (compared with the CAH) may result in greater displacement distances (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*). Temporary deflections of caribou within the NPR-A resulting from roads has already been observed by Nuiqsut hunters, who indicate that caribou tend to hesitate upon reaching the CD5 and Greater Mooses Tooth One (GMT1) roads and are less available in areas closer to the community, although hunters also observe caribou crossing roads and hunt for caribou along these roads (SRB&A 2018a). Road avoidance is particularly likely during times of high human activity, including ground vehicle use. In addition to general displacement from infrastructure and short-term delays, roads have been documented to cause longer-term delays in caribou migration, particularly when traffic levels are high.

An overall deflection of migration could have substantial impacts on residents hunting caribou in overland and riverine areas during the summer and fall. Temporary changes in distribution have not been shown to alter overall migration patterns or herd distribution; however, small changes in caribou distribution and movement from a biological perspective can have large impacts on hunter success, as residents are generally limited in how far and fast they can travel, particularly during the snow-free season. Impacts on resource availability resulting from changes in caribou migration are particularly likely if a community is on the periphery of a herd's seasonal movements (e.g., Nuiqsut is on the western periphery of the TCH and the eastern periphery of the CAH).

The six primary subsistence study communities harvest from both the WAH and the TCH, although some communities rely more on one herd than the other (e.g., Nuiqsut primarily harvests from the TCH). Hunting of both herds occurs year-round but peaks in the summer, when both herds migrate to riverine and coastal areas in the NPR-A for insect relief, and in the fall, when both herds migrate to their southern wintering grounds (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources*). If caribou experience long-term delays from their annual spring and fall migrations as a result of oil and gas and other non-oil and gas infrastructure, then they may arrive in traditional hunting areas later than expected or they may be diverted away from traditional hunting areas altogether, thus reducing resource availability for local hunters. Infrastructure related to oil and gas development is more likely to occur in the eastern portion of the NPR-A, which has high development potential. Thus, residents who hunt the TCH in the eastern portion of the NPR-A—particularly Nuiqsut and Utqiagvik—may be more likely to experience impacts on resource availability of caribou resulting from oil and gas infrastructure. Other areas with lesser development potential may experience infrastructure development not associated with oil and gas, such as a road across the NPR-A to Utqiagvik, and thus may also experience impacts on resource availability of caribou resulting from infrastructure. Finally, oil and gas development may still occur in areas of lower development potential.

The presence of roads within the NPR-A may serve to mitigate some of the impacts of roads and infrastructure on resource availability. In Nuiqsut, residents have reported that access to roads has offset some of the impacts of increased infrastructure and activity on resource availability by providing hunting access to areas farther from the community that may have been previously more difficult to access depending on the time of year and available transportation methods, although some report avoiding the roads altogether. Individuals not using roads to access subsistence use areas and resources may experience reduced success closer to their communities if roads affect resource availability through physical infrastructure or by creating hunting corridors. While use of roads has increased, caribou harvests in the vicinity of roads have not increased, indicating that while roads may mitigate impacts on resource availability they do not provide a net benefit to resource availability; however, these conclusions are based on a relatively small number of study years, and the use and benefits of roads may evolve over time (SRB&A 2019a).

Infrastructure may affect the availability of other land mammals on the North Slope, such as moose and furbearers. Impacts on moose likely would be minimal, as most infrastructure would be prohibited near rivers where moose occur in the highest densities. However, bridges across rivers and associated traffic may result in avoidance behaviors by moose in those areas. Furbearers such as wolf and wolverine may also display avoidance behavior near infrastructure, which could affect resource availability in traditional hunting areas. However, infrastructure would likely not cause large-scale changes in the distribution of furbearers in NPR-A hunting areas. Thus, moose and furbearer hunters may experience decreased hunting success in certain areas and may spend more time and effort harvesting resources in certain cases but would likely not experience overall declines in harvest amounts.

Infrastructure in marine habitat would be limited to barge landing sites, module transfer islands, seawater treatment plants, and ice roads. Nearshore infrastructure could result in habitat loss or alteration for seals, particularly ringed seals overwintering in nearshore areas, and denning polar bears (NPR-A IAP/EIS, Section 3.3.6, *Marine Mammals*). While nearshore infrastructure could temporarily displace marine mammals in the offshore environment during the open water months, most impacts of infrastructure on marine mammals would occur in winter. As a majority of marine mammal hunting occurs in the open water months, impacts on marine mammal resource availability would be minimal.

Infrastructure would result in the loss or degradation of some fish habitat, which could affect the availability of fish to subsistence users in certain drainages. Marine habitat loss would occur from direct placement of gravel fill associated with module transfer island infrastructure, but this would not affect lake or riverine habitat. Dust deposition from gravel roads and pads may also cause long-term degradation of fish habitat. Some infrastructure such as ice roads and bridge piers or piles may alter stream flows and obstruct passage of fish along river or stream corridors, thus affecting their availability upstream or downstream from infrastructure. However, alteration of stream flows and obstruction of fish passage is relatively unlikely, as these potential impacts would be mitigated by slotting of iced roads in the spring and, in the case of permanent infrastructure, installation of culverts or use of bridges (NPR-A IAP/EIS, Section 3.3.3, *Fish*). ROP E-6 (BMPs E-6 and E-14 under Alternative A) would mitigate impacts on waterbody crossings by requiring that all crossings undergo fish and hydrologic studies prior to construction and are designed to ensure fish passage. Introduction of nonnative aquatic plants by boats and float planes could also displace native species and alter flow patterns and habitat. Infrastructure would also cause habitat loss and alteration for waterfowl through placement of gravel fill, fugitive dust and associated effects on vegetation, and changes in drainage patterns. Such changes could cause displacement of waterfowl from traditional hunting areas. Roads and other oil and gas or community infrastructure may result in the removal of key berry and wild plant harvesting areas, depending on the location of the infrastructure. Subsistence users often have specific locations where they target fish (fish camps and net sites), waterfowl (bird blinds), and berries and plants (specific locations along rivers and coastal areas), and thus even minor displacement of these resources could have more substantial impacts on individual harvesters depending on the location of infrastructure. The more infrastructure there is (e.g., under the high development scenario), the more likely that displacement could affect overall resource availability for the study communities.

Contamination

Oil spills, transport of waste and hazardous materials, fugitive dust, and air emissions could affect the availability of certain resources due to documented or perceived contamination of those resources. Depending on its size and location, an oil spill could affect the terrestrial, riverine, and marine environments, thus affecting large portions of the study communities' resource bases. If an oil spill causes reduced health of certain resources or displaces resources from traditional hunting areas, then they could become less available to the subsistence users. Contamination could occur during all phases of oil and gas development and could range from being easily contained and site specific to occurring over a larger area and causing local or, in the case of a large-scale oil spill or a spill that affects migratory resources, regional effects. Contamination associated with oil spills would be most likely to occur in areas of high development potential and therefore most likely to affect communities such as Nuiqsut, Utqiagvik, and Atqasuk who use or are close to those areas. Impacts could also extend to other communities such as Wainwright and Point Lay if oil and gas development extends into areas of medium and low development potential or if infrastructure projects occur within their traditional lands.

Because of the lower possibility of containment, a spill in water (e.g., rivers, streams, or in nearshore areas) could have greater effects on resource availability, particularly for fish and marine mammals (e.g., seals and bowhead whales). Fish harvesting occurs in numerous river and lake systems across the NPR-A. If a spill or contamination event occurs or if residents perceive that activities upstream from fish camps and net sites are contaminating the water, they may reduce harvesting activities in the area due to concerns that the fish are unsafe to eat. Similarly, resources such as caribou and waterfowl that feed in areas that are affected by spills may also become unavailable to local residents due to these concerns. Small spills in the planning area or air contamination (either real or perceived) could also cause subsistence users to avoid harvesting certain resources, particularly near development areas. This could have potential indirect effects on human health through reduced consumption of nutritional foods and increased stress and anxiety (NPR-A IAP/EIS, Section 3.4.12, *Public Health*).

In addition to spills, use and storage of hazardous materials, solid waste, and drilling waste, generation of air emissions, treatment and disposal of wastewater, and dust deposition could result in real or perceived degradation of land mammal, marine mammal, waterfowl, and fish habitat. Dust deposition from gravel infrastructure, ground traffic, and construction activities could affect fish and other habitat over the long term (Section 3.3.3, *Fish*). Vegetation harvests may be affected by dust deposition along roads, and caribou, waterfowl, and other resources may ingest contaminated vegetation in the event of fugitive dust and small-scale spills along roadways (NPR-A IAP/EIS, Section 3.3.1, *Vegetation,* Section 3.3.4, *Birds,* and Section 3.3.5, *Terrestrial Mammals*). Along the Spur Road near Nuiqsut, most dust deposition has occurred within 50 feet of road edges, although dust deposition may occur up to 100 meters from roads in more heavily travelled areas (NPR-A IAP/EIS, Section 3.3.1, *Vegetation*).

Thus far, air and water quality sampling and testing of subsistence foods on the North Slope have found contaminant and VOC concentrations below the levels of concern for human health (NPR-A IAP/EIS, Section 3.4.12, *Public Health*). However, North Slope residents continue to be concerned about the impact of increasing development in the region on human health and the health of fish and wildlife upon which residents rely. If individuals perceive or confirm subsistence resources to be contaminated and avoid harvesting resources that feed near oil and gas or other non-oil and gas infrastructure, they may experience reduced resource availability. Resources that are perceived as contaminated by subsistence users are often considered unavailable for subsistence use (SRB&A 2009); during a recent Bureau of Ocean Energy Management-funded study, nearly a quarter of Utqiagvik, Wainwright, and Point Lay households (between 22 and 26 percent) and nearly half of Nuiqsut households (47 percent) reported avoidance in the previous year of certain subsistence foods due to concerns about contamination (SRB&A 2017b). Under Alternative A, BMPs A-9 and A-11 would require monitoring of air quality and contaminants in subsistence foods, which could help reduce concerns by local residents.

Access to Subsistence Resources

Infrastructure (e.g., gravel and ice roads, pipelines, and facilities) related to oil and gas development and other projects could occur throughout much of the NPR-A and could create physical and legal barriers to access for communities who use the NPR-A.

Development of road, pipeline, and other linear infrastructure could present a physical barrier to NPR-A subsistence users when accessing hunting or harvesting areas. Any subsistence uses areas permanently overlain by new infrastructure would be inaccessible to subsistence uses throughout the life of any oil and gas project. Additionally, infrastructure would pose physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel, or if bridges and causeways obstruct travel along rivers or coastlines. Some residents in Nuiqsut have reported difficulty safely crossing certain gravel roads with snowmachines or four-wheel vehicles, particularly when hauling trailers or sleds, due to the steep side slopes (SRB&A 2018a). Tundra access ramps and road pullouts at regular distances have reduced but not eliminated issues with off-road travel; in some cases, residents traveling overland may have to travel farther to find a suitable location to cross roads. ConocoPhillips Alaska, Inc. recently upgraded the subsistence ramps located at intervals along the CD5 and GMT1 roads to reduce crossing difficulties. Pipelines can also pose a physical obstruction to residents traveling overland, particularly during the winter when heavy snowdrifts reduce clearance in certain areas; however, 7-foot minimum pipeline heights are generally adequate for harvesters on snowmachines or four-wheelers to cross underneath. A number of ROPs address the potential for direct obstructions to access for subsistence users, including ROP E-1, E-4 (Alternative A only), E-5, and E-7. These ROPs address local use of roads, pipeline heights, and infrastructure footprints and may reduce physical barriers to harvester access.

During project construction, it is possible that local use of roads or access to new infrastructure could be restricted or prohibited due to high traffic volumes and safety concerns. It may also be difficult or impossible to safely cross over roads while they are under construction. Although such impacts would likely be limited to the construction phase of new infrastructure or project development, they would create a legal or regulatory barrier to harvester access. The magnitude of these impacts would be greater if the project construction phase is longer. Even after the construction phase, some roads or areas would be subject to standard safety rules or other regulations that would restrict use. Under Alternative A, 20 miles of gravel road and one satellite pad would be built under the low development scenario, 82 miles of gravel road, 5 satellite pads and 1 central processing facility would be built under the medium development scenario, and 128 miles of gravel road, 10 satellite pads, and 2 central processing facilities would be built under the high development scenario.

Discharge of firearms likely would be prohibited within a certain radius or in the direction of infrastructure, and residents would likely avoid hunting in certain areas due to concerns about human safety and damage to property. Thus, a larger area than project footprints would be unavailable for subsistence use as a result of infrastructure and oil and gas development. Pipelines or roads in coastal areas or in the vicinity of navigable waterways could affect residents' hunting activities if they are unable to shoot inland due to the presence of pipelines or roads; such impacts would also occur for individuals traveling overland if infrastructure forces hunters to reorient themselves or travel farther to hunt safely. In some cases, infrastructure may increase access for certain NPR-A residents if their communities have road access. Use of roads by subsistence users to access traditional hunting and harvesting areas has been documented in Nuiqsut and other rural Alaskan villages. Under ROP E-1 for the action alternatives, subsistence pullouts and access ramps will be incorporated into all future project designs on all roads, thus facilitating harvester access; under Alternative E, ROP E-1 additionally requires that permittees allow local use of gravel roads and ice roads where appropriate. ROPs H-1 and H-2 would require consultation with local residents to facilitate subsistence access and notify residents of upcoming activities. In the case of Nuiqsut, while the percentage of harvesters using roads has increased over time, the percentage of caribou harvested within the vicinity of roads has not increased (SRB&A 2019a). In addition, use of roads decreases with distance from the community of Nuiqsut and with density of infrastructure (BLM 2019). Roads are most likely to provide a net benefit for individuals who have limited time due to job or other commitments, or individuals who do not have access to overland or riverine methods of transportation (e.g., snowmachines, four-wheelers, or boats). Other hunters may benefit from the use of roads when resources are unavailable closer to their community. Nuiqsut residents have reported using roads to access caribou that are reported to be farther from the community as a result of increased development to the west. Depending on the nature and location of road infrastructure in the NPR-A, use of roads by local residents could result in increased subsistence harvesting competition between communities by concentrating harvesters into corridors and changing the dynamic of community use area patterns.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The Naval Petroleum Reserves Production Act of 1976, as amended, instructs the Secretary of the Interior to conduct oil and gas leasing in the NPR-A. Congress authorized petroleum production in 1980 and directed the Secretary of the Interior to undertake a program of competitive leasing of potential oil and gas tracts in the Reserve. The BLM has completed the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed development of an updated EIS that "strikes an appropriate balance of promoting development while protecting surface resources." Lands outside the NPR-A are not subject to the Naval Petroleum Reserves Product Act, or Secretarial Order 3352, and therefore would not fulfill the purpose sought to be achieved.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes. However, Alternative B would open fewer subsistence lands to oil and gas leasing and infrastructure development than Alternative A. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative A

1. **Reductions in the availability of subsistence resources described above for Alternative A may significantly restrict subsistence uses for the community of Nuiqsut.**
2. **Limitations on subsistence user access described above for Alternative A may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

This evaluation concludes that implementation of Alternative A is not expected to result in a large reduction in the abundance (population level) of caribou or any other subsistence resource, nor is there any expectation that there will be a major increase in the harvest of caribou by non-subsistence users. Therefore, this finding of "may significantly restrict" is only triggered by two other primary factors that must be considered: a) reduction in the availability of resources caused by alterations of their distribution, and; b) limitation of access by subsistence harvesters. Rationale for these findings and the determination of significance are summarized below.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative A

Under Alternative A, the community of Nuiqsut harvests eight of the ten subsistence resource categories in areas open to leasing that have a high development potential (see **Table E-2**). All four of the subsistence resources of high material and cultural importance (caribou, marine mammals, non-salmon fish, and migratory birds) are harvested in areas open to leasing and with a high potential for development. Of particular importance is the overlap of areas with high development potential with subsistence use areas for caribou harvest.

Temporary changes in caribou distribution have not been shown to alter overall migration patterns or herd distribution; however, small changes in caribou distribution and movement from a biological perspective can have large impacts on hunter success, as residents are generally limited in how far and fast they can travel, particularly during the snow-free season. Impacts on resource availability resulting from changes in caribou migration are particularly likely if a community is on the periphery of a herd's seasonal movements, and Nuiqsut is on the western periphery of the TCH and the eastern periphery of the CAH. Research on the CAH following development of the Kuparuk and Milne Point oilfields suggests that during and immediately after calving, maternal caribou with young calves tend to avoid areas within 1.25 to 3.1 miles of active roads and pads (Dau and Cameron 1986; Lawhead 1988; Cameron et al. 1992; Cronin et al. 1994; Nellemann and Cameron 1996; Lawhead et al. 2004; Vistnes and Nellemann 2008; Prichard et al. 2019) and caribou densities declined in areas with higher density of infrastructure (Nellemann and Cameron 1996). Aerial surveys conducted before and after construction of the Milne Point road indicated that caribou densities within 0 to 2.49 miles of the road decreased, while densities 2.49 to 3.75 miles from the road increased (Cameron et al. 1992) after construction. Displacement can occur even with low traffic levels, and impacts from roads are particularly high during times of high ground traffic (15 trips per hour). Should similar effects occur around infrastructure built in areas of high development potential near the community of Nuiqsut, hunters may have to travel further to harvest caribou in adequate amounts because there may be fewer animals available near infrastructure.

Infrastructure and activity in core hunting areas can also reduce availability by causing skittish behavior in caribou. Aircraft traffic, and to a lesser extent vehicle traffic, has been reported by local hunters to cause skittish behavior in caribou and decrease hunting success. Observed behavioral responses to aircraft traffic include caribou “scattering” rather than remaining in groups where they are easier to hunt, acting skittish, and deflecting away from the source of noise or away from riversides (where hunters wait for them) (SRB&A 2010b, 2011, 2012, 2013, 2014a, 2015, 2016, 2017a, 2018a). As areas that are open for leasing and new infrastructure under Alternative A are developed, Nuiqsut hunters may need to make additional trips to harvest animals that are skittish due human activity or travel farther to hunt in undisturbed areas. This would constitute a major redistribution of resources. which may significantly restrict subsistence uses for the community of Nuiqsut.

Rationale for the finding of limitations on subsistence user access under Alternative A

Under Alternative A, infrastructure (e.g., gravel and ice roads, pipelines, and facilities) related to oil and gas development and other projects would be allowed in Nuiqsut’s subsistence use area and could present legal and physical barriers to access.

Discharge of firearms likely would be prohibited within a certain radius or in the direction of infrastructure, and residents may avoid hunting in certain areas due to concerns about human safety and damage to property. Pipelines or roads along the Colville River could affect Nuiqsut residents’ hunting activities if they are unable to shoot inland from the river due to the presence of pipelines or roads. Although the Colville River has a 2-mile buffer from its western bank where infrastructure is prohibited, essential road and pipeline crossings would still be permitted within this setback. In addition, the entire setback area is available for leasing under Alternative A, which increases the likelihood of an essential crossing being necessary. Pipelines and roads can also impact individuals traveling overland west of the community if infrastructure forces hunters to reorient themselves (i.e., a caribou is spotted on the other side of the road or pipeline from the hunter) or travel farther to hunt safely. Under Alternative A, there is no requirement for permittees to grant local residents the right to use a permittee’s road during or after construction.

Access may also be physically restricted by linear infrastructure blocking hunters’ ability to travel overland or along rivers. Infrastructure would pose physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel, or if bridges and causeways obstruct travel along rivers or coastlines. Some residents in Nuiqsut have reported difficulty safely crossing certain gravel roads with snowmachines or four-wheel vehicles, particularly when hauling trailers or sleds, due to the steep side slopes (SRB&A 2018a). Tundra access ramps and road pullouts at regular distances have reduced but not eliminated issues with off-road travel; in some cases, residents traveling overland may have to travel farther to locate a suitable location to cross the road. If bridges and roads are not designed to allow subsistence hunters to cross them, or if there is an inadequate number of crossings or crossings are poorly designed, subsistence hunters would need to travel around infrastructure to reach their hunting areas.

During project construction, local harvesters may be restricted or prohibited from using roads, and crossing them may be difficult or unsafe due to high traffic volumes. Gravel roads cannot be driven on while they are being constructed, and ice roads used to support construction have high volumes of industrial traffic and may be legally restricted from subsistence use. Under the medium and high development scenarios, 82 and 128 miles of gravel road, respectively, could be constructed in Nuiqsut’s subsistence use areas.

Subsistence hunters' use of roads can provide a countervailing effect on impacts on access; however, it is unclear how big of an effect this would have. In the case of Nuiqsut, while the percentage of harvesters using roads has increased over time, the percentage of caribou harvested within the vicinity of roads has not increased (SRB&A 2019a). There is also no requirement to allow subsistence users access to a lessee's road or for the lessee to build ramps to facilitate access across roads under Alternative A. Under Alternative A, subsistence users in Nuiqsut may experience extensive interference with access, which may significantly restrict subsistence uses.

E.2.2 Evaluation and Finding for Alternative B

Alternative B is similar to Alternative A but would increase the amounts of land unavailable for oil and gas leasing and closed to infrastructure development. Under Alternative B, the area in the northeastern portion of the NPR-A closed to oil and gas leasing would extend farther to the east into the Fish Creek drainage, and leases would be deferred for at least 10 years in an area bounded by the Colville River in the east, Harrison Bay in the north, and Umiat in the south. It is important to note that much of the land in the deferral area has already been leased, and BLM cannot prohibit development or renewal of existing leases. Under Alternative B, 491,000 acres are closed to fluid mineral leasing but have valid existing leases. In addition, 844,000 of the acres subject to NSO under Alternative B also have valid existing leases. These areas may be subject to only standard terms and conditions while the terms of the existing leases are in effect. Thus, if existing leases are developed, the percentage of use areas potentially affected by oil and gas leasing, activity, and infrastructure under Alternative B (i.e., areas open to leasing and areas open only to standard terms and conditions) would increase for some study communities. However, if these leases were to expire or be surrendered, they would not be offered for sale again until the expiration of the deferral period.

Alternative B would also restrict oil and gas leasing in the lands around and to the east of Atqasuk and to the east and south of Utqiagvik. Alternative B would increase the area around most river and creek drainages that are subject to NSO. Alternative B would allow for two north-south pipeline corridors within the Teshekpuk Lake Special Area. The reasonably foreseeable development scenario under Alternative B is similar to that described under Alternative A, with development expected around Umiat and associated with the Alpine and Willow developments. Despite the decrease in areas open to infrastructure, the reasonably foreseeable development scenario anticipates a slightly higher amount of gravel roads in miles under Alternative B compared with Alternative A (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative B on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative B would make available a smaller portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a lower potential for direct impacts on subsistence.
2. Alternative B would make unavailable for leasing some core subsistence use areas for Nuiqsut and would defer leasing in key Nuiqsut subsistence use areas to the west of the Colville River, potentially providing a temporary reduction in the magnitude of ongoing development impacts on that community.

3. Alternative B would make lands directly around Atqasuk and Utqiagvik unavailable for oil and gas leasing, thus reducing the likelihood and magnitude of direct impacts on those communities' subsistence activities.

Overall, Alternative B would reduce the potential for direct impacts on the primary study communities, particularly Nuiqsut, Atqasuk, and Utqiagvik, because a smaller percentage of subsistence use areas would be available for oil and gas development and new infrastructure (**Table E-3**), and fewer subsistence use areas would be open to leasing in areas of medium to high development potential for certain communities (Utqiagvik and Atqasuk; **Table E-5**; NPR-A IAP/EIS, Appendix A, Map 2-3). Under Alternative B, the area in the northeastern portion of NPR-A closed to oil and gas leasing would extend farther to the east into the Fish Creek drainage, an area of key subsistence use for Nuiqsut for multiple resources. In addition, leasing would be deferred for at least 10 years in the northeast portion of the NPR-A between Harrison Bay in the north and Umiat in the south, a core Nuiqsut hunting ground for caribou, moose, fish, furbearers, and waterfowl. Deferring leases for 10 years in this area would allow for the continued monitoring of subsistence impacts resulting from the CD5, GMT1, and GMT2 developments, which could provide greater understanding of subsistence impacts to inform future development within the community's subsistence use areas. However, existing leases, such as those for the Bear Tooth and Greater Mooses Tooth units, extend throughout much of the deferral area and may experience development. Under Alternative B, 22 miles of gravel road and 1 satellite pad would be built under the low development scenario, 90 miles of gravel road, 6 satellite pads, and 1 central processing facility would be built under the medium development scenario, and 140 miles of gravel road, 11 satellite pads, and 2 central processing facilities would be built under the high development scenario.

Table E-5
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative B

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	M[1]	See "Non-Salmon Fish"
Non-Salmon Fish	N	M[2]	H	L	H	M[2]
Marine Mammals	ND	ND	H	N	M[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M[1]	ND
Marine Invertebrates	ND	ND	ND	ND	N	N
Vegetation	N	M	H	N	M	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Alternative B would close oil and gas leasing in the northernmost portion of the Utukok River Uplands Special Area, thus reducing potential impacts on subsistence harvesters from Wainwright, Point Lay, Atqasuk, and Utqiagvik. The western portion of the Colville River Special Area, a key hunting and trapping area among some Utqiagvik and Wainwright harvesters, would be open to leasing under Alternative B; however, Alternative B would also have the highest infrastructure setback from the Colville River, at 7 miles.

The larger area closed to infrastructure development and oil and gas leasing in the northeastern portion of the NPR-A would also reduce impacts on key habitat areas for caribou and waterfowl, and the larger buffers around major river drainages that would be subject to NSO, including those around the Colville River, would reduce impacts on fish and other resources that prefer riparian habitats (e.g., moose). Under Alternative B, permanent oil and gas infrastructure would be limited within 7 miles of the Colville River, thus reducing potential impacts on fish and other resources that prefer riparian habitats, such as moose. Finally, the addition of 12 wild and scenic rivers under Alternative B in the southwestern portion of the NPR-A would further reduce impacts on fish and other resources along key river systems, particularly for the communities of Wainwright and Point Lay. Thus, the potential for impacts on resource abundance and resource availability under Alternative B would be lower than under Alternative A. Because a larger area in the northeastern portion of the NPR-A would be closed to new infrastructure, any road development connecting Utqiagvik to Nuiqsut would likely be rerouted farther south and would therefore increase potential impacts and benefits to harvester access for the community of Atqasuk.

Table E-6
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative B

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X[1]	X[1]	X	X	X	X
Small Land Mammals	X[1]	X[1]	X	X	X	X
Salmon	ND	See “Non-Salmon Fish”	N	N	X	See “Non-Salmon Fish”
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X	N	X[1]	X	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for “Fish,” which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative B is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, and none would reduce the use of lands needed for subsistence purposes more than Alternative B. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative B

1. **Reductions in the availability of subsistence resources described above for Alternative B may significantly restrict subsistence uses for the community of Nuiqsut.**
2. **Limitations on subsistence user access described above for Alternative B may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative B

The rationale for the finding under Alternative B is the same as under Alternative A. Alternative B does provide more protection than Alternative A in Nuiqsut's caribou subsistence use areas, particularly near Fish Creek and along the Colville River's west bank; however, it is unlikely that these protections will have a substantial material effect on impacts because a majority of the land in these areas has already been leased (see Appendix B). The impacts on the availability of subsistence resources under Alternative B are likely to be the same for the community of Nuiqsut as under Alternative A.

Rationale for the finding of limitations on subsistence user access to resources under Alternative B

Under all action alternatives, ROP E-1 would require permittees to allow subsistence users to access permanent gravel and ice roads and to build subsistence pullouts and tundra access ramps along all gravel roads to facilitate access to subsistence use areas. ROP E-1 would also require permittees to construct boat ramps at all crossings of heavily used subsistence rivers to facilitate access by boat. This would substantially reduce the impacts of a road posing a physical barrier to overland travel and may increase access by boat to major subsistence rivers. This requirement would mitigate impacts on subsistence user access during the drilling and routine operations phases of an oil and gas development.

Nevertheless, there would remain both physical and legal barriers to user access that may significantly restrict subsistence user access to resources. ROP E-1 does not preclude the prohibition or limitation of harvester access of gravel or ice roads during construction phases for safety reasons (e.g., high traffic volumes). In instances of extended construction, such restrictions could create both physical and regulatory barriers to subsistence user access because subsistence users would need to route travel around them, requiring both more time and fuel. Even after construction, industrial road use is often subject to standard safety rules, some of which would restrict use for some residents (e.g., no unaccompanied minors). In addition, throughout the life of any oil and gas or other infrastructure project, the discharge of firearms likely would be prohibited within a certain radius or in the direction of infrastructure and residents may avoid hunting in certain areas due to concerns about human safety and damage to property. Although Alternative B makes unavailable for leasing some core subsistence use areas for Nuiqsut and would defer leasing in key Nuiqsut subsistence use areas to the west of the Colville River, the reasonably foreseeable development scenario nonetheless anticipates an increase in development around Nuiqsut. Under the medium development scenario, 90 miles of gravel road, 6 satellite pads, and 1 central processing facility could be built in Nuiqsut's subsistence use areas. Under the high development scenario, construction could increase to 140 miles of gravel road, 11 satellite pads, and 2 central processing facilities. This may lead to a situation in which there is continuously a development under construction, and gravel road construction and the ice roads used to support that construction present a physical and legal barrier to access because they cannot be used by hunters to travel to subsistence harvest areas. The footprint of these developments and their safety radius would also be effectively unavailable to subsistence hunters for the life of the project.

As such, the restrictions levied on gravel and ice road use during construction and the limitations to firearm use around infrastructure throughout the life of any oil and gas project may cause extensive interference with access for residents of Nuiqsut.

E.2.3 Evaluation and Finding for Alternative C

Alternative C would be similar to Alternative A but would increase the area available for oil and gas leasing and open to new infrastructure development. Alternative C would open a greater portion of the Teshekpuk Lake and Utukok River Uplands Special Areas to oil and gas leasing and infrastructure development, although core areas would remain closed to leasing and infrastructure. Alternative C would allow for one north-south pipeline to the east of Teshekpuk Lake. While 5,269,000 acres of land are subject to NSO under Alternative C, 866,000 acres of this land have existing leases, which may be subject only to standard terms and conditions while the terms of the leases are in effect. Thus, if the existing leases are developed, the percentage of use areas potentially affected by oil and gas infrastructure under Alternative C would increase for some study communities (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

According to the reasonably foreseeable development scenario for Alternative C, development could occur at Umiat and around Smith Bay. Development in Smith Bay would increase the potential for direct impacts on Utqiagvik harvesters who conduct marine mammal hunting offshore from Smith Bay and travel through Smith Bay to subsistence camps and cabins along the Miguakiak River (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*). The area open to infrastructure development under Alternative C would be similar to Alternative A but with a larger area open to infrastructure along the upper Colville River. Under Alternative C, 30 miles of gravel road and 2 satellite pad would be built under the low development scenario, 120 miles of gravel road, 8 satellite pads, and 1 central processing facility would be built under the medium development scenario, and 188 miles of gravel road, 15 satellite pads, and 2 central processing facilities would be built under the high development scenario.

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative C on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative C would make available a larger portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a higher potential for direct impacts on subsistence uses.

2. Alternative C would allow oil and gas leasing and development in key subsistence drainages in the northern NPR-A, including the Ikpikpuk, Chipp, Topaguruk, and lower Meade and Inaru rivers, thus increasing the likelihood of impacts on Utqiagvik and Atqasuk subsistence uses.
3. Alternative C would make available a greater portion of the area to the south, east, and southeast of Teshekpuk Lake, including the Atigaru Point area, for oil and gas leasing, thus increasing the potential for direct impacts on Nuiqsut subsistence uses and impacts on caribou calving habitat.
4. Alternative C would make available the southwestern portion of the NPR-A (in the Utukok River Uplands Special Area) for oil and gas leasing and infrastructure development, thus increasing potential impacts on WAH caribou and on resource availability for peripheral study communities.

Overall, Alternative C would increase the potential for direct impacts on the primary study communities, particularly Nuiqsut, Atqasuk, and Utqiagvik, because a larger percentage of the subsistence use areas would be made available for oil and gas leasing and new infrastructure (**Tables E-1** and **E-3**) and more subsistence use areas would be open to leasing in areas of medium to high development potential for certain communities (Utqiagvik and Atqasuk; **Table E-7**). The percentage of subsistence use areas open to oil and gas leasing under Alternative C would be higher than Alternative A for Atqasuk (92 percent of subsistence use areas), Utqiagvik (45 percent), Wainwright (41 percent), and Nuiqsut (35 percent; **Table E-1**). Subsistence use areas open to infrastructure development under Alternative C would be similar to Alternative A, except for Wainwright, whose potentially affected use areas would increase from 23 percent to 32 percent, increasing the likelihood of direct impacts for that community. Areas open to new infrastructure would overlap similar resource uses as Alternative A (**Table E-8**).

Table E-7
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative C

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	M	See "Non-Salmon Fish"
Non-Salmon Fish	N	H[2]	H	L	H	M[2]
Marine Mammals	ND	H[1]	H	L[1]	H[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	N
Vegetation	N	M	H	N	H	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Table E-8
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative C

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X[1]	N	X	X[1]	X
Migratory Birds	N	X	X	X	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Under Alternative C, oil and gas leasing would be allowed near a number of key subsistence drainages in the northern portion of the NPR-A and in core subsistence harvesting areas for the communities of Atqasuk and Utqiagvik (see **Maps E-3** and **E-6**). A greater acreage of fish, waterfowl, and land mammal habitat would be open to oil and gas leasing (see **Table E-7**) and infrastructure (see **Table E-8**) under Alternative C, thus increasing the potential for impacts on resource abundance and availability for the study communities. Alternative C would open additional WAH and TCH habitats to oil and gas leasing and infrastructure development. The southern portion of the Utukok River Uplands Special Area and areas along the upper Colville River would be opened to oil and gas leasing and infrastructure. These areas are consistently used by the WAH during their summer migrations; while oil and gas development is not expected to occur in these areas because of their low to medium development potential, such development could affect large groups of caribou. Under Alternative C, some areas near high-density TCH calving areas could be developed, thus causing displacement of calving caribou (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative C is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, although Alternatives A and B would make available fewer subsistence use areas to oil and gas leasing and infrastructure development than Alternative C. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered by Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative C

1. **Reductions in the availability of subsistence resources described above for Alternative C may significantly restrict subsistence uses for the community of Nuiqsut.**
2. **Limitations on subsistence user access described above for Alternative C may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative C

The rationale for the finding under Alternative C is the same as under Alternative A.

Rationale for the finding of limitations on subsistence user access to resources under Alternative C

The rationale for the finding under Alternative C is the same as under Alternative B.

E.2.4 Evaluation and Finding for Alternative D

Under Alternative D, the number of acres available for oil and gas leasing would be higher than under Alternatives A, B, and C. Alternative D would likely see a higher number of satellite pads (between 2 and 20) compared with Alternatives A, B, and C (NPR-A IAP/EIS, Appendix B, *Reasonably Foreseeable Development Scenario*). The entire Teshekpuk Lake Special Area would be available for oil and gas leasing subject to NSO stipulations and timing limitations in certain areas. Under Alternative D, the only areas entirely closed to oil and gas leasing are in the western portion of the NPR-A surrounding the Utukok River Uplands Special Area, Kasegaluk Lagoon, Peard Bay, and Kuk River. Under Alternative D, 767,000 acres of land subject to NSO have existing leases that may be subject only to standard terms and conditions while the terms of the leases are in effect. Thus, if the existing leases are developed, the percentage of use areas affected by oil and gas infrastructure under Alternative D would likely increase for some of the study communities (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

The remainder of the NPR-A would be open to oil and gas leasing subject to NSOs, controlled surface use, timing limitations, or standard terms and conditions. Areas closed to new infrastructure development under Alternative D are similar to Alternative A, with the exception of the southwestern portion of the NPR-A (including the upper Colville River and portions of the Utukok River Uplands Special Area) and a larger portion of lands surrounding Teshekpuk Lake being open to infrastructure development. Estimated miles of gravel roads under Alternative D (between 40 and 250 miles) are higher than under Alternative A.

Under the reasonably foreseeable development scenario for Alternative D, development around Smith Bay, Umiat, and Teshekpuk Lake could occur. Teshekpuk Lake is a key calving and insect relief area for the TCH and a traditional and contemporary subsistence harvesting area for Nuiqsut and Utqiagvik residents. A number of families from Utqiagvik have camps and cabins on Miguakiak River, an outlet of Teshekpuk Lake, from which they fish and hunt for caribou, waterfowl, and furbearers. Under Alternative D, 40 miles of gravel road and 2 satellite pad would be built under the low development scenario, 160 miles of gravel road, 10 satellite pads, and 1 central processing facility would be built under the medium development scenario, and 250 miles of gravel road, 20 satellite pads, and 3 central processing facilities would be built under the high development scenario. Alternative D would also open the southern portion of the Utukok River Uplands Special Area to oil and gas leasing. While in an area of low development potential, infrastructure and activity in this area could affect WAH caribou that regularly use the area during their spring migrations and summer movements (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*).

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative D on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative D would make available a larger portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a higher potential for direct impacts on subsistence.
2. Alternative D would allow oil and gas leasing throughout the northeastern portion of the NPR-A, including in all areas of high development potential and in key subsistence use areas for the communities of Utqiagvik, Atqasuk, and Nuiqsut.
3. Alternative D would make the entire Teshekpuk Lake Special Area available for oil and gas leasing and allow infrastructure development in 88 percent of the Teshekpuk Lake Special Area, thus increasing potential for impacts on caribou calving and insect relief habitat and migratory bird habitat.
4. Alternative D would make available the southwestern portion of the NPR-A (in the Utukok River Uplands Special Area) for oil and gas leasing and infrastructure development, thus increasing potential impacts on WAH caribou and on resource availability for peripheral study communities.

Overall, as compared with Alternative A, Alternative D would increase the potential for direct impacts on the primary study communities, particularly Nuiqsut, Atqasuk, and Utqiagvik, because a larger percentage of subsistence use areas would be open to oil and gas development and new infrastructure (**Tables E-1** and **E-3**), and more subsistence use areas would be in areas of medium to high development potential for certain communities (Utqiagvik and Atqasuk; **Table E-9**). The percentage of subsistence use areas open to oil and gas leasing under Alternative D would be substantially higher than Alternative A for Atqasuk (94 percent of subsistence use areas), Utqiagvik (49 percent), Nuiqsut (40 percent), and Wainwright (41 percent; **Table E-1**). Subsistence use areas open to infrastructure development under Alternative D would be similar to Alternative A (within a few percentage points), except for Wainwright, whose potentially affected use areas would increase from 23 percent to 32 percent, and Utqiagvik, whose potentially affected use areas would increase from 30 percent to 37 percent. These changes would increase the likelihood of direct impacts for those communities (**Table E-3**). The number of resource activities open to infrastructure development would be similar to Alternative A (**Table E-10**). Although exploration is likely and development is possible in areas of medium development potential, only high development potential areas are considered likely for development at this time (Appendix B). Within the NPR-A, most of Utqiagvik's core subsistence use area (**Map E-6**; SRB&A 2010a), and the majority of all Atqasuk subsistence use areas (**Map E-3**) occur in the medium development potential area (see Appendix B).

Under Alternative D, oil and gas leasing would be allowed near a number of key subsistence drainages in the northern portion of the NPR-A, including around Teshekpuk Lake, and in core subsistence harvesting areas for the communities of Nuiqsut, Atqasuk, and Utqiagvik (see **Maps E-2** through **E-7**). A number of families from Utqiagvik have camps and cabins on Miguakiak River, an outlet of Teshekpuk Lake, from which they fish and hunt for caribou, waterfowl, and furbearers. A greater acreage of fish, waterfowl, and land mammal

Table E-9
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative D

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	H	See "Non-Salmon Fish"
Non-Salmon Fish	N	H[2]	H	L	H	M[2]
Marine Mammals	ND	H[1]	H	L[1]	H[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	N
Vegetation	N	M	H	N	H	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Table E-10
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative D

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X[1]	N	X	X[1]	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

habitat would be open to oil and gas leasing and infrastructure under Alternative D, thus increasing the potential for impacts on resource abundance and availability for the study communities. Compared with Alternative A, the amount (in miles) of anadromous waterbodies closed to oil and gas leasing would decrease by 82 percent under Alternative D, increasing the potential for more widespread impacts on fish habitat (NPR-

A IAP/EIS, Section 3.3.3, *Fish*). In addition, three times as many white-fronted geese (17 percent of the birds in the NPR-A) would occur in areas open to infrastructure under Alternative D than Alternative A (NPR-A IAP/EIS, Section 3.3.4, *Birds*). Alternative D would open additional WAH and TCH habitats to oil and gas leasing and infrastructure development. The southern portion of the Utukok River Uplands Special Area and areas along the upper Colville River would be opened to oil and gas leasing and infrastructure. These areas are consistently used by the WAH during their summer migrations; while oil and gas development is not expected to occur in these areas because of their low to medium development potential, such development could affect large groups of caribou. Under Alternative D, much of the TCH calving area and other key migratory areas surrounding Teshekpuk Lake would be open to infrastructure development and oil and gas leasing, resulting in the potential for substantial displacement and impacts on migratory movements, thus reducing resource abundance and availability for users of this herd (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*).

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative D is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, although Alternatives A, B, and C would open fewer subsistence lands to oil and gas leasing and infrastructure development than Alternative D. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative D

1. **Reductions in abundance of subsistence resources described above for Alternative D may significantly restrict subsistence uses for the communities of Nuiqsut, Atqasuk, Utqiagvik, Wainwright, and Anaktuvuk Pass.**
2. **Reductions in the availability of subsistence resources described above for Alternative D may significantly restrict subsistence uses for the community of Nuiqsut.**
3. **Limitations on subsistence user access described above for Alternative D may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in abundance of subsistence resources under Alternative D

Under Alternative D, 75 percent of the calving range of the TCH would be available for leasing and infrastructure development (Appendix A, Map 2-7). Depending on the location of development, this alternative could result in substantial displacement from current calving areas, with potential impacts on caribou survival, body condition, and productivity. Limiting major construction activities could potentially lower the amount of displacement, but caribou are displaced from roads even with low traffic rates (Lawhead et al. 2004). The authorized officer can stop traffic for up to 4 weeks. Displacement from inactive infrastructure appears to be limited (Lawhead et al. 2004), so this stipulation could lower calving displacement if implemented; however, implementation is not required. The scale of the impacts would depend on the availability and quality of alternative calving areas as well as predator levels in alternative areas. If alternative calving areas have higher predator densities or lower habitat quality, as suggested by Wilson et al. (2012), there could be negative impacts on calf survival and negative effects on body condition and future productivity of maternal females. Substantial displacement could also result in longer movements between calving areas and mosquito-relief habitat, which could also lower caribou body condition. Because a substantial portion of calving TCH females could be displaced from preferred calving areas, the impacts on herd demographics are difficult to predict but could potentially be large. Increased use of late summer and winter range during calving could also decrease forage quality during those seasons.

The ability of caribou to access mosquito-relief habitat near the coast is also a concern for development on the TCH range. Because TCH caribou move fastest during mid-summer (Person et al. 2007, Prichard et al. 2014) a large proportion of the TCH could be exposed to infrastructure constructed in high-use areas of the mosquito season range. Alternative D has limited protections in place for the areas north of Teshekpuk Lake and the narrow corridors on either side of the lake used extensively during the mosquito season (Appendix A, Map 2-7). This could result in substantial delays or deflections in movements to mosquito-relief areas, with the potential for impacts on body condition and productivity.

No quantitative analysis of the proportion of community harvests by herd exists; however, general characterizations of use of the TCH indicate that because they occur primarily within the NPR-A, particularly the northern and eastern portions, the primary communities that rely on the herd are Nuiqsut, Atqasuk, and Utqiagvik (Braem 2017). Residents of two other North Slope villages, Wainwright and Anaktuvuk Pass, also harvest from the TCH; their caribou harvests are a variable mixture of WAH and TCH caribou. Impacts resulting from a large decrease in abundance of the TCH would be most severe for Anaktuvuk Pass, which obtains 86 percent of its total subsistence harvest by weight from caribou (see Appendix T, Table T-3). It is impossible to determine what proportion of the Anaktuvuk Pass annual harvest comes from TCH caribou; however, given the material importance of caribou for Anaktuvuk Pass, a large decrease in abundance of the TCH may significantly restrict subsistence uses for that community. In Wainwright, caribou is a resource of high material importance and accounts for 28 percent of its total subsistence harvest (see Appendix T, Table T-8). Wainwright also harvests caribou from the WAH; however, they are at the periphery of the WAH distribution, and it is unclear if a decrease in harvest of TCH caribou could be made up through more harvesting of WAH caribou (see Appendix A, Maps 3-21 and 3-22). A large decline in the abundance of the TCH may result in a significant restriction of subsistence use of the TCH for the communities of Anaktuvuk Pass, Utqiagvik, Nuiqsut, Wainwright, and Atqasuk.

Rationale for the finding of reductions in the availability of subsistence resources under Alternative D

The rationale for the finding under Alternative D is the same as under Alternative A for the community of Nuiqsut.

Rationale for the finding of limitations on subsistence user access to resources under Alternative D

The rationale for the finding under Alternative D is the same as under Alternative B.

E.2.5 Evaluation and Finding for Alternative E

Under Alternative E, the number of acres available for oil and gas leasing would be the highest of any alternative. The entire Teshekpuk Lake Special Area would be available for oil and gas leasing subject to NSO stipulations and timing limitations in certain areas. Under Alternative E, the only areas entirely closed to oil and gas leasing are in the western portion of the NPR-A, including Kasegaluk Lagoon, Peard Bay, and a large portion of the Utukok River Uplands Special Area. Under Alternative E, two WAH movement corridors in the southernmost portion of the Utukok River Uplands Special Area would be subject to NSO; under Alternatives C and D, these areas are only subject to timing limitations. Alternative E would also defer leases for at least 10 years in two areas near Teshekpuk Lake, including one area along the Miguakiak River to its confluence with the lake, and another area to the east of Teshekpuk Lake along Kogru River to Atigaru Point. The area along Miguakiak River is a key subsistence area for certain families from Utqiagvik; thus, these deferrals would delay potential impacts on these subsistence uses.

The remainder of the NPR-A would be open to mineral leasing subject to NSOs, controlled surface use, timing limitations, or standard terms and conditions. While 5,939,000 acres of land are subject to NSO under Alternative E, 893,000 acres of this land have existing leases. Thus, if the existing leases are developed, the percentage of use areas affected by oil and gas infrastructure under Alternative E would likely increase for some of the study communities (NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts*). The reasonably foreseeable development scenario for Alternative E is the same as that described under Alternative D, with development expected to occur around Teshekpuk Lake.

Areas closed to new infrastructure development under Alternative E would be lower than any alternative. A smaller portion of the Utukok River Uplands Special Area would be unavailable for new infrastructure, and the area north of Teshekpuk Lake would be available for a mixture of infrastructure, essential pipeline crossings, and essential coastal infrastructure. Areas closed to new infrastructure development under Alternative E are similar to those under Alternative D, except for the two WAH movement corridors in the southern portion of the Utukok River Uplands Special Area, which would be unavailable for new infrastructure except for essential roads and pipeline crossings.

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The effects of Alternative E on subsistence would be similar to those described for Alternative A with the following differences:

1. Alternative E would make available a larger portion of subsistence use areas for the primary study communities for oil and gas leasing and new infrastructure, thus resulting in a higher potential for direct impacts on subsistence.
2. Alternative E would allow oil and gas leasing throughout the northeastern portion of the NPR-A, including in all areas of high development potential and in key subsistence use areas for the communities of Utqiagvik, Atqasuk, and Nuiqsut.
3. Alternative E would make the entire Teshekpuk Lake Special Area available for oil and gas leasing and allow infrastructure development in 90 percent of the Teshekpuk Lake Special Area, thus increasing potential for impacts on caribou calving and insect relief habitat and migratory bird habitat.
4. Alternative E would make available the southwestern portion of the NPR-A (in the Utukok River Uplands Special Area) for oil and gas leasing subject to NSOs and essential pipeline crossings

associated with infrastructure development, thus increasing potential impacts on WAH caribou and on resource availability for peripheral study communities.

Overall, as compared with Alternative A, Alternative E would substantially increase the potential for direct impacts on the primary study communities, particularly for Nuiqsut, Atqasuk, and Utqiagvik because a larger percentage of subsistence use areas would be open to oil and gas development and new infrastructure (**Tables E-1** and **E-3**) and more subsistence use areas would be in areas of medium to high development potential for certain communities (Utqiagvik, Nuiqsut, and Atqasuk; **Table E-11**). The percentage of subsistence use areas open to oil and gas leasing under Alternative E would be substantially higher than Alternative A for Atqasuk (95 percent of subsistence use areas), Utqiagvik (49 percent), Nuiqsut (40 percent), and Wainwright (41 percent; **Table E-1**). Subsistence use areas open to infrastructure development under Alternative E would be similar to Alternative A (within a few percentage points), except for Wainwright, whose potentially affected use areas would increase from 23 percent to 32 percent, and Utqiagvik, whose potentially affected use areas would increase from 30 percent to 36 percent. These changes would increase the likelihood of direct impacts for those communities (**Table E-3**). The number of resource activities open to infrastructure development would be similar to Alternative A (**Table E-12**).

Under Alternative E, oil and gas leasing would be allowed near a number of key subsistence drainages in the northern portion of the NPR-A, including around Teshekpuk Lake, and in core subsistence harvesting areas for the communities of Nuiqsut, Atqasuk, and Utqiagvik (see **Maps E-2** through **E-7**). A greater acreage of fish, waterfowl, and land mammal habitat would be open to oil and gas leasing and infrastructure under Alternative E, thus increasing the potential for impacts on resource abundance and availability for the study communities. Compared with Alternative A, under Alternative E there is a 62 percent decrease in fish habitat units that are closed to fluid mineral leasing, and a 78 percent decrease in Anadramous Water Catalog stream habitat protections. Additionally, no Coastal Plain or Lower Colville habitat unit lands are fully closed to fluid mineral leasing under Alternative E, resulting in a significant decrease in potential aquatic habitat protections (NPR-A IAP/EIS, Section 3.3.3, *Fish*). In addition, the number of birds in areas open to oil and gas leasing in all three development potential areas under Alternative E would be the second highest among all alternatives. An estimated 66,732 birds, or 63 percent of the total birds, in the NPR-A occur in areas open to oil and gas leasing under Alternative E, similar to but slightly less than under Alternative D (NPR-A IAP/EIS, Section 3.3.4, *Birds*).

Compared with Alternative A, Alternative E would open additional WAH and TCH habitats to oil and gas leasing and infrastructure development. The area between Teshekpuk Lake and the coast is a critical habitat and calving area that, under Alternative E, would largely be available for new infrastructure and open to fluid mineral leasing, subject to NSOs and controlled surface use (NPR-A IAP/EIS, Section 3.3.5, *Terrestrial Mammals*). Compared with Alternative D, Alternative E would allow for infrastructure in closer proximity to Teshekpuk Lake on the south side. While Alternatives C and D open the southern portion of the Utukok River Uplands Special Area to infrastructure development, under Alternative E, two WAH migratory corridors in the Utukok River Uplands Special Area would be unavailable for new infrastructure except for essential roads and pipeline crossings. The lack of infrastructure in these key movement corridors would help to reduce impacts on WAH caribou movement and subsistence resource availability.

Table E-11
Subsistence Use Areas Overlapping Areas Open to Fluid Mineral Leasing, Alternative E

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	H[1]	H[1]	H	L	H	M
Small Land Mammals	H[1]	H[1]	H	L	H	M
Salmon	ND	See "Non-Salmon Fish"	N	N	H	See "Non-Salmon Fish"
Non-Salmon Fish	N	H[2]	H	L	H	M[2]
Marine Mammals	ND	H[1]	H	L[1]	H[1]	L
Migratory Birds	N	M	H	L	H	L
Upland Birds	N	M	H	L	H	M
Bird Eggs	ND	ND	H[1]	N	M	ND
Marine Invertebrates	ND	ND	ND	ND	M	L[1]
Vegetation	N	M	H	N	H	ND

H = Use Areas Overlapping Areas of High Development Potential Open to Fluid Mineral Leasing
M = Use Areas Overlapping Areas of Medium Development Potential Open to Fluid Mineral Leasing
L = Use Areas Overlapping Areas of Low Development Potential Open to Fluid Mineral Leasing
N = No Use Areas Overlapping Areas Open to Fluid Mineral Leasing
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Table E-12
Subsistence Use Areas Overlapping Areas Open to New Infrastructure, Alternative E

Resource	Anaktuvuk Pass	Atqasuk	Nuiqsut	Point Lay	Utqiagvik	Wainwright
Large Land Mammals	X	X	X	X	X	X
Small Land Mammals	X	X	X	X	X	X
Salmon	ND	See "Non-Salmon Fish"	N	N	X	See "Non-Salmon Fish"
Non-Salmon Fish	N	X[2]	X	X[1]	X	X[2]
Marine Mammals	ND	X[1]	N	X	X[1]	X
Migratory Birds	N	X	X	X[1]	X	X
Upland Birds	N	X	X	X	X	X
Bird Eggs	ND	ND	N	N	X	ND
Marine Invertebrates	ND	ND	ND	ND	X	X[1]
Vegetation	N	X	X	N	X	ND

X = Use Areas Overlapping Areas Open to New Infrastructure
N = No Use Areas Overlapping Areas Open to New Infrastructure
ND = No data
[1] Minimal/Slight Overlap of Use Areas
[2] Original sources list data for "Fish," which in some cases includes salmon; data specific to salmon or non-salmon fish are not available.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the NPR-A IAP/EIS Alternative E is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

No alternatives would eliminate the use of public lands needed for subsistence purposes, although Alternatives A, B, and C would open fewer subsistence lands to oil and gas leasing and infrastructure development than Alternatives D and E. The NPR-A IAP/EIS, Section 2.3, *Alternatives Considered but Eliminated from Detailed Analysis,* discusses other alternatives that were considered but eliminated from detailed analysis because they addressed issues that were adequately addressed under the other alternatives, or because they did not meet the purpose of the proposed action to conduct oil and gas leasing in the NPR-A.

Findings for Alternative E

1. **Reductions in abundance of subsistence resources described above for Alternative E may significantly restrict subsistence uses for the communities of Nuiqsut, Atqasuk, Utqiagvik, Wainwright, and Anaktuvuk Pass.**
2. **Reductions in the availability of subsistence resources described above for Alternative E may significantly restrict subsistence uses for the community of Nuiqsut.**
3. **Limitations on subsistence user access described above for Alternative E may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from the affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in abundance of subsistence resources under Alternative E

The rationale for the finding under Alternative E is the same as under Alternative D.

Rationale for the finding of reductions of availability of subsistence resources under Alternative E

The rationale for the finding under Alternative E is the same as under Alternative A.

Rationale for the finding of limitations on subsistence user access to resources under Alternative E

The rationale for the finding under Alternative E is the same as under Alternative B.

E.2.6 Evaluation and Finding for the Cumulative Case

The NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources* contains a description of the cumulative case, which evaluates the impacts of the proposed action in conjunction with past, present, and reasonably foreseeable future actions on subsistence. Impacts from past and present actions on subsistence are discussed in NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Current Impacts on Subsistence,* while impacts of climate change on subsistence are discussed in Section 3.4.3, *Subsistence Uses and Resources, Climate Change*. Reasonably foreseeable future projects in the NPR-A (as projected in the reasonably foreseeable development; NPR-A IAP/EIS, Appendix B) that are reasonably anticipated to occur as a result of a particular leasing alternative in the next 20 years are described in NPR-A IAP/EIS, Section 3.4.3, *Subsistence Uses and Resources, Direct and Indirect Impacts.* These impacts are summarized above in Sections E.2.1, E.2.2, E.2.3, E.2.4, and E.2.5.

In addition to actions directly resulting from oil and gas leasing within the NPR-A that are discussed under the individual alternatives discussions, other reasonably foreseeable activities include additional oil and gas development outside the NPR-A, such as the Nanushuk development in the Colville River region, continued development of Kuparuk and Prudhoe Bay, the Liberty Development in the Beaufort Sea, both federal and state offshore lease sales and development, and development of a natural gas pipeline from the North Slope to Canada, Valdez, or Cook Inlet. Other reasonably foreseeable infrastructure projects are new permanent and seasonal roads, airport and community infrastructure improvements, and continued and increased marine vessel traffic and air traffic associated with shipping, scientific research, and recreation and tourism activities and business in the region.

Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Cumulative effects on subsistence would vary in magnitude depending on the alternative selected. Cumulative impacts on subsistence would likely be highest under Alternatives D and E, which would make available the greatest amount of NPR-A lands for oil and gas leasing and infrastructure development and offer the least protections to subsistence resources such as caribou, moose, fish, and waterfowl. Cumulative impacts would be lowest under Alternative B, which would make large portions of the NPR-A unavailable for oil and gas leasing and infrastructure development and offers additional protections to key subsistence resources and lands. Regardless of the alternative selected, the types of impacts that would occur in the cumulative case would be similar. Cumulative oil and gas activity, transportation projects, and climate change will increasingly restrict subsistence uses and affect the availability of subsistence resources such as caribou.

Oil and gas development within the NPR-A is relatively new and confined to the northeastern portion of the NPR-A. The no action and action alternatives would allow for continuing expansion of oil and gas leasing and development into a large area, most of which is relatively undeveloped and has been used primarily for subsistence and recreation purposes. Six communities have direct uses of the NPR-A and an additional seven communities have documented historic (although not current) peripheral uses of the planning area. These and the 42 caribou study communities rely heavily on the WAH and TCH, both of which calve in and migrate through the NPR-A.

Reasonably foreseeable future activities in the region include continued oil and gas development outside of and offshore from the NPR-A (e.g., the Nanushuk development, Liberty Development in the Beaufort Sea, and Beaufort Sea OCS lease sales); development of a natural gas pipeline; infrastructure projects, including new permanent and seasonal roads; and continued and increased marine vessel traffic and air traffic associated with shipping, scientific research, and recreation and tourism activities and business in the region. These activities, in combination with the no action or action alternatives, would contribute to the cumulative effects of development on subsistence resources and activities, because it would represent a net increase in the amount of land used for oil and gas and other development, in addition to a related increase in industrial activity, including air and ground traffic. Development of the NPR-A in combination with reasonably foreseeable future actions would likely result in impacts on resource abundance, resource availability, and harvester access for the six primary study communities. In the event of large-scale changes in resource migration, distribution, or abundance resulting from infrastructure development or a large-scale contamination event, impacts on resource abundance and availability could extend outside the NPR-A to the 7 peripheral and 42 caribou study communities.

The community of Nuiqsut would likely feel the greatest cumulative impacts from development within the NPR-A, as they are currently impacted by oil and gas development in and around the Colville River Delta, and any future development to the west, south, or north of the community would further contribute to those impacts. Since 2000, oil and gas exploration and development has expanded into Nuiqsut's core subsistence use areas, including the Colville River Delta (Alpine drill sites CD1 through CD4) and to the north and west of the community toward Fish (Uvlutuuq) Creek (Alpine drill site CD5, GMT1, and GMT2). As a result, the frequency of conflicts between subsistence and development activities have increased (SRB&A 2019a). Further development of the NPR-A, in combination with existing and future developments, would continue a pattern of development infrastructure surrounding the Nuiqsut to the north, west, and southwest of the community and the perception by many in the community that they are being boxed in by development. Many in Nuiqsut perceive that they are also surrounded to the east by infrastructure associated with the Prudhoe Bay and Kuparuk developments, areas which are now considered off-limits to subsistence uses despite being considered part of the community's traditional use area (SRB&A 2018b). Development of the Nanushuk project would introduce infrastructure directly to the east of the Colville River Delta and leave only the southerly direction untouched by oil and gas infrastructure. Despite the lack of infrastructure to the south, oil and gas leasing and exploration has occurred to the south of the community and may result in oil and gas development in the future.

To date, major oil and gas development has not occurred within the core hunting areas for the other five primary study communities of Anaktuvuk Pass, Atqasuk, Point Lay, Utqiagvik, or Wainwright. However, these communities have experienced impacts from oil and gas exploration and other research and recreation-related activities in the NPR-A. Development of the currently proposed Willow Project within the Bear Tooth Unit would introduce a major oil and gas development in the eastern edge of Utqiagvik's hunting area and would facilitate additional oil and gas development farther west. The development would include up to five drill sites, a central processing facility, and some combination of gravel and ice roads that would connect Willow to the Alpine Development, thus resulting in impacts on subsistence related to development infrastructure and activity, particularly for the community of Nuiqsut. The development would also contribute to offshore impacts through the delivery of sealift modules via barges to Oliktok Dock. Further development of the NPR-A, particularly under Alternatives D and E, would likely result in the introduction of major oil and gas infrastructure and activity into core hunting areas for Utqiagvik and Atqasuk, and potentially for other communities as well. As development infrastructure expands into previously undeveloped areas, additional communities may experience impacts similar to those felt by the community of Nuiqsut and, eventually, the perception that they are surrounded by development.

Development activities and infrastructure can change hunting patterns and use areas over time by introducing barriers, impediments, or restrictions to access; by facilitating access to lesser-used hunting areas via roads; or by causing changes to the availability of subsistence resources in the vicinity of development. Nuiqsut's core subsistence use area has shifted west over time due to Prudhoe Bay development, and recent research has documented decreased use of traditional use areas, including the Nigliq Channel, in part due to development activities and infrastructure (SRB&A 2019a). Similar impacts could occur as development encroaches into the eastern portion of subsistence use areas for Utqiagvik and Atqasuk. While NPR-A subsistence users would adapt, to varying extents, to the changes occurring around them and may even continue to harvest resources at adequate levels, their connection to certain traditional areas may decrease over time.

Decreased use in some development areas may occur in conjunction with increased use of road-accessible areas. The Kuukpik Spur Road was constructed in 2014 and 2015 to facilitate access for Nuiqsut hunters to the Alpine development's roads. The road has provided access to residents, and the road system has seen increased use in every year since its construction. Despite the increased use, caribou harvests within the road-connected area, as a percentage of the total reported harvest, have not seen a corresponding increase, indicating that the roads provide a countervailing effect that partially mitigates the impacts of roads and associated development on subsistence resource availability (SRB&A 2019a). Road development within the NPR-A, particularly if roads are connected to NPR-A communities, would likely provide benefits to access while also contributing to habitat fragmentation and changes in resource availability. Communities not connected to future roads may experience greater impacts on resource availability, as they would not experience the countervailing benefits to harvester access.

Increased development of infrastructure and development activity (e.g., traffic and human presence) on the North Slope would continue to cause displacement and habitat alteration/degradation for key subsistence resources, including caribou, furbearers, fish, and geese. Offshore activity associated with NPR-A development could also displace key marine resources such as fish, eiders, seals, and bowhead whales. Over time, these changes could affect the health and abundance of different subsistence resources on the North Slope. Under Alternatives C, D, and E, if development occurs in the core calving areas for the TCH or WAH, or if development reduces access to key insect relief habitats, the herds could experience an overall decline in productivity and abundance, thus affecting any of the 42 communities who use this herd. Because they open more lands to development in the vicinity of Teshekpuk Lake, Alternatives D and E would have the greatest potential to contribute to impacts on TCH habitat. In addition to the additive effects of increasing oil and gas infrastructure in the region, increased activity, including oil and gas exploration and seismic activity, air traffic, vessel traffic, scientific research, recreation, and sport hunting and fishing activities, would also contribute to subsistence impacts on Nuiqsut, Utqiagvik, Atqasuk, Point Lay, Wainwright, and Anaktuvuk Pass by increasing the frequency of noise and air traffic disturbances, vessel disturbances, and interactions with non-local researchers, workers, and recreationists. Increased noise disturbances would contribute to existing impacts on subsistence resource availability.

The cumulative effects of current and future activities related to restrictions on access to traditional areas, changes in hunting patterns, and reduced resource abundance and availability are likely to continue as long as oil and gas exploration and development continues on the North Slope.

Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

The evaluation of the cumulative case is identical to that provided in Section E.2.1 for Alternative A.

Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence Purposes

The evaluation of the cumulative case is identical to that provided above in Section E.2.5.

Findings for Alternatives A, B, C and the Cumulative Case

1. **Reductions in the availability of subsistence resources described above for Alternatives A, B, and C and the cumulative case may significantly restrict subsistence uses for the communities of Nuiqsut, Utqiagvik, Wainwright, and Point Lay.**
2. **Limitations on subsistence user access described above for Alternatives A, B, and C and the cumulative case may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the availability of subsistence resources in the cumulative case

In the cumulative case, the availability of marine mammals, particularly whales, for subsistence harvest may decrease as a result of the development and activity on State and federal offshore leases in the Beaufort and Chukchi Seas. Development of offshore leases in both State and federal waters would overlap in time and space with barge traffic associated with onshore development in the NPR-A. Bowhead whales are one of the most important species for subsistence and cultural practices for Arctic communities, and whale harvest often provides the largest portion of a community's yearly protein. Although development of offshore leases in conjunction with barge traffic traveling to the NPR-A is unlikely to have significant biologic effects on whales, the noise and activity associated with development and operation on offshore leases could deflect whales further from shore as they migrate and cause a major redistribution of that resource from a subsistence perspective, leading to increased expense and risk in order to harvest whales in adequate amounts.

For the community of Nuiqsut, terrestrial development on State lands in conjunction with development in the NPR-A is also expected to produce a major redistribution of caribou in Nuiqsut's traditional subsistence use areas. The rationale for this finding is the same as under Alternative A.

Rationale for the finding of limitations on subsistence user access in the cumulative case

The rationale for this finding is the same as for the base case for all alternatives, but development on State and private lands near the NPR-A will increase the magnitude of these impacts. Development on State lands of the Nanushuk project along the Colville River, as well as existing developments such as the Alpine development and Kuparuk, would cumulatively restrict access for Nuiqsut hunters in conjunction with development in the NPR-A. Subsistence harvesters have reported difficulty navigating the Nigliq Channel bridge crossing by boat, and developments on State lands do not all have access ramps to mitigate the impacts of roads, forming a physical barrier to overland travel. Discharge of firearms would likely be prohibited within a certain radius or in the direction of infrastructure on State lands, and residents have avoided hunting in certain areas due to concerns about human safety and damage to property. Leases on State lands have a 0.5-mile development setback along the Colville River, a heavily used subsistence corridor for caribou hunting. Pipelines or roads along the Colville River could affect Nuiqsut residents' hunting activities if they are unable to shoot inland from the river due to the presence of pipelines, roads, camps, and drill pads. Cumulatively, the physical and legal restrictions on access resulting from development on State lands and in the NPR-A constitutes extensive interference with access to traditional subsistence use areas for Nuiqsut under Alternatives A, B, C and the cumulative case.

Findings for Alternative D, E, and the Cumulative Case

1. **Reductions in the abundance of subsistence resources described above for Alternative D and E and the cumulative case may significantly restrict subsistence uses for the communities of Nuiqsut, Utqiagvik, Atqasuk, Wainwright, and Anaktuvuk Pass.**
2. **Reductions in the availability of subsistence resources described above for Alternative D and E and the cumulative case may significantly restrict subsistence uses for the communities of Nuiqsut, Utqiagvik, Wainwright, and Point Lay.**
3. **Limitations on subsistence user access described above for the cumulative case may significantly restrict subsistence uses for the community of Nuiqsut.**

Because these effects may reach the level of a significant restriction, a positive determination pursuant to ANILCA Section 810 is required and hearings must be held with subsistence users from affected communities before final determinations, described below in Section E.4, can be made.

Rationale for the finding of reductions in the abundance of subsistence resources in the cumulative case

The rationale for this finding is the same as under Alternative D.

Rationale for the finding of reductions in the availability of subsistence resources in the cumulative case

The rationale for this finding is the same as under Alternatives A, B, C and the cumulative case.

Rationale for the finding of limitations on subsistence user access in the cumulative case

The rationale for this finding is the same as under Alternatives A, B, C and the cumulative case.

E.3 NOTICE AND HEARING

ANILCA Section 810(a) provides that no "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of the public lands which would significantly restrict subsistence uses shall be effected" until the federal agency gives the required notice and holds a hearing in accordance with ANILCA Sections 810(a)(1) and (2). BLM provided notice in the *Federal Register* that it made positive findings pursuant to ANILCA Section 810 that Alternatives A, B, C, D and the cumulative case presented in the NPR-A IAP Draft EIS met the "may significantly restrict" threshold. As a result, public hearings were held in the potentially affected communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright in order to solicit public comments from the subsistence users in potentially affected communities. Notice of these hearings were provided in the *Federal Register* and by way of the local media, including the Arctic Sounder newspaper, and KBRW, the local Barrow radio station with coverage to all villages on the North Slope. Meeting dates and times were posted on BLM's website at www.blm.gov/alaska.

E.4 SUBSISTENCE DETERMINATIONS UNDER THE ANILCA SECTIONS 810(A)(3)(A), (B), AND (C)

ANILCA Section 810(a) provides that there would be no "withdrawal, reservation, lease, permit, or other use, occupancy or disposition of the public lands which would significantly restrict subsistence uses," until the federal agency gives the required notice and holds a hearing, in accordance with ANILCA Section 810(a)(1) and (2), and makes the following three determinations required by ANILCA Section 810(a)(3)(A), (B), and (C): 1) that such a significant restriction of subsistence use is necessary, consistent with sound management principles for the use of the public lands; 2) that the proposed activity would involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other such disposition; and 3) that reasonable steps would be taken to minimize adverse impacts on subsistence uses and resources resulting from such actions (16 U.S.C. 3120(a)(3)(A), (B), and (C)). The BLM has found in this evaluation that all alternatives and the cumulative case will result in a significant restriction to subsistence uses. The BLM undertook the notice and hearing procedures required by ANILCA Section 810 (a)(1) and (2) in conjunction with releasing the Draft EIS in order to solicit public comment from the potentially affected communities of Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright.

The determinations below satisfy the requirements of ANILCA Section 810(a)(3)(A), (B), and (C).

E.4.1 Significant Restriction of Subsistence Use is Necessary, Consistent with Sound Management Principles for the Utilization of Public Lands

The BLM is undertaking a revision to the NPR-A IAP/EIS to determine the appropriate management of all BLM-managed lands in the NPR-A in a manner consistent with existing statutory direction and Secretarial Order 3352. Secretarial Order 3352 directed the development of a schedule to "effectuate the lawful review and development of a revised IAP for the NPR-A that strikes an appropriate balance of promoting development while protecting surface resources." While Secretarial Order 3352 directs the development of a schedule for the review and development of a revised IAP for the NPR-A, the order does not inform the purpose of the underlying actions that are being considered in this IAP/EIS. The Naval Petroleum Reserves Production Act of 1976, as amended, and its implementing regulations require oil and gas leasing in the NPR-A and the protection of surface values to the extent consistent with exploration, development, and transportation of oil and gas.

It was in furtherance of these objectives, together with other management guidance found in the Naval Petroleum Reserves Production Act, Federal Land Policy and Management Act, National Environmental Policy Act, and ANILCA that this IAP/EIS was undertaken. After considering a broad range of alternatives, Alternative E was developed to fulfill the purpose and need of this planning effort, while incorporating protective measures that serve to minimize impacts on important subsistence resources and subsistence-use areas. Alternative E considers the necessity for economically feasible development while providing effective protections to minimize any impacts on subsistence resources and uses. Under Alternative E, the lease stipulations and required operating procedures that accompany the alternative serve as the primary mitigation measures to be used to reduce the impact of the proposed activity on subsistence uses and resources.

The BLM has considered and balanced a variety of factors with regard to the proposed activity on public lands, including, most prominently, the comments received during the public meetings and hearings, which stressed the importance of protecting essential caribou movement/migration corridors for both the Teshekpuk Lake and Western Arctic caribou herds. The BLM has determined that the significant restrictions that may occur under Alternative E, when considered together with all the possible impacts of the cumulative case, is necessary, consistent with sound management principles for the use of these public lands, and for BLM to fulfill the management goals for the planning area as guided by Secretarial Order 3352 and the statutory directives in the Naval Petroleum Reserves Production Act, Federal Land Policy and Management Act, and other applicable laws.

E.4.2 The Proposed Activity will involve the Minimal Amount of Public Lands Necessary to Accomplish the Purposes of such Use, Occupancy, or Other Disposition

The BLM has determined that Alternative E involves the minimal amount of public lands necessary to accomplish the purposes of the planning effort—namely, to consider consistent oil and gas leasing stipulations and required operating procedures across the entire NPR-A, while providing special protections for specific habitats and site-specific resources and uses, and allowing the opportunity for necessary infrastructure to support oil and gas exploration and development. Alternatives that varied between opening no additional lands, fewer additional lands, and some additional lands were analyzed.

Alternative E, including its stipulations and required operating procedures, emphasizes the protection of surface resources while making approximately 18.7 million acres of federally owned subsurface (82 percent of the total in NPR-A) available for oil and gas leasing. Facility footprints are required to be minimized and permittees are encouraged to use existing infrastructure. Alternative E would adjust the boundaries of two Special Areas to account for changes in the distribution of important surface resources and would eliminate the Colville River Special Area. Alternative E makes available for leasing the entirety of the Teshekpuk Lake Special Area and partially protects critical habitat for migratory birds and the Teshekpuk Caribou Herd through lease stipulations and required operating procedures. A core area in the Utukok River Uplands Special Area would also be unavailable for leasing; this area includes important calving and insect-relief habitat for the Western Arctic Caribou Herd. Major coastal waterbodies that are integral for subsistence uses and needs such as Admiralty Bay, Wainwright Inlet, Peard Bay, and Kasegaluk Lagoon are unavailable for leasing or are available with NSO under Alternative E.

E.4.3 Reasonable Steps will be Taken to Minimize Adverse Impacts upon Subsistence Uses and Resources Resulting from such Actions.

When BLM began its National Environmental Policy Act scoping process, it internally identified subsistence as one of the major issues to be addressed. The BLM gathered information during consultation with Native entities, regional working groups, cooperating agencies, and during public meetings to develop protective measures that minimize adverse impacts on subsistence uses. These include:

- ROP E-1 protects subsistence use and access to terrestrial subsistence hunting and fishing areas.
- ROP E-3 protects subsistence use and access to marine subsistence hunting and fishing areas.
- ROP E-7 sets standards for road and pipeline design to ensure unimpeded travel of subsistence users.
- ROP F-4 reduces the impacts of air traffic on subsistence users.
- ROP H-1 requires consultation with affected communities to prevent unreasonable conflicts with subsistence users.
- ROP H-3 prevents competition from outside hunters for subsistence resources.
- Stipulation K-1 establishes development setbacks for important subsistence rivers.

Given these steps, as well as other lease stipulations and required operating procedures that serve to directly protect various subsistence resources or their habitat, the BLM has determined that Alternative E includes reasonable steps to minimize adverse impacts on subsistence uses and resources.

E.5 BLM AUTHORIZED AGENT

Name & Title | Date

E.6 LITERATURE CITED

BLM (Bureau of Land Management). 2019. "Willow Master Development Plan Draft Environmental Impact Statement."

Braem, N. 2017. Revised Options for Amounts Reasonably Necessary for Subsistence Uses of the Teshekpuk Caribou Herd. Special Publication No. BOG 2017-02. Alaska Department of Fish and Game, Division of Subsistence, Fairbanks, Alaska.

Cameron, R. D., D. J. Reed, J. R. Dau, and W. T. Smith. 1992. “Redistribution of calving caribou in response to oil-field development on the Arctic Slope of Alaska.” *Arctic* 45: 338–342.

Cronin, M. A., W. B. Ballard, J. Truett, and R. Pollard. 1994. Mitigation of the Effects of Oil-field Development and Transportation Corridors on Caribou. Final report prepared for the Alaska Oil and Gas Association, Anchorage, by LGL Alaska Research Associates, Anchorage.

CPAI (ConocoPhillips Alaska, Inc.). 2018. Eed Willow Master Development Plan Npr-a on Alaska's North Slope.

Dau, J. R., and R. D. Cameron. 1986. “Effects of a road system on caribou distribution during calving.” *Rangifer*, Special Issue 1: 95–101.

Engas, A., E. Lokkeborg, and A. V. Soldal. 1996. "Effects of Seismic Shooting on Local Abundance and Catch Rates of Cod (*Gadus Morhua*) and Haddock (*Melanogrammus Aeglefinus*)." *Canadian Journal of Fisheries and Aquatic Sciences* 53:2238-2249.

Engas, A., and S. Lokkeborg. 2002. "Effects of Seismic Shooting and Vessel-Generated Noise on Fish Behaviour and Catch Rates." *Bioacoustics* 12:313-315.

Lawhead, B. E. 1988. Distribution and movements of Central Arctic Caribou Herd during the calving and insect seasons. Pages 8–13 in R. D. Cameron and J. L. Davis, editors. Reproduction and calf survival: Proceedings of the 3rd North American Caribou Workshop. Wildlife Technical Bulletin 8. Alaska Department of Fish and Game, Juneau.

Lawhead, B. E., A. K. Prichard, M. J. Macander, and M. Emers. 2004. Caribou mitigation monitoring study for the Meltwater Project, 2003. Third annual report for ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc., Fairbanks. 104 pp.

Nellemann, C., and R. D. Cameron. 1996. Effects of petroleum development on terrain preferences of calving caribou. Arctic 49: 23–28.

NRC (National Research Council). 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Washington, D.C.: National Academies Press.

Person, B. T., A. K. Prichard, G. M. Carroll, D. A. Yokel, R. S. Suydam, and J. C. George. 2007. Distribution and movements of the Teshekpuk caribou herd, 1990–2005, prior to oil and gas development. Arctic 60: 238–250.

Prichard, A. K., D. A. Yokel, C. L. Rea, B. T. Person, and L. S. Parrett. 2014. The effect of telemetry locations on movement-rate calculations in arctic caribou. Wildlife Society Bulletin 38: 78–88.

Prichard, A. K., M. J. Macander, J. H. Welch, and B. E. Lawhead. 2019. Caribou monitoring study for the Bear Tooth Unit Program, Arctic Coastal Plain, Alaska, 2018. Annual report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc.—Environmental Research & Services, Fairbanks. 65 pp.

SRB&A (Braund, Stephen R. & Associates). 2009. Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters. Prepared for North Slope Borough, Department of Wildlife Management. Anchorage, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/Braund%20NSB%20Oil%20and%20Gas%20Impacts%20July%2009.pdf.

SRB&A (Braund, Stephen R. & Associates). 2010a. Mms Ocs Study No. 2009-003: Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow. U.S. Department of the Interior Minerals Management Service, Alaska OCS Region, Environmental Studies Program. Anchorage, Alaska. Available online at https://www.boem.gov/BOEM-Newsroom/Library/Publications/2009/2009_003.aspx.

SRB&A (Braund, Stephen R. & Associates). 2010b. Nuiqsut Caribou Subsistence Monitoring Project: Results of 2009 Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2011. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Two Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2012. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Three Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

wil (Braund, Stephen R. & Associates). 2013. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 4 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2014a. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 5 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2014b. Point Lay Subsistence Use Areas and Traditional Knowledge Interviews. Supported by the North Slope Borough Department of Wildlife.

SRB&A (Braund, Stephen R. & Associates). 2015. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 6 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2016. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 7 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2017a. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 8 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2017b. Social Indicators in Coastal Alaska, Arctic Communities. Final Report. OCS study. Technical Report No. BOEM 2017-035. U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/OCS/2017/2017-035.pdf.

SRB&A (Braund, Stephen R. & Associates). 2018a. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 9 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2018b. Nuiqsut Paisaŋich: A 2018 Addendum. Prepared for the City of Nuiqsut. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2019a. Nuiqsut Caribou Subsistence Monitoring Project: Years 1 through 10 Final Report. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A (Braund, Stephen R. & Associates). 2019b. Nuiqsut Caribou Subsistence Monitoring Project: Years 1 through 10 Final Report. Prepared for Conocophillips Alaska, Inc. Anchorage, Alaska.

Vistnes, I., and C. Nellemann. 2008. The matter of spatial and temporal scales: a review of reindeer and caribou response to human activity. Polar Biology 31: 399–407.

Wilson, R. R., Prichard, A. K., Parrett, L. S., Person, B. T., Carroll, G. M., Smith, M. A., Rea, C. L., & Yokel, D. A. (2012). Summer resource selection and identification of important habitat prior to industrial development for the Teshekpuk Caribou Herd in northern Alaska. PloS one, 7(11), e48697. https://doi.org/10.1371/journal.pone.0048697.

Wilson, R. R., L. S. Parrett, K. Joly, and J. R. Dau. 2016. "Effects of Roads on Individual Caribou Movements During Migration." *Biological Conservation* 195:2-8.

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Appendix F
Approach to the Environmental Analysis

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations	Full Phrase
ASTAR	Arctic Strategic Transportation and Resources
BLM	Bureau of Land Management
CD	Colville Delta
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CPF	central processing facility
EIS	environmental impact statement
GHG	greenhouse gas
GMT-1	Greater Mooses Tooth-1
GMT-2	Greater Mooses Tooth-2
IAP	integrated activity plan
NEPA	National Environmental Policy Act of 1969
NPR-A	National Petroleum Reserve-Alaska
NSB	North Slope Borough
OHV	off-highway vehicle
PFYC	Potential Fossil Yield Classification
RFD	reasonably foreseeable development
RFFA	reasonably foreseeable future action
ROP	required operating procedure
ROW	right-of-way
STP	seawater treatment plant
U.S.	United States
VRM	visual resource management
VSM	vertical support member

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Appendix F. Approach to the Environmental Analysis

F.1 INTRODUCTION

The impact assessment method conforms to the guidance found in the following sections of the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act of 1969 (NEPA): 40 Code of Federal Regulations (CFR) 1502.24 (Methodology and Scientific Accuracy); 40 CFR 1508.7 (Cumulative Impact); and 40 CFR 1508.8 (Effects). CEQ regulations require that agencies "rigorously explore and objectively evaluate" the impact of all alternatives. The action alternatives presented in this environmental impact statement (EIS) offer specific areas of the National Petroleum Reserve in Alaska (NPR-A) as available for lease sale,[1] rather than project-level exploration and development of oil and gas. Because of this, the focus of the analysis is on the potential impacts of these future phases, which may follow leasing. Since existing leases are from 1999 to 2019, past integrated activity plan (IAP) lease stipulations are in place for different leases. To analyze the effect of stipulations that are less protective than this IAP, the BLM examined existing leased areas as if they were open, subject to standard stipulations. The existing leased areas' environmental impacts were analyzed in past IAPs.

F.2 DIRECT AND INDIRECT IMPACTS

Direct and indirect impacts are considered in Chapter 3 of the Final IAP/EIS, consistent with direction provided in 40 CFR 1502.16.

> **Direct effects**—These are caused by the proposed action and occur at the same time and place (40 CFR 1508.8). Two examples of direct effects are wetlands are filled when placing gravel pads and the direct mortality of wildlife or vegetation.
>
> **Indirect effects**—These are caused by the proposed action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects "may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). Indirect effects are caused by the proposed action but do not occur at the same time or place as the direct effects.

Potential effects are quantified where possible using geographic information systems and other applications; in the absence of quantitative data, best professional judgment prevails. Impacts are sometimes described using ranges of potential impacts or in qualitative terms.

The standard definitions for terms used in the analysis are as follows, unless otherwise stated:

> **Context**—Describes the area or location (site-specific, local, program area-wide, or regional) in which the impact could occur. Site-specific impacts would occur at the location of the action, local impacts would occur in the general vicinity of the program area, program area-wide impacts would

[1]Subject to applicable laws, terms, conditions, stipulations of the lease, and project-specific environmental review and permits.

affect most or all of the program area, and regional impacts would extend beyond the program area boundaries.

Duration—Describes the duration over which an effect would occur, either short term or long term. Short term is anticipated to begin and end within the first 5 years after the action is implemented; long term lasts beyond 5 years to the end of or beyond the 20-year program time frame.

Intensity—Impacts are discussed using quantitative data, where possible.

F.3 CUMULATIVE IMPACTS

The cumulative impact analysis considers impacts of a proposed action and its alternatives that may not be consequential when considered individually, but, when combined with impacts of other actions, they may be consequential. As defined by CEQ regulations (40 CFR 1508.7 and 1508.25(a)(2)), a cumulative impact is ". . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (RFFAs) regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

The purpose of the cumulative impacts analysis is to determine if the impacts of the actions considered in this EIS, together with other past, present, and RFFAs, could interact or accumulate over time and space, either through repetition or combined with other impacts. Another purpose is to determine under what circumstances and to what degree they might accumulate.

Additional requirements of other regulatory agencies would further reduce any cumulative impacts.

F.3.1 Method

The method used for cumulative impacts analysis in this EIS consists of the following steps:

- Identify issues, characteristics, and trends in the affected environment that are relevant to assessing cumulative effects of the action alternatives—This includes discussions on lingering effects from past activities that demonstrate how they have contributed to the baseline condition for each resource. This information is summarized in Chapter 3 of the Final IAP/EIS.
- Describe the potential direct and indirect effects of future oil and gas exploration, development, and production—As noted above, issuing oil and gas leases would have no direct impacts on the environment, because by itself a lease does not authorize any on-the-ground oil and gas activities; however, issuing a lease represents an irretrievable commitment of oil and gas resources for potential future exploration and development, subject to further environmental review and authorization, that would result in impacts on the environment. These are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the NPR-A; therefore, the analysis in Chapter 3 of the Final IAP/EIS for each resource is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.
- Define the spatial (geographic) and temporal (time frame) for the analysis—This time frame may vary between resources, depending on the historical data available and the relevance of past events to the current baseline.
- Identify past, present, and RFFAs, such as other types of human activities and natural phenomena that could have additive or synergistic effects; summarize past and present actions, within the

defined temporal and spatial time frames; and identify any RFFAs that could have additive, countervailing, or synergistic effects on identified resources.

- Use a specific method to screen all of the direct and indirect effects, when combined with the effects of external actions, to capture those synergistic and incremental effects that are potentially cumulative—Both adverse and beneficial effects of external factors are assessed and then evaluated in combination with the direct and indirect effects for each alternative on the various resources to determine if there are cumulative effects.
- Evaluate the impact of the potential cumulative effects and assess the relative contribution of the action alternatives to cumulative effects.
- Discuss the rationale for determining the impact rating, citing evidence from the peer-reviewed literature, and quantitative information, where available. When confronted with incomplete or unavailable information, ensure compliance with 40 CFR 1502.22.

The analysis also considers the interaction among the impacts of the proposed action with the impacts of various past, present, and RFFAs, as follows:

- Additive—The impacts of actions add together to make up the cumulative impact
- Countervailing—The impacts balance or mitigate the impacts of other actions
- Synergistic—The impact of the actions together is greater than the sum of their individual impacts

In this EIS, both the temporal and geographic scope of the cumulative impact analysis could vary according to the resource under consideration. Generally, the appropriate time frame for cumulative impacts analysis spans from the 1970s through full realization of the hypothetical development scenario (Appendix B of the Final IAP/EIS). The BLM anticipates that to occur approximately 70 years after the Record of Decision for this EIS is signed; it recognizes that the time frame for production could be more or less than 70 years, given the speculative nature of the hypothetical development scenarios.

The geographic scope generally encompasses the North Slope of Alaska and the near-shore marine environment but extends beyond these areas for some resources, such as terrestrial wildlife. Details associated with the impact indicators, geographic scope, and analysis assumptions for each resource are found in **Section F.4**, below.

F.3.2 Past, Present, and RFFAs

Relevant past and present actions are those that have influenced the current condition of the resource. For the purposes of this EIS, past and present actions are both human-controlled and naturally occurring events. Past actions were identified using agency documentation, NEPA analyses, reports and resource studies, peer-reviewed literature, and best professional judgment.

The RFFA is used in concert with the CEQ definitions of indirect and cumulative effects, but the term itself is not defined further. Most regulations that refer to "reasonably foreseeable" do not define the meaning of the words but do provide guidance on the term. For this analysis, RFFAs are those that are external to the proposed action and are likely (or reasonably certain) to occur, although they may be subject to a degree of uncertainty. Typically, they are based on such documents as plans, permit applications, and fiscal appropriations. RFFAs considered in the cumulative effects' analysis consist of projects, actions, or developments that can be projected, with a reasonable degree of confidence, to occur over the next 70 years.

Recent environmental reports, surveys, research plans, NEPA compliance documents, and other source documents have been evaluated to identify these actions. RFFAs were assessed to determine if they were speculative and would occur within the analytical time frame of the EIS. Projects and activities considered in the cumulative effects analysis are summarized in **Table F-1** and shown in **Map F-1**. These projects and activities are discussed in more detail below.

Table F-1
Past, Present, and RFFAs Considered in the Cumulative Effects Analysis

Category	Area	Actions and Activities	Description
Oil and gas exploration, development, and production	• Onshore North Slope • State and federal waters (Beaufort Sea, Chukchi Sea, Smith Bay, Harrison Bay) • Western Canadian Arctic	• Geological and geophysical surveys • Infrastructure development • Gravel mining, e.g., Arctic Slope Regional Corporation Gravel Mine • Geotechnical borehole surveys • Construction and maintenance • Exploration • Production wells • Surface, air, and marine traffic • Scientific research, directly related to oil and gas, for avian studies, bathymetry, cultural resources, and fisheries	Competitive oil and gas lease sales, lease exploration, and development have occurred across the North Slope; continued activity is expected. The number of flights by cargo-rated planes associated with oil and gas development tends to increase dramatically during summer. See below for an additional discussion.
Transportation (separate from oil and gas)	• Surface • Air • Marine	• Roads and vehicular traffic in communities • International marine vessel traffic • Shipping and barging to Deadhorse, Kaktovik, Point Hope, Point Lay, Utqiagvik, and Wainwright • Aircraft traffic • Ambler Road	Surface, air, and marine transportation services are available in the program area. Federal, state, and tribal governments maintain plans for ongoing maintenance and development. Marine transportation is projected to increase with decreases in sea ice associated with climate change. See below for an additional discussion.

Category	Area	Actions and Activities	Description
Subsistence activities	• Utqiagvik • Nuiqsut • Wainwright • Atqasuk • Kaktovik	• Hunting • Trapping • Fishing • Whaling • Sealing • Traveling • Berry picking	Anticipate a continuation of traditional past and present subsistence practices (see Section 3.4.3 of the Final IAP/EIS). See below for an additional discussion.
Recreation and tourism	• Arctic National Wildlife Refuge • Various locations across the North Slope • Beaufort Sea and nearshore areas • North American Arctic	• Wildlife and scenic viewing and photography • Sport and commercial hunting and fishing • Boating and river recreation • Camping • Hiking • Ecotourism	Past and present recreational uses of the program area are expected to continue (see Section 3.4.6 of the Final IAP/EIS). See below for an additional discussion.
Scientific research	• Onshore North Slope • Nearshore waters • Outer continental shelf waters • Colville River Delta • Teshekpuk Lake • Arctic National Wildlife Refuge	• Arctic National Wildlife Refuge studies • Threatened and endangered species studies • Biological, geophysical, archaeological, and socioeconomic surveys • Stock and harvest assessments	Scientific research and surveys have occurred throughout the program area and are expected to continue. See below for an additional discussion.
Community development	• Utqiagvik • Nuiqsut • Atqasuk • Kaktovik • North Slope Borough (NSB)	• Demographic/population change • Migration • Infrastructure development projects	Anticipate a continuation of infrastructure development projects. See below for an additional discussion.
Climate change	Global	Trends in climate change are described in the Greater Mooses Tooth-2 (GMT2) Supplemental EIS (BLM 2018, Section 3.2.4) and are projected to continue and interact with other RFFAs in the program area.	Long-term changes in temperature and precipitation, with associated changes in the atmosphere, water resources, permafrost, vegetation, wetlands, fish and wildlife habitat, and subsistence practices

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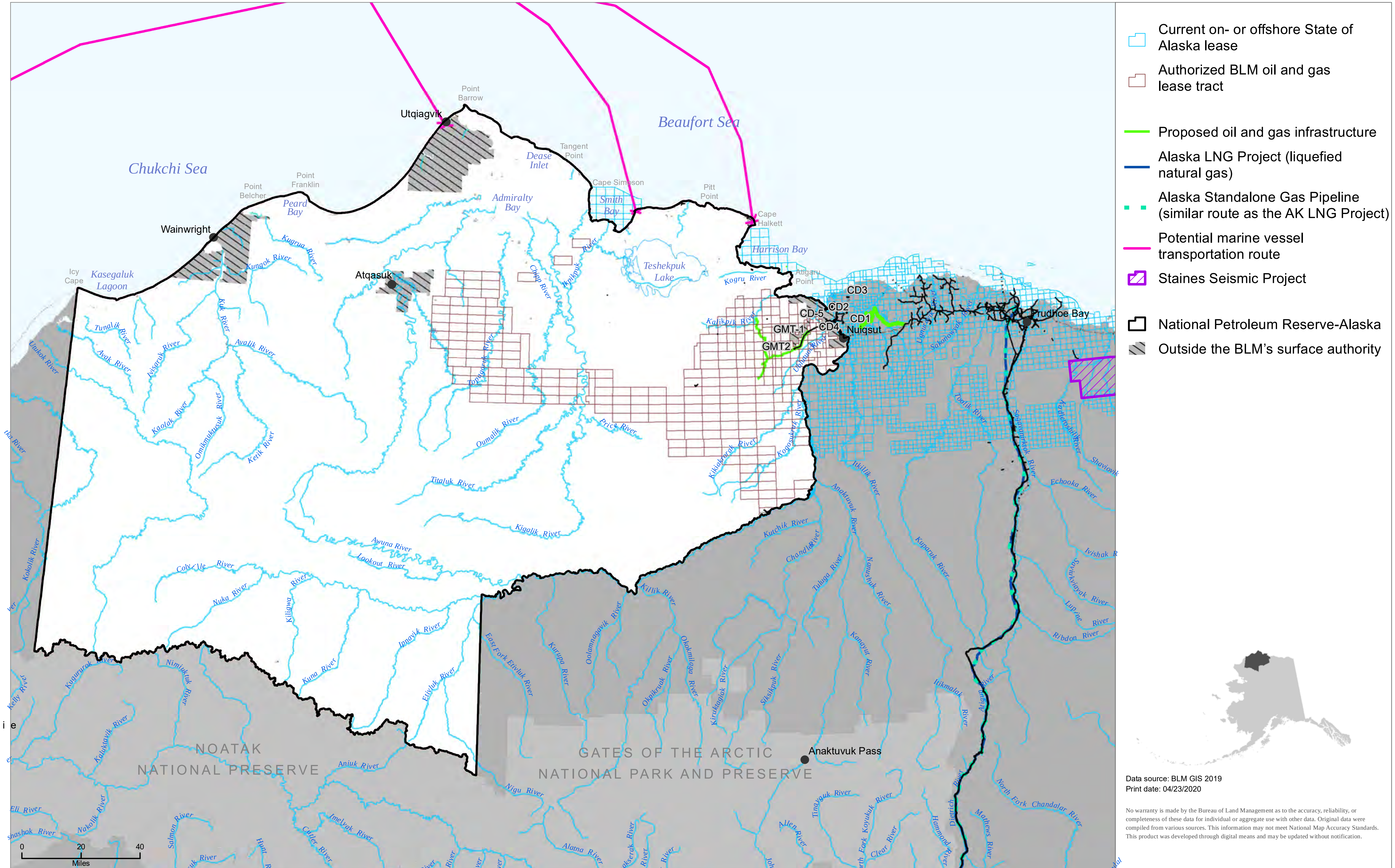
Current on- or offshore State of Alaska lease
Authorized BLM oil and gas lease tract
Proposed oil and gas infrastructure
Alaska LNG Project (liquefied natural gas)
Alaska Standalone Gas Pipeline (similar route as the AK LNG Project)
Potential marine vessel transportation route
Staines Seismic Project
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Chukchi Sea
Beaufort Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Atigaru Point
Admiralty Bay
Point Franklin
Point Belcher
Peard Bay
Wainwright
Icy Cape
Kasegaluk Lagoon
Atqasuk
CD3
CD2
CD-5
CD1
CD4
Nuiqsut
GMT-1
GMT2
Prudhoe Bay
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
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Miles
Data source: BLM GIS 2019
Print date: 04/23/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

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Oil and Gas Exploration, Development, and Production

Onshore oil development has been a primary agency of industrial change on the North Slope. Oil and gas exploration has occurred on the North Slope since the early 1900s, and oil production started at Prudhoe Bay in 1977. Onshore gas production from the Barrow Gas Field began over 60 years ago. Associated industrial development has included the creation of industry-supported airfields at Deadhorse and Kuparuk and an interconnected industrial infrastructure that includes roads, pipelines, production and processing facilities, gravel mines, and docks. Air traffic is also associated with oil and gas development, primarily from May through August, involving small propeller-driven aircraft and larger cargo-rated planes, such as the DC-6 and C-130. Oil and gas activities that have occurred in the Beaufort Sea are exploration wells and seismic surveys, geohazard surveys, geotechnical sampling programs, and baseline biological studies and surveys.

Both onshore and offshore reasonably foreseeable future oil and gas activities are considered in the cumulative effects' analysis. It includes a discussion of activities on federal mineral estate in the NPR-A that have already begun or where NEPA compliance has been completed, as well as activities on non-federal mineral estate in and next to the NPR-A. The discussion does not include small discoveries and undiscovered resources that are unlikely to be developed within the temporal scope of this EIS.

Activities anticipated to occur on federal mineral estate in the NPR-A, where the NEPA compliance process has not yet begun, are accounted for in the reasonably foreseeable development (RFD) scenario (see Appendix B of the Final IAP/EIS) and are analyzed as part of direct/indirect impact analysis. The impacts of present projects described below are accounted for in the affected environment sections (see Chapter 3 of the Final IAP/EIS).

The following present and reasonably foreseeable future oil and gas projects are included in the cumulative effects' analysis, either through referencing the affected environment discussion or through analysis in the cumulative effects section:

- **SAExploration 3-Dimensional Seismic Exploration Surveys (reasonably foreseeable future)—** A proposed 3-dimensional seismic exploration of the Coastal Plain of the Arctic Refuge that would begin the winter after it is approved. The project would include program area access from Deadhorse, fuel storage, and up to two mobile camps, each capable of housing up to 160 people. There would be 360 miles of snow trails associated with moving as many as two camps across the program area. There also would be approximately 50 trailers, including support trailers that make up a camp. Fuel would be delivered daily by ground vehicles to the camps. Crews would be changed twice weekly, either by aircraft or ground vehicle. Seismic operations would be conducted using 12 to 15 rubber-tracked vibrators and 20,000 to 25,000 wireless autonomous recording devices for each of the two crews. Vibroseis vehicles would be positioned 41, 25, and 200 feet from an adjacent receiver point on a given line. In a typical square mile, there would be 4 linear miles of receivers and 8 linear miles of source.
- **Liberty (reasonably foreseeable future)—**The Liberty Prospect is 5 miles offshore in about 20 feet of water, inside the Beaufort Sea's barrier islands. It is 20 miles east of Prudhoe Bay and about 8 miles east of the Hilcorp Alaska LLC-operated Endicott oil field. Development would include constructing a gravel island for production facilities, including 16 wells. Oil produced from the island would be piped through a subsea pipe to an elevated 1.5-mile-long onshore pipeline to a tie-in with the onshore Badami oil pipeline.

- **Point Thomson (present)—**Point Thomson, a gas condensate field, produces condensate that is shipped via a 22-mile oil pipeline to a tie-in into the Badami Oil Pipeline that then transports the oil to Pump Station 1 on the Trans-Alaska Pipeline. The drill site and production facilities are on State onshore lands just west of the Arctic Refuge. The project includes production pads, process facilities, an infield road system, a pipeline, infield gathering lines, and an airstrip.
- **Nanushuk (reasonably foreseeable future)—**The project is southeast of the East Channel of the Colville River, approximately 52 miles west of Deadhorse and about 6.5 miles from Nuiqsut (at the southernmost project boundary). The project will include construction of the Nanushuk pad, comprised of drill site 1, a central processing facility (CPF), drill site 2, drill Site 3, an operations center pad, infield pipelines, the export/import Nanushuk pipeline, infield roads, an access road, a tie-in pad, and a potable water system. The project also includes temporary discharges to 5.8 acres of jurisdictional waters of the United States for screeding[2] at the Oliktok Dock.
- **Alpine Colville Delta (CD) 5 (present)**—This Alpine field satellite development drill site is on Alaska Native Claims Settlement Act Corporation lands near Nuiqsut. It is the first commercial oil production from the NPR-A and went into production in late 2015. As a satellite to the Alpine CPF, CD5 has only minimal on-site processing facilities; however, it required 6 miles of gravel road, 4 bridges, and 32 miles of pipelines. It includes a gravel road and natural gas pipeline from Alpine CPF into Nuiqsut. ConocoPhillips Alaska, Inc., plans to continue drilling an additional 18 wells at CD5 after the original 15 wells are completed, for an eventual total of 33 wells.
- **Narwhal Reservoir (reasonably foreseeable future)—**This is a potential future project located primarily in the Colville River Unit. Production from this reservoir could occur from existing pads, such as the CD1 or CD4 pads, from a drill site at or near the location of the 2018 Putu exploration well, or a combination of these. If development occurs from an existing pad, there may be accompanying pad expansion. If a new drill site is constructed, ConocoPhillips Alaska expects that it would connect by road and pipeline to existing Alpine infrastructure. ConocoPhillips Alaska anticipates that any fluids produced from an existing or new drill site would be processed at the Alpine CPF.
- **Greater Mooses Tooth (present/reasonably foreseeable future)—**The Greater Mooses Tooth-1 (GMT1) project was the first commercial development on federal lands in the NPR-A; the first oil was produced in October 2018. The GMT1 development involves an 11.8-acre drilling pad, with a 7.6-mile-long road, two bridges, and pipelines that connect to Alpine CPF through the CD5 road and pipeline extension. The drilling pad can support up to 33 wells, but initially it will have only nine wells. Production from GMT1 is expected to peak at 25,000 to 30,000 barrels of oil per day. The GMT2 project is also on federal lands in the NPR-A. The project could include up to 48 wells drilled from a 14-acre drill pad, 8 miles to the southwest of GMT1. The proposed 8.2-mile gravel road and pipeline would connect through GMT1 and on to Alpine CPF through the existing CD5 extension. Construction for GMT2 began in early 2019. GMT2 anticipated peak production will be higher than GMT1 at 35,000 to 40,000 barrels of oil per day.
- **Willow (reasonably foreseeable future)—**The Willow oil and gas prospect is on federal oil and gas leases that ConocoPhillips holds in the Bear Tooth Unit of the NPR-A, approximately 30 air miles west of Nuiqsut. The proposed project includes the construction, operation, and maintenance of up to five drill sites, with 251 total wells across the five pads (40 to 70 wells per drill pad), a

[2]Screeding is the use of a straight surface or purpose-made tool to smooth and flatten concrete or asphalt after it is placed on a surface.

CPF, an operations center pad, gravel roads, ice roads and ice pads, one or two airstrips (varies by alternative), pipelines, and a gravel mine site on BLM-managed lands in the NPR-A. In its master development plan/EIS, the BLM will analyze an option for connecting a module transfer island to facilitate module delivery via sealift barges. This would occur in waters managed by the State of Alaska or the marine traffic ending at Oliktok Dock, using existing gravel roads and ice roads. First production is anticipated to be around 2025.

- **State of Alaska Offshore Leases (present)—**The State of Alaska has issued 69 leases in state waters off the coast of NPR-A. There are 26 leases in Smith Bay, 24 in upper Harrison Bay, and 19 in lower Harrison Bay.
- **Greater Prudhoe Bay/Kuparuk (reasonably foreseeable future)—**This main producing part of the North Slope is expected to have numerous small developments, as smaller accumulations of oil are discovered and can be produced using existing infrastructure.
- **Alaska Liquid Nitrogen Gas Project (reasonably foreseeable future)—**This development would include a gas treatment plant at Prudhoe Bay, a 42-inch-diameter, high-pressure, 800-mile pipeline, and eight compressor stations to move the gas to a proposed liquefaction plant at Nikiski, on the Kenai Peninsula. The pipeline would be designed to accommodate an initial mix of gas from the Prudhoe Bay and Point Thomson fields and room to accommodate other gas fields in the decades ahead. The Alaska LNG project would be mutually exclusive to the Alaska stand-alone gas pipeline (below), meaning only one, if any, would be built.
- **Alaska Stand Alone Gas Pipeline (reasonably foreseeable future)—**This pipeline is envisioned to be a reliable, affordable energy source to Alaskan communities. Production from this project would emphasize in-State distribution, although surplus gas would also likely be condensed and exported. The 727-mile, low pressure pipeline route would generally parallel the Trans-Alaska Pipeline System and the Dalton Highway corridor. The pipeline would be underground, with approximately five elevated stream crossings, compressor stations, possible fault crossings, pigging facilities, and off-take valve locations. A gas conditioning facility would need to be constructed near Prudhoe Bay and would likely require one or more large equipment modules to be offloaded at the west dock loading facility. Shipments to the west dock would likely require improving the dock facilities and dredging to deepen the navigational channel to the dock head. The Alaska Stand Alone Gas Pipeline would be mutually exclusive to the Alaska LNG Project (above), meaning only one, if any, would be built.

Arctic Strategic Transportation and Resources (ASTAR)—This program is a collaboration between the State of Alaska, the NSB, and other North Slope stakeholders. Its purposes are to prioritize community needs and to identify infrastructure opportunities that offer the most cumulative benefit for the region.

ASTAR will consider a broad range of potential infrastructure projects, such as permanent and seasonal roads, utilities, new or updated community facilities, fiber optics, trail marking programs, airport facilities, and improved wastewater infrastructure (proposed road networks do not currently connect to Arctic Village or Venetie). The planning area includes the entire NSB boundary, including State lands, the NPR-A, and the Arctic Refuge.

The effects of the ASTAR program could include increasing the cultural and community connectivity, lowering the cost of goods and services, preserving or enhancing subsistence traditions, increasing health and safety for NPR-A residents and stakeholders, increasing access to education, improving workforce development opportunities, and reducing environmental impacts by identifying potential ways for the public and private project owners to work together.

The ASTAR team is also working to identify and fill data gaps, such as gravel material locations, water resources, and LiDAR, needed to advance projects in the region. Information collected from ASTAR will be made public, with the intent of assisting with future infrastructure decisions.

- **Umiat Development—**The BLM has received an application for an exploration unit in the Umiat area. All requirements and obligations under 43 CFR 3137 would need to be met to maintain the unit and lead to development. As per regulation, once a unit is established, the operator would have 10 years to reach production. Road access would be necessary to support future development. The most likely routes would depend on the closest infrastructure. If a road were constructed under the ASTAR program, under one proposal, it would be through Umiat and would connect to the Dalton Highway near Franklin Bluffs. If this road does not get built, the operator may choose to construct an approximately 70-mile road north and connect it to a point near the proposed Willow development. Due to distance from other infrastructure, a CPF would be built at Umiat.
- **Federal Offshore Leasing Program in the Chukchi and Beaufort Seas—**All of the Chukchi Sea and most of the Beaufort Sea are unavailable for leasing and development. Leasing in the Chukchi and Beaufort Seas is governed by the current Bureau of Ocean Energy Management 5-year leasing plan, which will expire in 2022. The issue of whether this closure can be lifted is being litigated at the 9th Circuit Court of Appeals. If the Department of the Interior prevails in the litigation, a leasing plan would likely be developed that would offer tracts for sale in the Chukchi Sea and in those portions of the Beaufort Sea currently closed to leasing.

Transportation

In addition to air, land, and marine transport associated with oil and gas activities, there is frequent marine and air traffic associated with coastal communities on the North Slope. It is reasonable to assume that trends associated with transportation to facilitate the maintenance and development of coastal communities will continue. Typically, vessels offshore of the program area are those that support oil and gas industries, barges or cargo vessels used to supply coastal villages, smaller vessels used for hunting and location transportation during the open water period, research vessels, and a limited number of recreational vessels. Passenger and air cargo flights between Fairbanks and each of the communities across the North Slope often include several scheduled flights of small propeller-driven aircraft. Government agencies, researchers, and recreationists often charter aircraft for travel and research. Aircraft traffic is expected to continue; levels of traffic may increase because of increased industrial activity, tourism, and community development.

The proposed Ambler Road project proponent would construct a new 211-mile roadway on the south side of the Brooks Range, extending west from the Dalton Highway to the south bank of the Ambler River. The road would be open only to mining-related industrial use and would be closed to the public. It would include bridges, material sites, maintenance stations, and related infrastructure and utilities.

Subsistence Activities

Subsistence activities occur throughout the NPR-A and in the surrounding areas. Subsistence hunters primarily use off-highway vehicles (OHVs), boats, and snow machines for access. The types of subsistence uses and activities that were described in Section 3.4.3 of the Final IAP/EIS are expected to continue. Current and past hunting, gathering, fishing, and trapping would be similar in the types of activities and areas used by the communities in the program area in the foreseeable future.

Recreation and Tourism

Recreational fishing in the NPR-A occurs predominantly opportunistically by people in the area, primarily for recreation, such as big game hunting or float trips. As of 2019, there were no commercial sport fishing recreation permit requests or authorizations for the area.

The NPR-A offers opportunity, but limited access, for primitive unconfined recreation, including backpacking and hiking, wildlife viewing, hunting, fishing, and boating. There are no federal, State, or NSB public recreational facilities in the project area. The lack of a developed public road system into or through the area limits recreational access almost exclusively to charter aircraft during summer or snow machines or dogsleds during winter. In 2018, there were six special recreational permit holders authorized to conduct hunting and viewing of scenery and wildlife in the NPR-A.

Scientific Research

There are scientific research programs that take place in the NPR-A and surrounding areas. These activities involve vessel, air, and overland transport of researchers and equipment, and they could contribute to cumulative effects. This would come about through the disturbance of terrestrial and marine wildlife, impacts on subsistence harvest, or sediment/soil disturbance through biological or chemical sampling.

Community Development

Community development projects in Arctic communities involve both large and small infrastructure projects. For example, the bridge to Nuiqsut is a past community development project. Smaller projects resulting from and leading to community growth could further increase demand for public services and infrastructure, such as airport construction upgrades, roads, port and dock construction, telecommunications, alternative energy infrastructure, and telecommunications projects.

Climate Change

Climate change is an ongoing factor in the consideration of cumulative effects in the Arctic. It could affect the habitat, behavior, distribution, and populations of fish and wildlife in the program area. Climate change could also affect the availability of, or access to, subsistence resources. The trends in climate change that were described in the GMT2 Final Supplemental EIS (BLM 2018), and incorporated by reference into this EIS, are expected to continue.

F.3.3 Actions Not Included in the Cumulative Analysis

Developments for which a solid proposal has not been submitted or that seem unlikely to occur in the foreseeable future are considered speculative. These may include projects that are discussed in the public arena but are not currently authorized by law or for which there is no current proposal before an authorizing agency. Speculative developments are not considered reasonably foreseeable and are not evaluated as part of the cumulative impacts' analysis.

F.3.4 Oil and Gas Activities on Non-Federal Lands

The program area is next to State of Alaska lands and waters and contains inholdings owned by Alaska Native Claims Settlement Act corporations. Although there are no plans to develop these non-federal lands for oil and gas, leasing in the NPR-A could result in exploration and development of recoverable hydrocarbons. Future NEPA analyses associated with NPR-A leasing will consider oil and gas activities on non-federal lands once project-specific details are available.

F.4 RESOURCE INDICATORS AND ASSUMPTIONS

For organizational purposes, Chapter 3 is divided into sections by subject area, such as water resources, terrestrial mammals, and recreation. Though they are described and analyzed in discrete sections, these subjects are dynamic and interrelated. A change in one resource can affect other resources. For example, water quality affects fish populations, which in turn influences subsistence harvests, which can have implications for other outcomes, such as human health and sociocultural systems. As a result, there is some overlap among the resource sections in Chapter 3 of the Final IAP/EIS, and the impacts described in one section may depend on the analysis from another section.

During the writing process, resource specialists shared data and discussed interrelated aspects of the analyses to better capture the interrelated nature of environmental resources. The indicators, analysis areas, and assumptions used for each resource analysis are detailed below.

F.4.1 Climate and Meteorology

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—General activity • Use and storage of heavy construction equipment in the project area • Use and storage of hazardous materials during construction phases, such as fuels, lubricants, and solvents	Indirect. Use of equipment releases greenhouse gases (GHG) emissions, affecting climate.	• GHG emissions, reported in metric tons, are used as an indicator for climate impacts. • Production-related GHG emissions would be compared to Alaska emission. • Total (production plus downstream) indirect GHG emissions would be compared to U.S. and global emissions totals.
Construction—Freshwater withdrawal and domestic water disposal • Use of water withdrawal pumps and additional equipment associated with water withdrawal during construction	See Row 1	See Row 1
Construction—Gravel mining • Blasting • Excavation and transport of gravel at mine site • Stockpiled overburden associated with gravel mine • Annual dewatering of mine during operations	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—Site Preparation • Preparations associated with constructing ice roads and pads (compacting snow, placing insulation, and creating ice infrastructure) • Preparations associated with gravel road and pad construction (placing gravel fill, adjusting previously undisturbed terrain, compacting gravel, and grading)	See Row 1	See Row 1
Construction—Deep excavation and drilling activity • Excavation for pipeline vertical support member placement • Horizontal directional drilling underneath waterbodies during pipeline installation	See Row 1	See Row 1
Construction—In-water work, freshwater • Installing culverts for stream crossings • Pile driving and sheet piling during construction • Placing fill in waterbodies • Installing water withdrawal intake from lakes and ponds	See Row 1	See Row 1
Construction—Traffic activity • Increased air traffic • Increased ground traffic • Increased marine vessel traffic	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Drilling and operations—General activity • Use and storage of heavy equipment in project area • Use and storage of hazardous materials during drilling and operations, such as fuels, lubricants, and solvents	See Row 1	See Row 1
Drilling and Operations—Domestic wastewater disposal • Use of wastewater disposal pumps and additional equipment associated with wastewater disposal	See Row 1	See Row 1
Drilling and operations—Traffic activity • Increased air traffic • Increased ground traffic	See Row 1	See Row 1
Drilling—General drilling • Production and injection well drilling • Subsurface injections of water, drill waste, or miscible-injectant	See Row 1	See Row 1
Operations—Gas and oil processing and infrastructure pad • Natural gas flaring at Willow Central Facility • Subsurface injection of produced water and natural gas as part of pressure maintenance and water flood for secondary recovery • Use of facilities equipment operating at the Willow Central Facility, infrastructure pad, or other nearby facilities, such as incinerators, turbines, and generators	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Transportation, processing/refining, and combusting produced oil • Oil transported via pipeline outside of the NPR-A and connecting with the Trans-Alaska Pipeline System • Oil refinement into commercial products • Oil product combustion	Indirect. Use of equipment and combustion of oil products releases GHG emissions, affecting global climate.	See Row 1
Effects of climate change on the NPR-A	Effects of climate change on oil development infrastructure that could be authorized in the NPR-A	Qualitative

Impact Analysis Area

- Direct—No direct impacts from this management plan; all impacts are indirect
- Indirect—The geographic extent of the NPR-A, plus downstream oil refining and consumption
- Cumulative—U.S., with focus on the Arctic North Slope

Analysis Assumptions

- Willow Master Development Plan Draft EIS, Alternative B (BLM 2019) greenhouse gas emissions normalized to emissions per barrel of oil produced during peak production would be representative of NPR-A IAP indirect emissions per barrel of oil produced in future developments.
- Market effects that would reduce net downstream emissions (from refining and consumption) of oil produced in the NPR-A are ignored in the calculations of downstream emissions.

F.4.2 Air Quality

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—General activity • Use and storage of heavy construction equipment in project area • Use and storage of hazardous materials during construction phases, such as fuels, lubricants, and solvents	Indirect. Use of equipment releases criteria and hazardous air emissions, affecting air quality and air quality related values.	• Criteria pollutant impacts in micrograms per cubic meter relative to National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards • Hazardous air pollutant impacts in micrograms per cubic meter, relative to short-term, chronic, and carcinogenic thresholds • Visibility (units of delta deciviews) and deposition (units of kilograms per hectare per year), relative to air quality related value thresholds

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—Freshwater withdrawal and domestic water disposal • Use of water withdrawal pumps and additional equipment associated with water withdrawal during construction phases	See Row 1	See Row 1
Construction—Gravel mining • Blasting • Excavation and transportation of gravel at mine site • Stockpile overburden associated with gravel mine • Annual dewatering of mine during operations	See Row 1	See Row 1
Construction—Site Preparation • Preparations for ice road and pad construction (compacting snow, placing insulation, and creating ice infrastructure • Preparations associated with gravel road and pad construction (gravel fill placement, adjustments to previously undisturbed terrain, compaction of gravel, and grading)	See Row 1	See Row 1
Construction—Deep excavation and drilling activity • Excavation for pipeline vertical support member placement • Horizontal directional drilling underneath waterbodies during pipeline installation	See Row 1	See Row 1
Construction—In-water work, freshwater • Installation of culverts for stream crossings • Pile driving and sheet piling during construction • Placement of fill in waterbodies • Installation of water withdrawal intake from lakes and ponds	See Row 1	See Row 1

Action Affecting Resource	Type of Impact	Impact Indicators
Construction—Traffic activity • Increased air traffic • Increased ground traffic • Increased marine vessel traffic	See Row 1	See Row 1
Drilling and operations—General activity • Use and storage of heavy equipment in project area • Use and storage of hazardous materials during drilling and operations, such as fuels, lubricants, and solvents	See Row 1	See Row 1
Drilling and operations—Domestic wastewater disposal • Use of wastewater disposal pumps and additional equipment associated with wastewater disposal	See Row 1	See Row 1
Drilling and operations—Traffic Activity • Increased air traffic • Increased ground traffic	See Row 1	See Row 1
Drilling—General drilling • Production and injection well drilling • Subsurface injections of water, drill waste, or miscible-injectant	See Row 1	See Row 1
Operations—Gas and oil processing and infrastructure pad • Natural gas flaring at Willow Central Facility • Subsurface injection of produced water and natural gas as part of pressure maintenance and water flood for secondary recovery • Use of facilities equipment operating at the Willow Central Facility, infrastructure pad, or other nearby facilities, such as incinerators, turbines, and generators	See Row 1	See Row 1

Impact Analysis Area

- Direct—No direct impacts from this management plan; all impacts are indirect
- Indirect—The geographic extent of the NPR-A plus three assessment areas (conservation system units) near the NPR-A: Arctic National Wildlife Refuge, Gates of the Arctic National Park, and Noatak National Preserve
- Cumulative—NPR-A plus three assessment areas (conservation system units) near the NPR-A: Arctic National Wildlife Refuge, Gates of the Arctic National Park, and Noatak National Preserve

Analysis Assumptions

- Willow Master Development Plan Draft EIS, Alternative B (BLM 2019) criteria and hazardous air pollutant emissions normalized to emissions per barrel of oil produced during peak production would be representative of IAP indirect emissions per barrel of oil produced in future developments.
- Willow Master Development Plan Draft EIS, Alternative B (BLM 2019) multi-well horizontally drilled wells pads, pad sizes, sources, layout, and connecting infrastructure to processing facilities are representative of typical future development in the NPR-A.

F.4.3 Acoustic Environment

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Noise from drill rigs • Noise from pile driving • Noise from aircraft • Noise from gravel mining and blasting • Noise from construction of roads, well pads, and other ancillary support activities • Noise from the CPF • Noise from flaring • Noise from coastal and offshore sources • Noise from seismic surveys of unleased areas • Noise from non-oil and gas construction activities, such as construction of community infrastructure • Noise from the use of motorized equipment such as snow machines, all-terrain vehicles, occasional small aircraft, and limited local vehicle traffic associated with scientific activities	Impacts on human receptors from noise- and vibration-generating activities—Human receptors likely to be affected by post-lease oil and gas development activities are residents of NPR-A communities, including Nuiqsut and Utqiagvik; subsistence users of the Nuiqsut and Utqiagvik subsistence use areas; and recreationists in the southeastern portion of the NPR-A. Human receptors who could be affected by development activities unrelated to oil and gas, such as community infrastructure development and scientific activities, are residents of the NPR-A communities, subsistence users of subsistence areas, and recreationists throughout the NPR-A. Impacts on sensitive species from noise- and vibration-generating activities—Sensitive species are caribou, polar bear, seals, whales, and migratory birds.	• Estimated sound levels from noise-generating activities at various distances in decibels • Duration of sound (short-term or long-term) • Number of aircraft flights

Impact Analysis Area

The impact area for noise resources is the NPR-A and surrounding sensitive resources that could be affected by activities on the NPR-A. Stinchcomb (2017) suggests that noise from aircraft can be detected up to 65 miles away, with background noise, providing an outer estimate for the geographic area for aircraft noise disruption.

- Direct/Indirect
  - The high potential area illustrated in Figure B-1, Appendix B of the Final IAP/EIS
  - Throughout the planning area, including areas open to leasing and areas where activities unrelated to oil and gas, such as infrastructure development, would occur
  - The marine transit route illustrated in Figure B-2, Appendix B of the Final IAP/EIS
  - Areas under aircraft flight routes associated with post-leave development in the NPR-A
  - Coastal areas where infrastructure and facilities necessary for oil and gas production in the NPR-A would be located, such as a seawater treatment plant (STP) and barge landings (potential barge landings are shown on Figure B-2, Appendix B of the Final IAP/EIS; an STP location would depend on where an oil and gas development is sited)
  - Cumulative—Same as direct/indirect, plus development east of the NPR-A

Analysis Assumptions

- Background ambient noise levels are approximately 35 decibels, based on Stinchcomb (2017) and 50 decibels for developed areas.
- Future IAP post-lease development would be focused in the high potential areas illustrated in Appendix B of the Final IAP/EIS, Figure B-1, and little to no change in the acoustic environment would occur in the remaining portion of the NPR-A, with the possible exception of increases or decreases in noise from aircraft overflights.
- Decibels typically attenuate at a rate of 6 per doubling of distance for point sources.

F.4.4 Physiography

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resource extraction sites • Embankment fill	• Direct surface disturbance to vegetation; removal of surface and subsurface; destruction of surface landforms	• Acres and volume of material disturbed

Impact Analysis Area

- Direct/Indirect—The program area is the geographic scope of the analysis area.
- Cumulative—The program area is the geographic scope of the analysis area.

Analysis Assumptions

- None.

F.4.5 Geology and Minerals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resource extraction sites • Reclamation	• Direct surface disturbance to vegetation; removal of surface-insulating organics, causing frozen soils to thaw and destroying surface landforms • Sand and gravel mining in streams • Placing fill for construction of pads/roads • Changes in surface drainage/water impoundment • Changes in erosion where surface vegetation is removed • Change in river geomorphology as material is removed	• Acres and volume of material disturbed

Impact Analysis Area

- Direct/Indirect—The program area is the geographic scope of the analysis area.
- Cumulative—The program area is the geographic scope of the analysis area.

Analysis Assumption

- Mineral exploration and leasing, other than for petroleum and aggregate, will continue to be disallowed in the program area.

F.4.6 Petroleum Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Extraction of oil and gas	Reduction of oil and gas resources available for future use	Percentage of estimated total available reserves removed
Spills of oil and gas and releases of gas to the atmosphere	Loss of oil and gas resources for productive use	Number and volume of spills and gas leaks
Exploration phase	Improved understanding of petroleum oil and gas resources	Not applicable

Impact Analysis Area

- Direct/Indirect—Reduction in oil and gas resources available in the planning area
- Cumulative—Planning area

Analysis Assumptions

- Oil and gas development will occur under all action alternatives.
- Development will occur in a similar manner and will have impacts similar to other North Slope oil and gas developments.

F.4.7 Renewable Energy

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Lands closed to renewable energy leasing	Reduction in the acreage available to renewable energy leasing and reduction in potential generation of renewable energy	Acres of federal surface closed to renewable energy leasing

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumption

- Areas recommended for withdrawal from renewable energy leasing are withdrawn.

F.4.8 Paleontological Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Ground-disturbing activities resulting from oil and gas development, infrastructure, gravel pits, and pipeline and road corridors	Permanent potential destruction and loss of paleontological resources; also deterioration through exposure, increased access, vandalism, and looting	Focus on areas where Potential Fossil Yield Classification (PFYC) 4-5 units are present; quantify acres, if possible; if there are known localities or exposures from past research, describe qualitatively.
Designation and management of special areas and Wild and Scenic Rivers, regarding whether paleontological resources would be at reduced risk of impacts	Positive impact by limiting allowable activities or giving special (maximum) consideration to resource values and reducing chances resources may be disturbed or destroyed	Acres of PFYC 4-5, or qualitatively
Climate change, natural weathering, erosion	Permanent destruction and loss of paleontological resources through exposure, direct damage, and unauthorized collecting from natural river and coastal erosion and climate change trends	Qualitative discussion of potential impacts in areas that may contain PFYC 4-5 units or known localities

Impact Analysis Area

- Direct/Indirect—All parts of the planning area where ground-disturbing activities will be permitted on BLM-managed land
- Cumulative—The program area, the North Slope of Alaska, and the near-shore marine environment

Analysis Assumptions

- Surrogate PFYC data from Brent Breithaupt has been developed in lieu of waiting for full review of the Alaska PFYC data.
- Paleontological resources are nonrenewable, but development projects can lead to new discoveries.
- Many more resources and locales likely exist in the NRP-A than are currently inventoried.
- The affected environment descriptions and impact analysis assumptions from the 2013 EIS will guide this analysis.

- The acres of known PFYC 4-5 units is relatively small in relation to the overall NPR-A, and known localities are few.
- Allocations are not equivalent to impacts, but allocations may increase or decrease the risk of impacts or affect the discovery, research, or interpretive potential of paleontological resources.
- The alternatives do not specify the specific locations' ground-disturbing activities.
- There will be further assessment of paleontological resource potential and impacts associated with ground-disturbing actions that may require a field inventory.
- The 2012 EIS and Record of Decision conclude that proposed NPR-A activities would have a very low probability of affecting paleontological resources.

F.4.9 Soil and Permafrost Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resources extraction sites • Access roads/pads/staging areas/airstrips (gravel fill or ice) • Off-road tundra travel/activities • Construction of structures (e.g., pipeline vertical support members [VSMs] and building foundations) • Reclamation of embankments and pads	• Direct surface disturbance to vegetation • Removal of surface insulating organics to cause frozen soils to thaw and destroying surface landforms • Sand and gravel mining in streams affecting stream structure • Mining impacts on soil and permafrost (thawing, removal of soils) • Placement of fill for construction of pads/roads • Installation of piling for VSMs and infrastructure foundations (bridges)	• Acres of disturbance to soil and permafrost • Changes to soil and permafrost from placement of fills for embankments and pad, such as ground temperature and organic mat thickness • Changes to erosion of soil from placing fills for embankments and pad • Fugitive dust extents • Changes in drainage patterns due to permafrost thaw and redirection by embankments

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- Gravel fill roads and pads will be constructed across frozen soils.
- Pads and roads will be constructed to minimize potential thaw of frozen soils (use of thicker embankments or use of insulation).
- Water will pond at the base of embankments.
- Ice roads will be used for access during winter.
- Roads and pads will be reclaimed.
- Material will likely be extracted in sand, gravel, and hard rock sources.
- Material sites will be permitted separately from other infrastructure.

F.4.10 Sand and Gravel Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resource extraction sites • Ice access roads and pads • Reclamation	• Direct surface disturbance to vegetation; removal of surface-insulating organics, causing frozen soils to thaw and destroying surface landforms • Sand and gravel mining in streams • Placing fill for construction of pads and roads • Changes in surface drainage and water impoundment • Changes in erosion where surface vegetation is removed • Change in river geomorphology as material is removed	• Acres and volume of material disturbed • Acres available for mineral material disposal

Impact Analysis Area

- Direct/Indirect—The program area is the geographic scope of the analysis area.
- Cumulative—The program area is the geographic scope of the analysis area.

Analysis Assumptions

- Sand and gravel will be extracted in both uplands and floodplains.
- Access roads constructed from ice roads will be required to access material sources.
- Material resources are to be considered within the entire analysis area.
- Only mineral material mining and petroleum resources will be developed in the planning area.

F.4.11 Water Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
General disturbance caused by construction • Use of heavy equipment (general equipment operations) • Storage of heavy construction equipment in work areas	• Equipment will be taken across streams and will pass near lakes and ponds. There is a potential for erosion and increased turbidity and a potential to impound water and alter drainage patterns and flow regime. • There is an additional potential for hazardous contamination during transport to and from the site.	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing • Length of rivers and area of lakes in high development potential areas

Action Affecting Resource	Type of Impact	Impact Indicators
General disturbance caused by construction • Use and storage of hazardous materials during construction, such as fuels, lubricants, and solvents	• A spill or leak of hazardous material spill could affect surface waterbodies and shallow groundwater and consequently affect water quality. The extent would depend on the spill size, location, and response activities.	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing • Length of rivers and area of lakes in high development potential areas
Installation of culverts and bridges • Installation of culverts/bridges for stream crossings • Includes both initial summer placement and summer adjustments	• Culverts may alter surface flow and drainage and inundate or dry surrounding areas. • Bridge crossings may increase velocity and, as a result, increase erosion and turbidity, alter stream hydraulics and possible scour. • May affect downstream water quality due to increased erosion/turbidity. • May affect channel stability/alignment. Potential for culverts to wash out, causing deposition of sediment. Undersized culverts may impound water and lead to thermokarsting.	• Number of proposed culverts, bridges
Freshwater withdrawal caused by construction and drilling operation • Freshwater withdrawal associated with well drilling and associated construction of ice pads and ice roads and potable uses	• Water withdrawal from surface waterbodies may affect water resources (winter water volume available to fish species) and quality (dissolved oxygen available to resident fish). • There is also a potential for water withdrawal to affect availability or water quality of connected shallow groundwater.	• Water volume: Gallons of water withdrawn.

Action Affecting Resource	Type of Impact	Impact Indicators
Domestic wastewater disposal caused by construction and drilling operation • Wastewater that construction facilities, camps, and drilling operations create and dispose of	• Domestic wastewater may be disposed of via Class I injection wells or discharged to surface waterbodies, per Alaska Pollutant Discharge Elimination System General Permit. • Treated domestic wastewater effluent may affect water quality of receiving waterbodies, and there is a potential for spills if wastewater is transported. Discharged wastewater effluent may affect flows and channel stability in streams. • Water levels could be lowered by the need to use it for potable water, fire suppression, and maintenance.	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Proposed discharge rate into each waterbody • Description of condition of the wastewater being discharged with regard to pertinent water quality regulations
Gravel mining • Excavation of gravel at mine site	• There is a potential for changes in flow of adjacent stream channels, including alterations to channel alignment and erosion. • There is a potential for thermokarsting around pits. • Groundwater may be intercepted, creating ponds that would require pumping.	• Length of rivers in area open to sand/gravel mining • Area of lakes in area open to sand and gravel mining • Length of rivers and area of lakes in high development potential areas
Gravel mining • Ice pad stockpiling of overburden associated with gravel mine	• Stormwater runoff from stockpiled overburden could deposit sediment on tundra and transport pollutants.	• Length of rivers in area open to sand and gravel mining • Area of lakes in area open to sand and gravel mining • Length of rivers and area of lakes in high development potential areas

Action Affecting Resource	Type of Impact	Impact Indicators
Gravel mining • Annual mine dewatering during operational years	• Increase in sedimentation • Disruption of recharge • Thaw bulbs in the permafrost • Alteration of surface flow • Interception of groundwater flow • Discharges from dewatering may affect water quality of receiving waterbodies; discharges may affect flows in streams, potentially affecting channel stability or accelerating erosion and deposition, and the potential for increased thermokarsting. • Potential for dewatering to affect availability and discharge of effluent to affect water quality of connected shallow groundwater resources	• Drawdown of water table during pumping; volume (million gallons)
Site preparation and construction of ice roads and pads • Compacting snow • Installing insulation, as needed • Creating ice infrastructure	• Construction of ice roads would affect surface drainage patterns and may change the natural flow direction. Flow obstructions may increase depth and impoundment of flow and may affect channel stability or alignment. Flow over, around, and through obstruction may cause erosion of tundra or stream channels and deposition of sediment on tundra. • Potential loss of floodplain connectivity or changes to floodplain • Infiltration of meltwater into thawed soils in the active layer or unfrozen ground may affect shallow groundwater and water quality by changing alkalinity and pH.	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing • Water volume required for ice roads and pads

Action Affecting Resource	Type of Impact	Impact Indicators
Site preparation of gravel roads • Gravel placement for roads and pads • Fill material placement on previously undisturbed terrestrial terrain	• Gravel placement would affect surface drainage patterns and may change the natural flow direction. Flow obstructions due to absent or misplaced culverts may increase depth and impoundment of flow and may increase the potential for thermokarsting and cause turbidity. There could be impacts that would change stability and alignment. • Water overtopping roads and flowing around ends of pads or a culvert washout may erode and deposit sediment on tundra. • Potential loss of floodplain connectivity or changes to floodplains • Potential for stormwater runoff, leading to deposition of sediment and transport of pollutants	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Construction of deep excavations and drilling • Horizontal directional drilling underneath waterbodies during pipeline installation	• There is a potential for spills of drilling fluids.	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
In-water work—freshwater pile driving • Pile driving (vibratory and impact) • Sheet pile installation • Excavation and auger drilling to install pipeline vertical support member	• May affect downstream water quality due to increased erosion and turbidity as a result of disturbing ground and the stream bed. • Backwater from bridge piles and sheet pile may affect channel stability and alignment.	• Length of rivers in area open to infrastructure
In-water work—Freshwater fill placement • Placing fill in waterbodies for roads • Possibility of placing fill in waterbodies for pads	• Potential drainage patterns, impound water, and lead to thermokarsting • Potential water quality degradation due to erosion and increased turbidity • Potential for overtopping or fill washout • Potential stormwater runoff when fill is put in place and contributing pollutants	• Length of rivers in area open to infrastructure • Volume of gravel required

Action Affecting Resource	Type of Impact	Impact Indicators
Freshwater in-water work • Installation of intake for water withdrawal from lakes and ponds	• May affect water quality due to bed disturbance	• Area of lakes in area open to infrastructure and leasing • Volume of water withdrawal required
In-water work • Screeding or other contouring of the subsurface	• Increase in turbidity during in-water work	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Marine In-Water Work • Placing fill in water to construct the module transfer island • Cutting sea ice to accommodate module transfer island construction • Pile and sheetpile driving (includes vibratory and impact) • Reclaiming module transfer island	• Temporary increase in turbidity during in-water work • Alteration of regional hydrodynamics • Possible alteration of coastal sediment transport such that erosion and sedimentation may occur; possible infill of lagoons and estuaries • Scour of seabed due to increased velocities in areas of carved ice in spring	• Acres to be filled, volume of fill • Bathymetry, water depth (feet)
Traffic • Increased ground traffic on gravel and ice roads; includes light- and heavy-duty trucks and gravel hauling • Travel on community roads • Increased road/off-road traffic to access sites for subsistence hunting and fishing, recreation, and scientific research	• Potential for dust to affect water quality through increased turbidity and deposition of sediment on tundra • Water for dust suppression may contribute stormwater runoff	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Traffic • Increased marine vessel traffic from barges and vessels supplying fuel and commercial goods, and drilling operations • Increased pass-through marine vessel traffic • Marine vessel support of scientific operations • Marine traffic from ships completing seismic or bathymetric studies	• Possible propeller wash from barges and tugs could stir up bottom sediments and increase turbidity.	• Number of vessel trips • Locations of barge landings

Action Affecting Resource	Type of Impact	Impact Indicators
Traffic • Increased traffic by small vessels on streams and lakes to access sites for subsistence hunting and fishing, recreation, and scientific research	• Temporary increase in turbidity from propellers	• Length of rivers in area open to infrastructure and leasing • Area of lakes in area open to infrastructure and leasing
Drilling and operations • Presence of new infrastructure • Changes in existing conditions of public access to the project site	• Potential for stormwater runoff from roads and pads that may cause turbidity, erosion, and sediment deposition	• Acres of new infrastructure
General disturbance caused by drilling and operations • Use and storage of fuels, chemicals, and other hazardous materials on the drill sites and other project locations	• Potentials for leaks and spills of hazardous materials to reach waterbodies and affect water quality; potential for spills during transport • A hazardous material spill could affect shallow groundwater	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas
Drilling and operations • Production and injection well drilling • Subsurface injection of produced water and natural gas for secondary recovery • Associated mud pit • Flaring of natural gas	• Potential for blowout during drilling to affect surface water, shallow groundwater, or deep groundwater quality • Potential for reserve-pit fluids to affect shallow groundwater quality if they reach surface waterbodies • Potentials for leaks and spills of hazardous materials to reach waterbodies and affect water quality • Potential thermokarsting created by insufficient insulation, warm drilling fluids in mud pits, flaring elevation; associated water pooling in subsided areas	• Length of rivers in area open to infrastructure • Area of lakes in area open to infrastructure • Length of rivers and area of lakes in high development potential areas

Impact Analysis Area

- Direct/indirect—Streams, lakes, ponds and wetlands of the planning area
- Cumulative—Watershed boundaries of streams/drainage flowing to and through the project area; drainage areas of ponds and lakes; boundaries of waterbodies, including aquifers

Analysis Assumptions

- Impacts on water resources are similar to those described in other North Slope EISs.
- Water withdrawals will be limited to lakes and no water will be withdrawn from streams and shallow aquifers.

F.4.12 Solid and Hazardous Waste

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Management of solid waste generated by the development and operation of facilities • Exploratory drilling • Facility operations • Seismic activities • Road and facility construction Introduction of contaminants, including petroleum products, caused by the following: • Spills • Vehicle accidents and rollovers • Well blowouts • Pipeline leaks • Tank overfills Disposal of unregulated nonhazardous fluids Injection of nonhazardous fluids through Class I underground injection control	• Temporary and permanent storage of solid waste generated from activities in the storage area, landfill, or monofill (where one homogeneous type of waste is placed) • Air quality impacts from burning refuse • Design and implementation of wastewater facilities • Management of spills • Underground injection well • Staging and storage areas • Underground injection control (Class I or II wells)	• Underground injection control wells depth of discharge and type of materials • Include potential spill volumes (gallons and barrels) • Square footage needed for staging and storage
Management of solid waste generated by activities unrelated to oil and gas: • Subsistence and off-road travel • Recreation, such as camping, hiking, hunting, and off-road travel • Scientific activities and archaeological and paleontological digs • Community infrastructure projects	• Temporary and permanent storage of solid waste generated from activities	• Qualitative discussion of solid waste disposal from these scattered, localized activities

Impact Analysis Area

- Direct/Indirect—Direct impacts evaluated for the geographic extent of the NPR-A (minus communities); indirect impacts area is 0.25 miles outside of the direct impact geographic area
- Cumulative—Cumulative impacts evaluated for the same geographic area as the indirect impacts area, for example Willow and other known leases and development activities

Analysis Assumptions

- Projects will require a stormwater pollution protection plan, a spill, prevention, control, and countermeasure plan, a solid waste general permit, and an oil discharge prevention and contingency plan.
- Facilities will require a facility response plan to operate.
- Wastewater design will require approval from the Alaska Department of Environmental Conservation.
- Class I or Class II underground injection wells will require a permit/authorization from the Alaska Department of Environmental Conservation or the U.S. Environmental Protection Agency or both.
- Storing more than 55 gallons (in one container) of oils and other hazardous materials will have appropriate secondary containment.
- Best management practices will be implemented to prevent the discharge or accidental spill of petroleum or hazardous materials.

F.4.13 Vegetation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration: Use of tracked seismic-vibrator vehicles and camp trains pulled by tracked vehicles	• Direct Impacts on vegetation and plant communities from tracked vehicle traffic and the development of seismic trails	• Acres of vegetation classes in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by seismic surveys in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available) • No indicator available to assess possible plant community changes
Exploration drilling: Ice placement for ice roads, pads, and airstrips	• Direct impacts on vegetation and plant communities from ice placement and operation of ice roads, pads, and airstrips	• Acres of vegetation types in areas open to and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by ice infrastructure in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available) • No indicator available to assess possible plant community changes

Action Affecting Resource	Type of Impact	Impact Indicators
Project construction: Gravel mining	• Direct impacts, permanent loss of vegetated areas	• Acres of vegetation classes in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative
Project construction: Gravel placement for roads, pads, and airstrips	• Direct impacts, permanent loss of vegetated areas	• Acres of vegetation classes in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by gravel fill under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative
Project construction: Pipeline installation	• Direct impacts; permanent loss of vegetated areas	• Acres of vegetation types in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by the placement of VSMs for elevated pipelines under the theoretical high, medium, and low development scenarios presented in the RFD scenario (acreage figures are not available for each alternative separately) • Acreage expected to be affected by the installation of buried gas pipelines in the decision area from the 2012 IAP/EIS (revised acreage estimates for buried pipelines in this EIS are not available)

Action Affecting Resource	Type of Impact	Impact Indicators
Project operations: Use of gravel roads, pads, and airstrips	• Indirect impacts on vegetation and plant communities from drifted snow, altered hydrologic drainage patterns, and possible increases in thermokarst	• Acres of vegetation classes in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of gravel infrastructure • No indicator available to assess possible plant community changes
Project operations: Traffic on gravel roads	• Indirect alterations to vegetation and plant communities from gravel spray and dust fallout	• Acres of vegetation types in areas open to leasing and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of vehicle traffic on gravel roads • No quantitative indicator available to assess potential plant community changes
Project construction and operations: All disturbances with the capacity to introduce nonnative and invasive species	• Indirect changes to native plant communities and vegetation structure, with the potential introduction of nonnative and invasive species	• No quantitative indicator available to assess possible plant community changes
Project construction and operations: Oil and contaminant spills	• Direct impacts on vegetation and plant communities from tundra spills	• No indicator available to assess possible spill locations or magnitudes in relation to vegetation classes in the planning area
Abandonment and reclamation: Ice road construction, off-road tundra travel, gravel infrastructure removal, VSMs, and power poles	• Direct impacts on vegetation from reclamation	• No indicator available to assess possible reclamation locations or the intensity of reclamation in relation to vegetation types in the planning area
Community infrastructure, scientific, and subsistence activities: Off-road vehicle use, military site cleanup, tundra travel, off-runway landings, scientific research, and new community infrastructure	• Impacts on vegetation from community infrastructure projects, cleanup, tundra travel, off-runway landings, scientific research, and subsistence activities	• No indicator available to assess possible community infrastructure, scientific research, or subsistence activity locations or the intensity of those activities in relation to vegetation types in the planning area

Impact Analysis Area

- Direct/Indirect—No future development projects are planned under the revised leasing plans being considered in this EIS, and therefore no specific areas are known in which new developments could occur. Because of this, the impact analysis area for direct and indirect impacts was defined as the high development potential zone in the northeastern portion of the planning area. As described in the RFD scenario, the high development potential zone comprises 3,580,000 acres (see Appendix B of the Final IAP/EIS, Map B-1) and is the most likely area in which future developments would occur.
- Cumulative—The geographic area considered for cumulative impacts is the entire NPR-A and the foothills of the Brooks Range. The time frame for the analysis is all past and present developments on the NPR-A and extending forward 70 years. The 70-year time frame follows from Appendix B of the Final IAP/EIS, which notes that individual petroleum projects can be producing for 10 to 70 years.

Analysis Assumptions

- The analysis of possible direct impacts on vegetation resources during exploration—seismic surveys, ice roads, pads, and airstrips–depends on the estimates of acres likely to be affected by those activities that were prepared for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected during exploration were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The comparative analysis of possible direct impacts on vegetation resources among alternatives during construction and operations depends on the acreage estimates for the theoretical low, medium, and high development scenarios for gravel mining, gravel fill, and elevated pipeline impacts described in Appendix B of the Final IAP/EIS.
- The analysis of possible direct impacts on vegetation resources from installing buried gas pipelines depends on the number of acres likely to be affected by gas pipelines that were estimated for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected by gas pipelines were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The analysis of possible indirect effects on vegetation resources from the construction and use of gravel roads, pads, and airstrips depends on studies indicating that the most far-reaching indirect effects (dust deposition) were detectable up to 328 feet from the edge of gravel structures. No quantitative criteria are available to assess the extent of possible impacts on vegetation from petroleum and other contaminant spills, abandonment and reclamation, and community infrastructure, scientific, and subsistence activities. These impacts were qualitatively discussed.

F.4.14 Wetlands and Floodplains

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration: Use of tracked seismic-vibrator vehicles and camp trains pulled by tracked vehicles	• Direct alteration of wetland types from tracked vehicle traffic and the development of seismic trails	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by seismic surveys in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available)
Exploration drilling: Ice placement for ice roads, pads, and airstrips	• Direct alteration of wetland types from ice placement and operation of ice roads, pads, and airstrips	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by ice infrastructure in the decision area from the 2012 IAP/EIS (revised acreage estimates for seismic survey impacts in this EIS are not available)
Project construction: Gravel mining	• Direct impacts: Permanent loss of wetlands and Waters of the U.S.	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acres expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative
Project construction: Gravel placement for roads, pads, and airstrips	• Direct impacts: Permanent loss of wetlands and Waters of the U.S.	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by gravel fill under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative

Action Affecting Resource	Type of Impact	Impact Indicators
Project construction: Pipeline installation	• Direct impacts: Permanent loss of wetlands and Waters of the U.S.	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Acreage expected to be affected by the placement of VSMs for elevated pipelines under the theoretical high, medium, and low development scenarios presented in the RFD scenario (acreage figures are not available for each alternative separately) • Acreage expected to be affected by the installation of buried gas pipelines in the decision area from the 2012 IAP/EIS (revised acreage estimates for buried pipelines in this EIS are not available)
Project operations: Use of gravel roads, pads, and airstrips	• Indirect alteration of wetland types from drifted snow, altered hydrologic drainage patterns, and possible increases in thermokarst	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of gravel infrastructure
Project operations: Traffic on gravel roads	• Indirect alteration of vegetation and wetland types from gravel spray and dust fallout	• Acres of wetlands and water types in areas open and closed to leasing (in the high development potential zone only) for each alternative, classified by EIS-specific lease stipulations • Area of a disturbance buffer zone expected to be affected by the indirect effects of vehicle traffic on gravel roads
Project construction and operations: Oil and contaminant spills	• Direct impacts on wetlands and plant communities from spills on tundra	• No indicator available to assess possible spill locations or magnitudes in relation to wetland types in the planning area
Abandonment and reclamation activities: Ice road construction, off-road tundra travel, gravel infrastructure removal, VSMs, and power poles	• Direct impacts on wetlands from reclamation	• No indicator available to assess possible reclamation locations or the intensity of reclamation activities in relation to wetland types in the planning area

Action Affecting Resource	Type of Impact	Impact Indicators
Community infrastructure, scientific, and subsistence activities: Off-road vehicle use, military site cleanup, tundra travel, off-runway landings, scientific research, and new community infrastructure	• Impacts on wetlands from community infrastructure projects, cleanup activities, tundra travel, off-runway landings, scientific research, and subsistence activities	• No indicator available to assess possible community infrastructure, scientific research, or subsistence activity locations, or the intensity of those activities in relation to wetland types in the planning area

Impact Analysis Area

- Direct/Indirect—No development projects are planned under the revised leasing plans being considered in this EIS, so no specific areas are known in which new developments could occur. Because of this, the impact analysis area for direct and indirect impacts was defined as the high development potential zone in the northeastern portion of the planning area. As described in the RFD scenario, the high development potential zone comprises 3,580,000 acres (see Appendix B of the Final IAP/EIS, Map B-1) and is the most likely area in which developments would occur.
- Cumulative—The geographic area considered for cumulative impacts is the entire Arctic NPR-A and the foothills of the Brooks Range. The time frame for the analysis is all past and present developments on the NPR-A and extending forward 70 years. The future 70-year time frame follows from Appendix B of the Final IAP/EIS, which notes that individual petroleum projects can be producing for 10 to 70 years.

Analysis Assumptions

- The analysis of possible direct impacts on wetland resources during exploration (seismic surveys, ice roads, pads, and airstrips) depends on the estimates of acres likely to be affected by those activities that were prepared for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected during exploration were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The comparative analysis of possible direct impacts on wetland resources among alternatives during construction and operations depends on the acreage estimates for the theoretical low, medium, and high development scenarios described in Appendix B of the Final IAP/EIS for gravel mining, gravel fill, and elevated pipeline impacts.
- The analysis of possible direct impacts on wetland resources from installing buried gas pipelines depends on the acres likely to be affected by gas pipelines that were estimated for the decision area in the 2012 NPR-A IAP/EIS. Updated estimates of the area expected to be affected by gas pipelines were not prepared for this EIS, so the acreage figures from the 2012 IAP/EIS are assumed to apply to all current alternatives.
- The analysis of possible indirect effects on wetland resources from the construction and use of gravel roads, pads, and airstrips depends on studies indicating that the most far-reaching indirect effects (dust deposition) were detectable up to 328 feet from the edge of gravel structures.

No quantitative criteria were available to assess the extent of possible impacts on wetlands from petroleum and other contaminant spills, abandonment, and reclamation and from community infrastructure, scientific, and subsistence activities. These impacts were qualitatively discussed.

F.4.15 Fish and Aquatic Species

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic surveys: ● Use of tracked seismic-vibrator vehicles and camp trains pulled by tracked vehicles ● Use of vibroseis, air guns, or dynamite (or other explosives) to image the subsurface	● Compaction of ice over and surrounding waterbodies could cause short-term delays in melt. ● Increased sound pressure in unfrozen waterbodies (springs) could disturb, injure, or kill fish.	● No quantitative indicator available to assess potential seismic survey impacts on fish
Water withdrawal from lakes for ice roads, water supply, dust suppression, and other uses	Alteration or loss of winter and summer aquatic habitat due to water withdrawal may include the following: ● Changes in water levels ● Ice compaction ● Increased turbidity and other changes in water chemistry ● Alteration of water flow during breakup; that is, seasonal changes to water quantity and quality ● Changes in permafrost or groundwater sources ● Injury or mortality of fish from entrainment or impingement at water intake	● Describe lake acreage that could be affected
Submarine pipeline construction for STP	Temporary loss of marine fish habitat	● No quantitative indicator available to assess habitat loss from submarine pipeline trenching
STP discharge to marine waters	Changes to salinity or other water quality from discharging brine from saltwater treatment plant	● No quantitative indicator available to assess potential STP water discharge impacts on water quality
Gravel mining for road and pad construction	Alteration or loss of aquatic habitat: ● Changes in water quality, including turbidity ● Direct mortality of aquatic species, if mining occurs in waterbodies ● Creation of deep aquatic habitat in gravel pits post-mining	● Acreage expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative; however, there is no specific indicator available to assess direct effects of gravel mining in fish-bearing waters, because mine site locations are unknown.

Action Affecting Resource	Type of Impact	Impact Indicators
Gravel fill for new roads, pads, culverts, and bridges	Direct aquatic habitat loss; indirect aquatic habitat alteration from the following: ● Gravel dust and spray ● Temporary turbidity and sedimentation during gravel placement, compaction, and grading ● Changes in natural drainage patterns, such as water impoundment	● Acreage expected to be affected by gravel mining under the theoretical high, medium, and low development scenarios presented in the RFD scenario for each alternative; however, there is no specific indicator available to assess direct effects of gravel mining in fish-bearing waters, because mine site locations are unknown.
Vehicle traffic on ice or gravel infrastructure	● Displacement of fish due to blocked passage from delayed melt of ice roads or pads and ice plugs in culverts or blockage at bridges ● Habitat and water quality alterations, due to dust, gravel spray, or sediment runoff from gravel roads	● No quantitative indicator available to assess potential indirect impacts on fish and fish habitats from use of ice and gravel infrastructure
Bridge construction: ● Placement of bridge piers or pile ● Foundations in water pile driving	● Loss or alteration of aquatic habitat from changes in water flow or ice blockage during spring breakup ● Disturbance or displacement of fish during in-water bridge construction or, assuming all work in winter, no in-water work	● No quantitative indicator available to assess potential impacts on fish and fish habitats during bridge construction
● Potential spills from storage, use, and transport of waste and hazardous materials, including crude oil, fuels, saltwater, drilling fluids, and other chemicals ● Potential oil spills from wells, pipelines, or other infrastructure	● Habitat alteration if spill enters waterbodies ● Injury or mortality of fish from spilled material if it enters waterbodies	● No quantitative indicator available to assess potential indirect impacts on fish and fish habitats from contaminant spills
Entrainment of fish during water gather activities for gravel mining and ice infrastructure construction	● Fish injury or mortality from entrainment	● No quantitative indicator available to assess potential fish entrainment impacts
Abandonment and reclamation to restore habitats and habitat functions	● Potential beneficial impacts for fish from the improvement of aquatic habitat functions	● No quantitative indicator available to assess potential impacts on fish from habitat reclamation activities

Impact Analysis Area

- Direct/Indirect—No future development projects are planned under the revised leasing plans being considered in this EIS, so no specific areas are known in which new developments could occur. Because of this, the impact analysis area for direct and indirect impacts in onshore areas is the high development potential zone in the northeastern portion of the planning area. As described in the

RFD scenario, this zone is the most likely area in which future developments would occur. Offshore, the analysis area includes nearshore coastal areas that could be used for barge routes, offshore STP facility pad construction, STP mixing zones, and other connected actions in marine waters.

- Cumulative—The geographic area considered for cumulative impacts is the entire NPR-A, adjacent nearshore waters in the Beaufort and Chukchi Seas, and the foothills of the Brooks Range. The time frame for the analysis is all past and present developments on the NPR-A and extending 70 years. The future 70-year time frame follows from Appendix B of the Final IAP/EIS, which noted that individual petroleum projects can be producing for 10 to 70 years.

Analysis Assumptions

- The BLM leases are for onshore development; offshore activities could be considered connected actions, but the analysis does not include assessment of offshore infrastructure.
- Barge landing areas or docks will be part of the alternatives.
- Knowledge of fish and aquatic invertebrate use of NPR-A waters is still relatively sparse. Because of this, the analysis assumes use by the species recorded over a broader area than has been sampled.
- Alternatives will include water withdrawal from freshwater sources and from marine waters via an onshore STP.
- Not all streams and lakes in the planning area are fish-bearing, and EFH and Anadromous Waters Catalog designations for the NPR-A are incomplete; therefore, the analysis relies on an incomplete, though likely representative index—the Anadromous Waters Catalog—of aquatic resources in the NPR-A. The analysis assumes that fish use most of the planning area.
- The high development potential zone predominantly encompasses lands in the Lower Colville River and NPR-A fish habitat units. The analysis primarily focuses on impacts on these units, which have the greatest likelihood of being affected by development under all alternatives. Impacts on other units will be of the same type but will be less likely to occur.
- Pipeline corridors in the Teshekpuk Lake Special Area were not included in the analysis of areas conditionally available to infrastructure development. The pipeline corridors will be assessed in the revised version of the fish section of Chapter 3 of the Final IAP/EIS.
- Deep (5 to 13 feet) and very deep (over 13 feet) lake habitats are collectively referred to as deep lake habitat. For the purposes of this analysis, both depth ranges provide fish habitat.

F.4.16 Birds

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Open to leasing	• Loss or degradation of habitat or disturbance and displacement of birds if oil and gas exploration or development occurs. Associated drilling and ice roads can degrade habitat, increase bird strikes with vehicles, buildings, elevated structures, and suspended lines	• Acres open or closed to leasing

Action Affecting Resource	Type of Impact	Impact Indicators
Open to surface occupancy	● Loss or degradation of habitat or disturbance and displacement of birds if development infrastructure is constructed. Associated roads and infrastructure can increase bird strikes with vehicles, buildings, elevated structures, and suspended lines. Associated drilling and pipelines increase risk of spills and contamination. Increased access would increase subsistence harvest mortality.	● Acres open or closed to surface occupancy; stopover and breeding habitats would have a higher level of impacts if developed; if possible, acres of wetlands, waterbodies, coast, foothill, and riverine areas should be described.
Open to mineral materials (salables)	● Habitat loss, degradation, and disturbance and displacement	● Acres open to mineral materials with suitable bird habitat by species
Wild and Scenic River designation	● Designation would formalize habitat protection important for birds and their fish prey. Alternatives B, C, and D would open the possibility of degradation.	● River miles either designated (under Alternative B) or not designated (under Alternatives A, C, D, and E) as Wild and Scenic Rivers
River buffers	● Larger river buffers increase habitat protection.	● Acres of buffer widths
Open to right-of-way (ROW) corridors	● Loss or degradation of habitat or disturbance and displacement of birds if development infrastructure is constructed; associated roads and infrastructure can increase bird strikes with vehicles, buildings, elevated structures, and suspended lines; increases the risk of spills and contamination and mortality from hunting from increased access	● Acres occupied by gravel infrastructure and linear miles of pipelines; stopover, breeding habitats, and brood-rearing/molting areas would have a higher level of impacts; describe acres of wetlands, waterbodies, and coast, if possible.
Utqiagvik-Nuiqsut Road	● Loss or degradation of habitat or disturbance and displacement of birds if development infrastructure is constructed; associated roads and infrastructure can increase bird strikes with vehicles, buildings, elevated structures, and suspended lines; increases the risk of spills and contamination and mortality from hunting from increased access	● Acres occupied by gravel infrastructure and linear miles; stopover, breeding habitats, and brood-rearing/molting areas would have higher level of impacts; parse out acres of wetlands, waterbodies, and coast, if possible

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbance from infrastructure footprints, such as open pit mine sites, cleared facility sites, pipeline corridors, tailing reservoirs, waste rock dumps, and timber harvest	● Habitat loss and alteration, including altered successional patterns; with rehabilitation after abandonment, potential creation of avian habitats previously absent on that site for some species and actions	● Non-quantitative locations of infrastructure uncertain
Gravel placement for roads and pads	● Habitat loss	● Non-quantitative locations of roads uncertain
Gravel placement (roads and pads)	● Habitat alteration from drifted snow and altered drainage patterns	● Non-quantitative locations of roads uncertain
Road traffic on gravel roads	● Habitat alteration from gravel spray and dust fallout	● Non-quantitative locations of roads uncertain
Water withdrawal from lakes for dust suppression and other uses	● Habitat alteration by reduced or fluctuating water levels, loss of nesting sites on lakeshores, reduced water quality and fish availability	● Describe extent of effect in qualitative terms by aquatic habitat (lakes, rivers, springs)
Road traffic, air traffic, noise, and human activities	● Disturbance and displacement of birds from affected areas	● Non-quantitative locations of facilities uncertain
Road traffic	● Injury and mortality from accidental collisions	● Describe potential for vehicle collisions
Towers, power lines, guy wires, and other aboveground structures	● Injury and mortality from accidental collisions	● Describe potential for bird strikes
Use and storage of hazardous materials	● Injury and mortality from accidental releases and discharges or insecure containment	● Describe potential for accidental exposure
Use and storage of hazardous materials	● Habitat loss and alteration from accidental releases	● Describe potential for releases and spills
Tailings and waste rock storage	● Contaminant exposure (habitat effects covered under infrastructure)	● Describe potential hazards
Impoundments/reservoirs	● Habitat loss and alteration, creation of aquatic habitat	● Non-quantitative locations uncertain
Mine impoundments	● Contaminant exposure	● Describe potential hazards
Human activities and waste management	● Attraction of predators and scavengers, including increased abundance of some birds, and resulting decrease in survival and nesting success for prey species	● Potential impacts on bird populations and predator/prey dynamics (non-quantitative)
Human activities and increased access	● Habitat alteration from OHV traffic	● Non-quantitative, describe potential effects
Human activities and increased access	● Disturbance and displacement from OHV traffic and foot traffic and habitat alteration from OHV traffic	● Non-quantitative, describe potential effects
Human activities and increased access	● Injury and mortality from increased hunting pressure for some species	● Non-quantitative potential for population impacts

Impact Analysis Area

- Direct/Indirect—NPRA, 5-mile coastal buffer, and marine corridor
- Cumulative—NPRA, 5-mile coastal buffer, and marine corridor

Analysis Assumptions

- Specific development-related impacts cannot be quantified because no specific projects are proposed. Impacts can be described only qualitatively, both because resource and impact data are unavailable and because project details are unknown. Also, vegetation mapping information is coarse over the planning area and habitat use data are lacking for most species.
- Alternatives will be compared in terms of acres open or closed to various resource extraction or other reasonably foreseeable future activities. These acreages will not differ among resources. Additionally, broad groupings of birds that may be affected will be discussed within these broadly defined vegetation types (based on generalized knowledge of habitat use and distribution). The vegetation map will intersect with no surface occupancy areas, with areas of high fluid mineral potential, and with pertinent land management actions associated with each management alternative.
- As in the 2012 IAP, the most important potential actions in the planning area will be related to oil and gas exploration, leasing, development, ROWs, and associated gravel mines (salable mineral materials disposal and extraction). As no maps are available for ROWs, no quantification of related impacts is possible.

F.4.17 Terrestrial Mammals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration	• Direct and indirect effects on vegetation and behavioral disturbance affecting caribou and other ungulates, carnivores (including denning grizzly bears and wolverines), and small mammals	• Acres under different land status, by alternative
Construction of ice roads and pads to support winter exploration and construction	• Habitat alteration by ice roads and pads	• Acres under different land status, by alternative
Gravel placement for roads and pads	• Direct habitat loss	• Acres under different land status, by alternative • Acres of high quality habitat (Wilson et al. 2012) under different land status, by alternative
Traffic on gravel roads	• Habitat alteration from gravel spray and dust fallout	• Acres of potentially affected habitat, by habitat type
Gravel mining	• Direct habitat loss • With rehabilitation after abandonment • Indirect habitat loss by disturbance during mining	• Acres or square miles of potentially affected habitat, by habitat type

Action Affecting Resource	Type of Impact	Impact Indicators
Road traffic, air traffic, noise, and human activities	• Disturbance and displacement of caribou and other species from affected areas	• Area of seasonal range use for Western Arctic Herd and Teshekpuk Caribou Herd in potential disturbance zones
Roads and pipelines	• Potential obstructions to caribou movements, especially to and from insect-relief habitat • Habitat loss due to spills or leaks	• Proportion of Western Arctic Herd and Teshekpuk Caribou Herd using the areas, based on kernel distribution (probability of density)
Road traffic	• Injury and mortality from accidental collisions	• Qualitative assessment
Potential spills from the following: • Storage, use, and transport of waste and hazardous materials, such as crude oil, fuels, saltwater, drilling fluids, and other chemicals • Wells, pipelines, or other infrastructure	• Injury and mortality from accidental releases and discharges or unsecured containment	• Describe potential accidental exposure for individuals and areas
Human activities and waste management	• Attraction of predators and scavengers, potential defense of life and property, mortality of grizzly bears • Increase in red fox density and decline in arctic fox density	• Qualitative assessment
Roads and pads	• Increased or altered access for subsistence hunters, out-of-area hunters, and other recreationists	• Qualitative assessment

Impact Analysis Area

- Direct/Indirect—Planning area (non-marine habitats)
- Cumulative—Annual ranges of the Western Arctic Herd, Teshekpuk Caribou Herd, and Central Arctic Herd

Analysis Assumptions

- Subsistence hunting will be allowed along gravel roads.
- Access approvals for recreation or non-subsistence uses in the program area will be dealt with at the application for permit to drill phase.
- Zone of influence during calving season—Maternal caribou may be displaced by up to 2.5 miles from roads and pads during and immediately after calving, spanning approximately 3 weeks, based on research in North Slope oilfields.
- Caribou will be locally displaced by subsistence hunting or other activity off roads and pads.
- Roads and pipelines may deflect and delay caribou movements, but long delays can be mitigated by appropriate design features, such as pipeline heights of 7 feet or more, pipeline/road separation of

500 feet or more, low traffic levels, and management of human activities, as developed in the existing North Slope oilfields.

- Known locations of occupied grizzly bear dens will be avoided by at least 0.5 miles, as stipulated by the State of Alaska.

F.4.18 Marine Mammals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Winter activities: Seismic exploration, construction, and use of ice roads and pads, gravel mining and blasting, hauling, and placement	• Direct habitat loss of polar bear critical habitat, including maternal denning habitat, from gravel mining and placement • Alteration of habitat and temporary loss of use of polar bear critical habitat, including maternal denning habitat, from construction of ice roads and pads • Behavioral disturbance of polar bears, especially denning females	• Acreage of critical habitat units, including mapped potential maternal denning habitat, affected by seismic exploration • Apply no-disturbance buffer of 1.0 mile around known, occupied maternal dens under regulatory requirements of current incidental take regulations, based on published literature on disturbance from equipment operation and noise
Marine vessel traffic during open-water season	• Behavioral disturbance of marine mammals by vessel passage and offloading during open-water season • Injury and mortality from accidental ship strikes	• Apply distance buffers along vessel route, from literature-based assessment of disturbance responses
Traffic, aircraft, noise, and human activities throughout the year	• Behavioral disturbance and displacement from affected areas • Injury and mortality of polar bears from vehicle strikes • Disturbance of polar bears through deterrence actions in areas of human activity	• Apply distance buffer of 1.0 mile from literature-based assessment of disturbance from equipment operation and noise and 1.0-mile no-disturbance buffer around barrier islands unit of critical habitat
Waste management and use and storage of hazardous materials throughout the year	• Potential attraction and injury and mortality of some polar bears • Injury and mortality from accidental releases and discharges or unsecured containment	• Qualitative assessment, considering required operating procedures for waste handling and human/bear interaction plans

Impact Analysis Area

- Direct/Indirect—Planning area (including docking structures and adjacent marine habitats) and associated marine transportation routes
- Cumulative—Range of affected species population/stock, such as the Southern Beaufort Sea stock of polar bears and Western Arctic stock of bowhead whales

Analysis Assumptions

- Onshore activities will affect polar bears primarily, except for activities in the vicinity of marine docking structures and module-staging pads at the coast.
- Alternatives will avoid destruction or adverse modification of designated critical habitat (to be addressed in biological assessments and biological opinions, which are being prepared separately).
- Maternal den surveys for polar bears will be conducted before any activities begin in the program area, so that occupied dens can be located and avoided by at least 1 mile during exploration and development.
- Vessel traffic can be expected each year, though the frequency is unknown.
- Barge landings may require habitat modification, such as dredging or screeding, that has direct effects (habitat modification) and indirect effects (loss of habitat use through disturbance from noise and activity) on seals and possibly walruses.

F.4.19 Landownership and Use

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas open or closed to leasing and infrastructure development • Avoidance criteria or stipulations that limit the placement or design of uses • Land tenure adjustments	• Restrictions of infrastructure development, including type, location, and design • Conveyance of lands out of federal management	• Acres managed as avoidance or exclusion areas for new ROWs, permits, or leases • Acres identified for conveyance out of federal management

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumption

- Demand for ancillary uses and permits, such as for communication sites, will increase, in conjunction with oil and gas development.
- There will be no lands conveyed into or out of federal management as part of this EIS.

F.4.20 Cultural Resources

Impacts and Indicators

Note: Types of impacts are not mutually exclusive and may occur across all actions that affect a resource.

Action Affecting Resource	Type of Impact	Impact Indicators
Construction • Ground disturbance • Traffic • Human presence • Ice roads • Water use requirements	• Physical destruction or damage • Removal of the cultural resource from its original location and loss of context • Vulnerability to erosion • Theft and vandalism	• Number of previously documented Alaska heritage resources in potentially affected area • Eligibility status of cultural resource sites • Traditional knowledge of culturally sensitive areas and traditional use areas and sites

Action Affecting Resource	Type of Impact	Impact Indicators
Proposed project operational infrastructure • CPF • Drill rigs and pads • Pipelines and VSMs • Roads • Material sites	• Change to character and setting • Change in use of or access to traditional sites • Proximity of proposed project components to culturally sensitive areas	• Same as above
Operation activities • Traffic • Human presence • Maintenance and security activities • Proposed project policies	• Introduction of vibration, noise, or atmospheric elements, such as visual, dust, and olfactory sense • Increased access to culturally sensitive areas	• Same as above
Oil spills	• Physical destruction or damage, including issues with dating damaged artifacts	• Same as above
General development	• Loss of cultural identity with a resource • Effects on beliefs and traditional religious practices • Neglect of a cultural resource that causes its deterioration • Lack of access to traditional use areas and effects on the broader cultural landscape	• Same as above
Construction • Ground disturbance • Traffic • Human presence • Ice roads • Water use requirements	• Physical destruction or damage • Removal of the cultural resource from its original location or loss of context • Vulnerability to erosion • Theft and vandalism	• Number of previously documented Alaska heritage resources in potentially affected area • Eligibility status of cultural resource sites • Traditional knowledge of culturally sensitive areas and traditional use areas and sites

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- All unsurveyed areas of the proposed program area could contain cultural resources.
- Cultural resource sites are eligible for listing under the National Register of Historic Places, unless previously evaluated.

F.4.21 Subsistence Uses and Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Noise, traffic, and human activity • Construction and drilling noise • Gravel mining • Air traffic • Ground traffic • Seismic activity • Barge traffic • Human presence	• Reduced resource availability due to changes in resource abundance, migration, distribution, or behavior • Increased costs and time associated with harvesting resources • Increased safety risks associated with traveling farther to harvest resources • Reduced user access due to harvester avoidance of development and human activity • Increased competition with outsider populations	• Results of wildlife chapters on impacts of noise, traffic, and human activity on wildlife • Use areas by resource and community in the planning area and by alternative, if possible • Analysis of material and cultural importance of subsistence species • Traditional knowledge of impacts on subsistence uses, resources, and activities
Infrastructure • Gravel roads • Ice roads • Pipelines • Gravel pads • Bridges • Gravel mines • Runways	• Loss of subsistence use areas to development infrastructure • Physical obstructions to hunters traveling overland • Physical obstructions to hunters along the coast due to pipelines • Reduced resource availability due to changes in resource abundance, migration, distribution, or behavior • Increased costs and time associated with harvesting resources • Increased safety risks associated with traveling farther to harvest resources • Reduced user access due to harvester avoidance of development infrastructure • Increased user access due to use of project roads for subsistence activities • Increased competition along roads as new roads are used as hunting corridors	See above.

Action Affecting Resource	Type of Impact	Impact Indicators
Contamination • Oil spills • Air pollution	• Reduced resource availability due to changes in resource abundance • Reduced resource availability due to harvester avoidance of contaminated resources • Reduced user access due to harvester avoidance because of concerns about contamination	• Results of NPR-A IAP/EIS Chapter 3 wildlife sections regarding impacts of oil spills on wildlife • Results of air quality and public health sections of the Final IAP/EIS • Traditional knowledge
Legal or regulatory barriers Security restrictions	• Reduced user access due to security restrictions around development infrastructure • Reduced user access due to harvester avoidance resulting from concerns about security restrictions and personnel • Reduced resource availability due to inability to hunt in or around certain infrastructure	• Use areas by resource by community in planning area and alternatives (if possible) • Traditional knowledge
Increased employment and revenues	• Increased subsistence activity due to cash from employment and other revenue • Decreased subsistence activity due to increased employment and resulting lack of time • Decreased overall community harvests resulting from lack of time to engage in subsistence activities	• Results of the Final IAP/EIS economy section • Traditional knowledge
Development—general	• Impacts on cultural practices, values, and beliefs	• Traditional knowledge
Noise, traffic, and human activity • Construction and drilling noise • Gravel mining • Air traffic • Ground traffic • Seismic activity • Barge traffic • Human presence	• Reduced resource availability due to changes in resource abundance, migration, distribution, or behavior • Increased costs and time associated with harvesting resources • Increased safety risks associated with traveling farther to harvest resources • Reduced user access due to harvester avoidance of development and human activity • Increased competition with outsider populations	• Results of the Final IAP/EIS wildlife sections regarding impacts of noise, traffic, and human activity on wildlife • Use areas by resource by community in planning area and alternatives (if possible) • Analysis of material and cultural importance of subsistence species • Traditional knowledge regarding impacts on subsistence uses, resources, and activities

Impact Analysis Area

- Direct—All areas used in the NPR-A planning area for subsistence purposes

- Indirect—All areas used by the primary and peripheral subsistence study communities, in addition to all caribou areas used by the 42 caribou study communities
- Cumulative—Same as direct and indirect

Analysis Assumption

- There will be oil and gas exploration, construction, drilling, and other operations similar to other developments on the North Slope.

F.4.22 Sociocultural Systems

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Disruptions to subsistence activities and uses	• Social stresses associated with reduced harvests or changes in effort, costs, and risk • Changes in social ties and organizations from changes in subsistence providers • Loss of traditional use areas and knowledge associated with those places	• Results of the Final IAP/EIS subsistence section regarding impacts on subsistence • Traditional knowledge
Influx of nonresident temporary workers associated with project	• Conflicts between subsistence users and workers • Discomfort hunting in traditional use areas	• Results of the Final IAP/EIS economy section regarding outside workers • Results of subsistence chapter • Traditional knowledge
Influx of outsiders into community	• Increased social problems • Lack of infrastructure to support populations • Lack of knowledge and respect of traditional values, history, and beliefs	• Results of the Final IAP/EIS recreation chapter • Results of the Final IAP/EIS health chapter • Traditional knowledge
Changes in available technologies	• Changes in equipment for subsistence • Changes in transportation routes • Changes in social ties, sharing, and interactions	• Results of the Final IAP/EIS economic chapter regarding potential changes in employment and income • Traditional knowledge
Development—general	• Impacts on belief systems • Impacts on cultural identity	• Traditional knowledge

Impact Analysis Area

- Direct/Indirect—Communities addressed under subsistence sections
- Cumulative—Same as direct/indirect analysis area

Analysis Assumption

- The impact analysis on sociocultural systems will be from oil and gas activities similar to other developments on the North Slope.

F.4.23 Environmental Justice

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development and construction phase activities • Operations phase activities • Production of oil and gas resources	Direct and indirect effects • Subsistence effects • Sociocultural effects • Economic effects • Public health and safety effects	• High and adverse effects identified in other resource area analyses that can be shown to disproportionately accrue to minority populations, low-income populations, or Alaska Native tribal entities, as defined or described under CEQ guidance on the implementation of Executive Order 12898

Impact Analysis Area

- Direct/Indirect—All subsistence communities
- Cumulative—Same as direct/indirect analysis area

Analysis Assumptions

- Environmental justice impacts will derive from disproportionately high and adverse human health or environmental effects identified in other resource area analyses that could accrue to minority populations, low-income populations, or Alaska Native tribal entities. This could include such effects identified in any specific resource analysis, but primarily applies to subsistence, sociocultural, economics, and public health and safety.
- Minority and low-income populations are defined by CEQ guidance on the implementation of Executive Order 12898. The general reference population for this analysis is the State of Alaska.

F.4.24 Recreation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Disturbance in priority recreation areas (direct) • Noise, lights, and human activity (direct/indirect)	• Change in the quality of the recreation setting or user experiences • Displacement of recreation opportunities from surface disturbance • Change in the level of access to recreation opportunities, including specially permitted commercial activities	• Acres of disturbance in priority recreation areas • Acres identified for conveyance out of federal management

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- Current recreation in the planning area will continue.
- Recreation numbers may increase due to population growth.
- The potential for user interactions between all types of users will increase with increasing use.

F.4.25 Wild and Scenic Rivers

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
• Managing suitable river segments to protect their free flow, water quality, and outstandingly remarkable qualities • Recommending or not recommending suitable river segments for designation as a Wild and Scenic River	• 0.5- to 7-mile buffers—Within these buffers, permittees could construct essential pipelines and roads that cross the river, but no other permanent infrastructure would be permitted.	• Outstandingly remarkable values, tentative classification, and free-flowing nature of the river segment or corridor

Impact Analysis Area

- Direct/Indirect—Up to 7 miles of either side of the ordinary high-water mark of the suitable rivers in the NPR-A
- Cumulative—Up to 7 miles of either side of the ordinary high-water mark of the suitable rivers in the NPR-A

Analysis Assumptions

- The BLM would not permit any actions that would adversely affect the free-flowing nature, outstandingly remarkable values, or tentative classification of any portion of the suitable rivers or actions that would reduce water quality to the extent that they would no longer support the outstandingly remarkable values.

F.4.26 Wilderness Characteristics

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
• Short-term and long-term surface disturbance caused by development and facilities, such as ice roads, pads, airstrips, snow trails, exploration wells, gravel pads, roads, and pipelines	• Surface disturbance activities from oil and gas development and facilities	• Changes to the naturalness, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values in the planning area

Impact Analysis Area

- Direct/Indirect—All lands in the NPR-A
- Cumulative—All lands in the NPR-A

Analysis Assumptions

- Wilderness characteristics are defined in Section 2 of the Wilderness Act and consist of size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation. They may also include supplemental values.
- For all of the alternatives, size is a characteristic that will not be affected.
- The impacts on wilderness characteristics will be similar for all alternatives.
- The biggest difference between the alternatives in relation to wilderness characteristics is the total amount of activity that will take place under each alternative.

F.4.27 Visual Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Visual resource management (VRM) classes by alternative	• Potential for changes to the form, line, color, or texture of the characteristic landscape based on VRM classes that vary by alternative	• Acres of visual resource inventory classes in each VRM class for each alternative; table of visual resource inventory compared with VRM

Impact Analysis Area

- Direct/Indirect— BLM-managed surface lands in decision area
- Cumulative— BLM-managed surface lands in decision area

Analysis Assumptions

- For production and development of oil and gas, appropriate design techniques will be applied to conform with the appropriate VRM class.
- Activities that cause the most contrast and are the most noticeable to the viewer will have the greatest impact on changes to visual resources.
- As the number of acres of disturbance increase, the amount of changes to visual resources will also increase.
- The severity of a visual impact depends on a variety of factors, including the size of a project (such as the area disturbed and physical size of structures), the location and design of structures, roads, and trails, and the overall visibility of disturbed areas and structures.
- The more protection that is associated with the management of other resources and special designations, the greater the benefit to the visual resources.
- VRM class objectives apply to all resources. VRM class objectives would be adhered to through best management practices, project design, avoidance, or mitigation.
- Due to the slow rate of recovery of vegetation and surface conditions, all impacts on visual resources from surface disturbances associated with production and development of oil and gas will be long term.

F.4.28 Transportation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas open, closed, or limited to public or subsistence access • Seasonal or other timing-related restrictions on access • Roads developed from the North Slope to the NPR-A developments • Pipelines and collocated infrastructure from the North Slope to the NPR-A developments	• Change in the level of access (increase or decrease) for subsistence and public access	• Acres or miles of designated routes open, closed, or limited to public or subsistence access

Impact Analysis Area

- Direct/Indirect—Planning area
- Cumulative—Planning area

Analysis Assumptions

- Commercial and casual visits will continue to increase, thereby increasing the demand for access.
- Development of infrastructure will increase access opportunities from roads developed.
- Those seeking access in the decision area have different and potentially conflicting ideas of what should constitute public access on public lands.
- The primary means of access in the decision area will continue to be by aircraft and, to a lesser extent, boat (summer) and snow machine (winter).

F.4.29 Economy

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development phase activities • Operations phase activities • Oil and gas activities	Direct and indirect effects • Employment effects • Income effects • Fiscal effects • NPR-A impact mitigation funds • Potential effects and opportunities on relevant and selected economic sectors	• Average number of part-time and full-time jobs • Income • Government revenues: property taxes, corporate income taxes, severance taxes, royalties, other local taxes and fees • Increase or decrease in economic activity by sector (most likely qualitative)

Impact Analysis Area

- Direct/Indirect
  - Local—Communities in the NPR-: Atqasuk, Nuiqsut, Wainwright, and Utqiaġvik, plus other North Slope communities that receive NSB grants and funds: Anaktuvuk Pass, Kaktovik, Point Hope, and Point Lay. Special focus and more details will be provided for Nuiqsut, being the closest community to current oil and gas activities in the planning area.
  - Regional—NSB
- State—Alaska
- Cumulative—Geographic scope would depend on the list of past, present, and RFFAs, most likely the North Slope region and statewide discussion.

Analysis Assumptions

The following assumptions and data were used in quantifying the potential economic impacts of post-leasing oil and gas activities:

- Description of potential oil and gas activities and time frames under each alternative—This includes scenarios or assumptions regarding exploration, development, and production activities, such as road/ice road construction, onshore pipelines, processing facilities, and camps. This is the basis for quantifying the magnitude and scale of economic impact (see Appendix B of the Final IAP/EIS).
- Production volumes by year—These data are used to calculate potential royalty payments and other state and federal government tax payments.

- Oil price forecasts—Oil price data are used to quantify potential royalty payments and other fiscal effects of the proposed project. Oil price projections were obtained from the Energy Information Administration Annual Outlook.
- Construction costs and construction schedule—This information is used to calculate indirect (or multiplier) effects of construction spending, as well as potential government revenues, including oil and gas property taxes and state corporate income taxes. These data can also be used to estimate direct employment requirements associated with construction.
- Annual operations and maintenance costs of the facilities—This information is used to calculate indirect (or multiplier) effects of operations and maintenance spending, as well as potential government revenues, including state corporate income taxes. These data can also be used to estimate direct employment requirements associated with the operations phase, if direct jobs data are not available.
- Tariffs and transportation costs—This information is used to calculate netback prices, which are the basis for calculating royalty payments. Data on existing tariffs and transportation costs are published by the Alaska Department of Revenue (ADOR 2018).
- Landownership—This is used to determine potential royalty and ROW payments that would accrue to the landowners.
- The effects on activities unrelated to oil and gas and those not associated with an NPR-A lease are discussed qualitatively.

F.4.30 Public Health and Safety

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbance associated with oil and gas development	• Impacts on subsistence harvest	• Acres of subsistence harvesting area disturbed • Change in wildlife patterns and avoidance of oil and gas development
Oil and gas development	• Increase in air pollution	• Change in quantity of air pollutants introduced from oil and gas operations
Oil and gas development	• Increase in noise pollution	• Change in noise levels
Oil and gas development	• Increase in water pollution	• Possibility of catastrophic oil spill • Change in quantity of water pollutants introduced from oil and gas operations
Oil and gas development	• Change in demand for the NSB public health system	• Change in unintentional accidents and injuries • Change in oil and gas revenue for the NSB
Oil and gas development	• Economic impacts on health	• Change in oil and gas revenue for NPR-A residents in the villages of the NSB
Oil and gas development	• Jobs and income	• Increase in income and employment for NPR-A residents

Action Affecting Resource	Type of Impact	Impact Indicators
Oil and gas development	• Accidents and safety	• Changes in NPR-A resident travel patterns for subsistence harvest • Increased construction and vehicle traffic
Oil and gas development	• Infectious diseases	• Influx of workers into the NPR-A and interaction between workers and NPR-A residents
Activities not associated with oil and gas exploration and development—aircraft use, river trips, site cleanup and remediation activities, overland moves, and community infrastructure projects	• Increase in noise pollution • Impacts on subsistence harvest	• Change in noise levels and potential impacts on subsistence harvesting • Presence of camps for recreation or scientific study that may result in avoidance of the area by hunters

Impact Analysis Area

- Direct/Indirect—NPR-A boundary, including the following eight villages of the NSB: Anaktuvuk Pass, Atqasuk, Kaktovik, Nuiqsut, Point Hope, Point Lay, Utqiagvik, and Wainwright; most villages of the Northwest Arctic Borough: Ambler, Kiana, Noatak, Shungnak, and, to a lesser extent, Kotzebue, Kobuk, Selawik and Noorvik, diet and nutrition includes the 42 communities outlined in the subsistence section in primary communities, peripheral communities, and those communities that rely on the Western Arctic Herd and Central Arctic Caribou Herd.
- Cumulative—NPR-A boundary; diet and nutrition includes the three communities outlined for direct and indirect impacts.

Analysis Assumptions

- The NPR-A IAP EIS analyzes various leasing alternatives and does not analyze specific developments in the NPR-A.
- A health impact assessment will be required for specific oil and gas development once the lease sale is complete.

F.5 References

ADOR (Alaska Department of Revenue). 2018. Revenue Sources Book Fall 2018. Internet website: http://www.tax.alaska.gov/programs/documentviewer/viewer.aspx?1532r.

BLM (U.S. Department of the Interior Bureau of Land Management). 2018. Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project Final Supplemental Environmental Impact Statement. Bureau of Land Management, Alaska State Office. September 2018. Anchorage, Alaska.

_____. 2019. Draft Environmental Impact Statement: Willow Master Development Plan. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Stinchcomb, T. R. 2017. "Social-ecological soundscapes: Examining aircraft-harvester-caribou conflict in Arctic Alaska." Master's thesis. University of Alaska Fairbanks. December 2017. Internet website: https://scholarworks.alaska.edu/handle/11122/8143.

Wilson, R. R., A. K. Prichard, L. S. Parrett, B. T. Person, G. M. Carroll, M. A. Smith, C. L. Rea, and D. A. Yokel. 2012. "Summer resource selection and identification of important habitat prior to industrial development for the Teshekpuk Caribou Herd in northern Alaska." *PloS One* 7(11): e48697. Internet website: https://doi.org/10.1371/journal.pone.0048697.

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Appendix G
Climate and Meteorology

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ATTACHMENT

ACRONYMS AND ABBREVIATIONS — Full Phrase

°F	Fahrenheit
AMAP	Arctic Monitoring and Assessment Programme
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BOPD	barrels of oil per day
°C	degrees Celsius
CH_4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
IAP	integrated activity plan
IWC	Interagency Working Group
IPCC	Intergovernmental Panel on Climate Change
GHG	greenhouse gas
GWP	global warming potential
MMT	million metric tons
NEPA	National Environmental Policy Act
NPR-A	National Petroleum Reserve-Alaska
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
N_2O	nitrous oxide
$PM_{2.5}$	particulate matter with diameters 2.5 micrometers or less
SCC	social cost of carbon
USGS	U.S. Geological Survey

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Appendix G. Climate and Meteorology

G.1 AFFECTED ENVIRONMENT

Climate change is affecting natural systems across the globe, with enhanced impacts in the Arctic. The atmosphere and oceans have warmed, the ice cover is shrinking, and permafrost is melting in high latitude and high elevation regions. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-twentieth century (Intergovernmental Panel on Climate Change [IPCC] 2014; World Meteorological Organization 2019).

G.1.1 Greenhouse Gases and Climate Change Overview

The major greenhouse gases (GHGs) are carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). GHGs are produced both naturally through volcanoes, forest fires, and biological processes and through human activities, such as the burning of fossil fuels, land use and water management changes, and agricultural processes. Since GHGs absorb infrared radiation emitted from earth's surface, they block heat from escaping to space and warm earth's atmosphere. GHGs are necessary for keeping the planet at a habitable temperature. Without GHGs, earth's surface temperature would be around 60 °F cooler than it is now.

Natural biological and geological processes regulate levels of naturally occurring GHGs in the atmosphere; however, human-caused emissions have driven atmospheric concentrations of GHGS to levels unprecedented in 800,000 years. Concentrations of CO_2, CH_4, and N_2O have increased by 40 percent, 150 percent, and 20 percent since 1750, largely due to economic and population growth (IPCC 2014). Continued emissions of GHGs are expected to continue to warm the planet (World Meteorological Organization 2019).

Although black carbon is not a GHG, it affects climate in a variety of ways. Black carbon is emitted as a combustion byproduct. The concentration of black carbon can vary spatially, seasonally, and vertically in the atmosphere (Creamean et al. 2018; Stohl et al. 2013; Xu et al. 2017; Arctic Monitoring and Assessment Programme [AMAP 2018). Black carbon affects the climate by absorption and scattering of sunlight. It can also influence clouds by altering the size and number of water droplets and ice crystals in water and ice clouds. Black carbon in cloud droplets decreases the cloud albedo, which heats and dissipates the clouds. This also changes the temperature structure in and around the cloud, changing cloud distribution.

There is considerable uncertainty regarding the effect of black carbon on climate, as it can either warm or cool the atmosphere; however, black carbon is considered an important reason for the rapid warming in the Arctic (Ding et al. 2018). Altogether, the total effect of black carbon is estimated to be +1.1 W/m^2, indicating a net warming effect (Bond et al. 2013). Ramanathan and Carmichael (2008) estimated that the total forcing from black carbon varies from 0.4 to 1.2 W/m^2, with an average of 0.9 W/m^2. A large fraction of the black carbon in the Arctic can be attributed to long-range transport from Europe, Russia, and Asia (Ikeda et al. 2017). Black carbon is considered to be a short-lived climate forcer, and targeting its emissions may provide more immediate benefits, compared with the longer term goals of reducing CO_2 levels (Boone 2012; Cavazos-Guerra et al. 2017).

G.1.2 Regulatory Framework

On March 28, 2017, Presidential Executive Order 13783 (EO 13783), "Promoting Energy Independence and Economic Growth," was issued. EO 13783 required agencies to immediately review existing regulations and suspend, revise, or rescind those that burden the development of domestic energy resources beyond the degree necessary to protect the public interest or otherwise comply with the law. As a result, many of the previous executive orders and federal guidance related to climate change have been revoked or rescinded.

On October 30, 2009, the USEPA issued the reporting rule for major sources of GHG emissions (40 CFR 98). The rule required a wide range of sources and source groups to record and report selected GHG emissions. Various oil and gas operations are required to monitor and report GHG emissions under this regulation. The State of Alaska does not have any GHG regulations beyond federal regulations.

G.1.3 Climatology of the NPR-A

Several monitoring stations were used to characterize climate and meteorology in the National Petroleum Reserve-Alaska (NPR-A). Monthly average precipitation and temperature data were acquired from National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) stations at Umiat, Kuparuk, Utqiagvik, and Nuiqsut (**Figure G-1**). Additional monthly average precipitation and temperature data were obtained from the Applied Climate Information System, which is maintained by the NOAA Regional Climate Centers, as well as from NOAA's National Centers for Environmental Information. A monitoring station operated at Nuiqsut by SLR International Corporation on behalf of ConocoPhillips Alaska, Inc. was used to characterize prevailing wind patterns.

Table G-1 provides summaries of average monthly temperatures and precipitation. The NPR-A is classified as northern polar climate, with long and cold winters and short and cool summers. The annual average temperature in the NPR-A is approximately 10°F, with monthly average temperatures below freezing from October to May (BLM 2012). The coldest temperatures, usually in February, range from 8 to -15°F at the maximum and from -6 to -30°F at minimum on average (**Table G-1**), with the lower temperatures along the coast and higher temperatures inland. Summer temperatures rise above freezing, with the highest temperatures typically being in July. The average maximum and minimum temperatures in July range from 45 to 65°F and 35 to 45°F.

Annual average precipitation in the NPR-A is low, ranging from 2.7 inches at Nuiqsut to 13.3 inches at Chandalar Shelf Dot (**Table G-1**). Precipitation is highest during summer, with over three-fourths of the total annual precipitation falling between June and September. Though snowfall is sparser during the summer, it can occur during any month, with the highest average snowfall in October. There is generally snow on the ground from October to May (BLM 2012).

The prevailing wind direction measured at the ConocoPhillips Alaska, Inc. Nuiqsut monitoring station from 2013 to 2017 was from the northeast, with wind speeds averaging 5 meters per second (m/s). The maximum observed wind speed was 22.4 m/s and calm winds were infrequent, occurring for less than 1 percent of the time during the 5-year period.

Since the NPR-A covers a large geographic area, meteorological conditions could differ from measurements collected at Nuiqsut, a site that is influenced by its proximity to the coast. Similar to measurements collected at Nuiqsut, prevailing winds in the coastal plains in the NPR-A are frequently intense, particularly during winter, with very few calm periods. The prevailing wind direction in winter is generally northeast or easterly. At coastal locations in summer, temperature gradients between the surface and the ocean set up a diurnal land/sea breeze effect, and the wind direction depends on the direction to the coast. Farther inland a similar physical driver sets up diurnal flow patterns in mountains and valleys (commonly referred to as Mountain/Valley Flow) between the Brooks Range Foothills to the south of the NPR-A and the coastal plains. Mountain/Valley flow influences the wind direction at interior locations of the NPR-A, such as Umiat.

Figure G-1. Monitoring Stations Used to Characterize Climate and Meteorology in the NPR-A

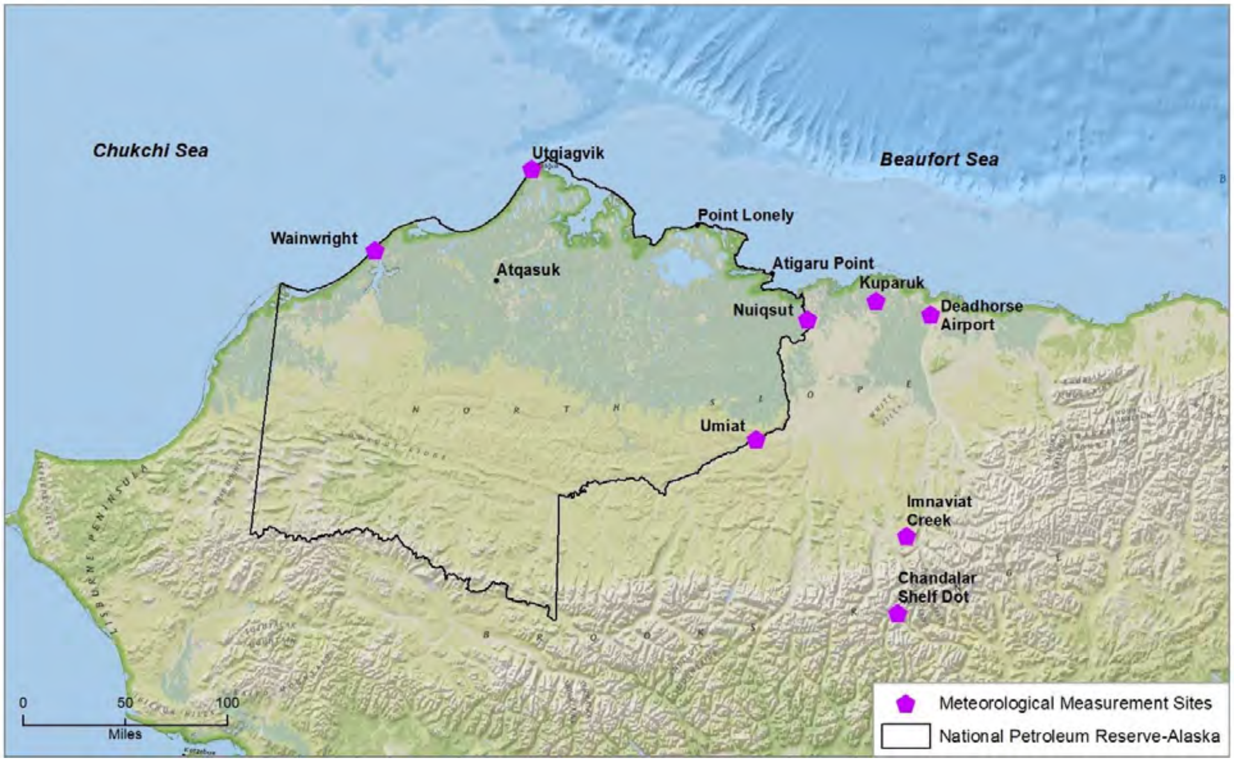

Table G-1
Monthly Climate Summary Data at Monitoring Stations in the North Slope for Air Quality

Utqiagvik [a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average max. temperature (°F)	-7.4	-10.6	-7.9	7.0	24.7	38.9	45.8	43.3	34.9	20.7	5.8	-4.4	15.9
Average min. temperature (°F)	-19.9	-22.7	-20.6	-6.8	15.3	30.1	34.1	34	28.2	11.6	-5.4	-16.2	5.1
Average total precipitation [b]	0.18	0.17	0.13	0.18	0.17	0.34	0.91	1.02	0.68	0.49	0.25	0.17	4.7
Average total snowfall [b]	2.4	2.7	2.0	2.8	2.3	0.6	0.3	0.7	4.0	7.7	4.3	2.8	32.5
Average snow depth	9	10	11	11	7	1	0	0	1	4	7	8	6

Kuparuk [a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F)	-11.3	-10.9	-8.4	8.7	28.1	47.4	56	50.8	39.2	21.5	4.0	-4.7	18.4
Average min. temperature (°F)	-23.9	-24.0	-22.6	-6.3	17.0	33.0	39.0	36.9	28.9	10.9	-8.9	-17.8	5.2
Average total precipitation [b]	0.13	0.17	0.08	0.14	0.07	0.32	0.87	1.06	0.48	0.35	0.16	0.13	4.0
Average total snowfall [b]	2.6	2.5	2.2	2.8	1.7	0.5	0.0	0.3	3.0	8.4	4.6	3.5	32.0
Average snow depth	9	9	9	10	5	0	0	0	0	3	6	7	5

Umiat [a]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F)	-12.7	-13.8	-6.7	11.5	32.4	57.5	66.2	57.7	41.4	18.2	-0.7	-11.9	19.9
Average min. temperature (°F)	-28.9	-31.2	-26.8	-11.0	15.7	37.0	42.5	37.2	26.1	2.4	-16.8	-28.0	1.5
Average total precipitation (in) [b]	0.38	0.26	0.16	0.21	0.07	0.68	0.79	1.06	0.47	0.68	0.38	0.33	5.5
Average total snowfall [b]	4.5	2.4	2.3	1.9	1.2	0.2	0.0	0.2	2.6	8.5	5.2	4.2	33.2
Average snow depth	14	16	17	17	9	0	0	0	0	5	9	12	8

Nuiqsut	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	-7.1	-9.6	-8.4	10.0	29.6	51.1	58.2	51.6	40.1	21.8	5.1	-2.5	20
Average min. temperature (°F) [c]	-22.9	-23.3	-21.5	-6.0	18.2	35.4	41.6	38.7	31.5	14.2	-8.7	-15.7	6.8
Average total precipitation [b, d]	0.07	0.09	0.03	0.16	0.18	0.29	0.71	0.88	0.39	0.04	0.05	0.09	2.7

Wainwright	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	-6.5	-7.7	-8.6	8.4	27.2	45.1	51.8	48.3	37.4	22.3	7.0	-1.9	18.6
Average min. temperature (°F) [c]	-17.0	-19.3	-19.3	-3.9	19.5	34.8	40.3	39.0	32.2	16.8	-2.6	-12.6	9.0
Average total precipitation [b, d]	0.02	0.02	0.03	0.05	0.17	0.44	0.97	0.91	0.5	0.24	0.1	0.04	4.4

Chandalar Shelf Dot	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	0.3	-0.1	6.6	20.3	38.8	53.9	55.8	49.3	36.2	17.5	5.1	2.7	23.9
Average min. temperature (°F) [c]	-10.6	-9.6	-5.1	6.9	26.2	41.2	43.9	37.6	27.3	9.1	-5.2	-7.7	12.8
Average total precipitation [b, c]	0.71	0.76	0.38	0.55	0.84	1.85	2.07	2.15	1.41	1.01	0.84	0.77	13.3

Deadhorse Airport	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F) [c]	-9.3	-11.6	-8.2	8.1	27.2	46	53.2	47.9	37.4	20.5	4.7	-3.8	17.7
Average min. temperature (°F) [c]	-23.1	-23.6	-23.1	-7.9	16.1	32.8	38.3	35.8	27.7	12.5	-8.1	-17.2	5.0
Average total precipitation [b, d]	0.05	0.03	0.01	0.09	0.19	0.44	0.84	0.91	0.47	0.2	0.06	0.07	3.14

Imnaviat Creek[e]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Average max. temperature (°F)	8.3	12.5	12.4	27.7	41.7	54.9	58.5	50.8	39.4	26.2	13.6	11.2	29.7
Average min. temperature (°F)	-5.9	-3.3	-4.6	9.7	25.9	40.3	45.2	38.7	28.4	15.6	1.7	-4.2	15.2
Average total precipitation [b]	0.37	0.45	0.45	0.4	0.7	1.55	3.21	2.6	1.32	0.88	0.5	0.44	12.6

a. Source: NOAA NWS data, obtained from Western Regional Climate Center (https://wrcc.dri.edu/summary/Climsmak.html). Period of record: Utqiaġvik (1901 to 2016); Umiat (1945 to 2001); Kuparuk (1983 to 2016). Historical records are under Utqiagvik's former name of Barrow.
b. Units of total precipitation are inches of liquid water equivalent; snowfall and snow depth in inches.
c. Source: NOAA NWS data obtained from NOAA National Centers for Environmental Information (https://www.ncdc.noaa.gov/cdo-web/datatools/normals). Period of record: 1981 to 2010.
d. Source: NOAA NWS data, obtained from USDA Natural Resources Conservation Service (http://agacis.rcc-acis.org/?fips=02185). Period of record: 2000 to April 2019.
e. Source: NOAA NWS data, obtained from USDA Natural Resources Conservation Service (http://agacis.rcc-acis.org/?fips=02185). Period of record: 2007 to April 2019.

Note: The average total annual precipitation does not exactly equal the sum of the average monthly precipitation because of differences in completeness requirements for monthly and annual data.

G.1.4 Observed Climate Trends

Arctic

Globally and nationally observed warming impacts are amplified in the Arctic; mean air temperature increases in the Arctic are double the global rate of increase. Average air temperatures in the region have increased by 3°F annually and 6°F in the winter over the past 60 years (Melillo et al. 2014). The annual average air temperature anomaly (meaning the departure from average conditions) for land north of 60°N latitude was the second largest from October 2016 to September 2017 since 1900, after 2015 to 2016 (Richter-Menge et al. 2017).

Spring snow cover extent, observed from satellites, has been decreasing over Arctic land since 2005, especially in May and June (Derksen et al. 2017). In 2017 snow cover extent was the lowest on record for April and May in the North American Arctic, and in 2016 snow cover extent was the lowest on record for June. Decreased snow cover extent and shorter snow cover duration in the Arctic is a reinforcing feedback effect, as more of the sun's energy is absorbed by the dark land surface, and warmer surfaces further reduce snow cover (Melillo et al. 2014).

Winter maximum ice extent in 2017 was the lowest on record, the third consecutive year of record low sea ice extent (Richter-Menge et al. 2017). Recent measurements of sea ice extent are approximately half of the size of sea ice when measurements began in September 1979 (Melillo et al. 2014). The extent of multiyear sea ice (ice that does not melt in summer) has also decreased, now comprising only 21 percent of ice cover in 2017, compared to 45 percent in 1985 (Richter-Menge et al. 2017). Generally, Arctic sea ice extent is two to three times larger at the end of winter (March) than the end of summer (September) (Perovich et al. 2017); however, from 1981 to 2010, anomalies in the ice extent show ice losses of 2.7 percent per decade in March and 13.2 percent per decade in September (Perovich et al. 2017).

Similar to decreases in snow cover extent, decreased sea ice extent also has a feedback effect on climate. An increased amount of the sun's energy is absorbed by the ocean, relative to oceans covered by ice, leading to increased rate of sea ice melting. Summertime sea ice has been decreasing throughout the twenty-first century, with a total loss of summertime sea ice expected by 2050 or earlier (Gunsch et al. 2017; Kolesar et al. 2017). Reductions in sea ice also make the Arctic more accessible by ships for transportation, oil and gas exploration, and tourism. This can lead to increased GHG emissions and other risks, such as oil spills and drilling and maritime-related accidents (Melillo et al. 2014).

Rising air temperatures over land affects the Arctic permafrost layer. Permafrost exists at or below 0°C for at least 2 years, and the active layer is the layer above the permafrost that thaws seasonally. The northern circumpolar permafrost zone stores 1,700 petagrams (billion metric tons) of organic carbon, locked there due to the slow rate of plant material decomposition in the frozen ground (Schuur et al. 2013). With rising temperatures and decreasing snow cover, permafrost extent is predicted to decrease significantly by 2100 (Slater and Lawrence 2013). Thawing permafrost releases carbon dioxide and methane to the atmosphere and delivers organic-rich soils to the bottoms of lakes, resulting in decomposition that releases further methane. These emissions can accelerate climate feedback effects (Markon et al. 2012). Voigt et al. (2017) suggest that thawing permafrost could lead to the release of large amounts of N_2O.

Reduction in sea ice has led to increased primary productivity in the Arctic Ocean (Richter-Menge et al. 2017). Warmer temperatures combined with reduced ice cover have led to tundra greening and increases in soil moisture and the amount of snow water available. These changes have led to increased active layer depth, changes in herbivore activity patterns, and reductions in human usage of the land due to a shorter period of time when the ground is frozen (Epstein et al. 2017; Clement et al. 2013). Though the greening of the tundra can store carbon as biomass, the effect of these changes in the Arctic has been a net release of carbon into the atmosphere (Richter-Menge et al. 2017; Epstein et al. 2017).

Black carbon has a magnified impact on climate in the Arctic due to the snow and ice feedback. This feedback occurs when black carbon settles on top of snow or ice and decreases the reflectivity (albedo) of the surface. This allows more heat to be absorbed by the surface, leading to increased melting, which further decreases the albedo. This feedback is prominent in the Arctic because so much of the surface is snow and ice, both of which have a high albedo.

North Slope

Similar to the Arctic as a whole, the North Slope has experienced increased average temperatures, decreased sea ice and snow cover extent, an expanded growing season, and thawing permafrost. Annual average temperatures in North Slope are expected to be -11.2°F to -9.0°F by the end of this decade (2019), 2.3°F higher than the annual average from 1961 to 1990 (-13.5°F to 11.3°F). By the 2050s, the annual average temperature is expected to be -8.9°F to -6.8°F (Scenarios Network for Alaska and Arctic Planning [SNAP] 2018).

Over the 35-year record (1982–2016) the North Slope has shown substantial increases in tundra greenness (Richter-Menge et al. 2017). A warming climate, in addition to regulatory changes and methods for measuring frost depth, has reduced the tundra travel open season from 200 days in the 1970s to less than 120 days in 2003 (North Slope Borough Oil and Gas Technical Report 2014). With continued climate warming and precipitation changes, the tundra travel season is expected to shorten further.

Since the mid-1980s, Alaskan permafrost on the Arctic coast has warmed between 6 and 8°F at a depth of 3.3 feet. In 2016, the highest temperatures at all but one permafrost observation site recorded at a 20-meter depth on the North Slope. At this depth, temperatures in this region have been increasing by between 0.21°C and 0.66°C per decade since 2000. The active layer depth was at a 210-year maximum in the North Slope in 2016 (Richter-Menge et al. 2017).

Measurements by the United States Geological Survey (USGS) climate and permafrost observing network show that near-surface permafrost has warmed by 3 to 4ºC since the 1980s and the warming is ongoing (Urban and Clow 2018). Air temperatures across the Arctic Slope have been warming by approximately 1ºC per decade during summer/autumn. Active layer temperatures are warming by about 1ºC per decade during all seasons, and the active layer is refreezing later in the autumn, by about 2 to 3 weeks, from mid-November in 1998 to late December in 2017. Consistent with this delay in autumn sea-ice formation, the timing of the snowfall peak shifts from early autumn to December, as more of the precipitation falls as rain during the autumn, resulting in shorter snowpack duration; however, the year-to-year and site-to-site variabilities in snowpack depth and duration are large, and trend toward shorter snowpack duration is weak.

Similar to the effects described for Alaska, the snow and ice albedo feedback from black carbon is magnified on the North Slope. It can come from a variety of sources, including international transport (Stohl 2006; Matsui et al. 2011; Ikeda et al. 2017; Xu et al. 2017; Ding et al. 2018), shipping (Corbett et al. 2010; Lack and Corbett 2012), oil and gas production (Stohl et al. 2013; Ault et al. 2011), and residential combustion (Stohl et al. 2013).

G.1.5 Trends in U.S. Alaska, and Global Greenhouse Gas Emissions

Greenhouse gas emissions in the U.S. are tracked by the U.S. Environmental Protection Agency (EPA) and documented in the Inventory of U.S. Greenhouse Gases and Sinks (EPA 2019). In 2017, 6,457 million metric tons (MMT) of carbon dioxide equivalents (CO_2e) were emitted in the U.S. The major economic sector contributing to GHG emissions in the U.S. in 2017 was transportation (29 percent). This was followed by electricity generation (28 percent), industry (22 percent), and agriculture (9 percent). Emissions of CO_2 accounted for 82 percent of all GHG emissions in the U.S. in 2017. As the largest source of U.S. GHG emissions, CO_2 from fossil fuel combustion has accounted for approximately 77 percent of U.S. GHG emissions since 1990. From 1990 to 2017, CO_2 emissions from fossil fuel combustion increased by 3.7 percent, and in 2016, the U.S. accounted for 15 percent of global fossil fuel emissions (EPA 2019).

Greenhouse gas emissions in Alaska are documented in the Alaska Greenhouse Gas Emissions Inventory. Emissions are calculated using a top-down approach, where emissions factors are applied to statewide activity data from 1990–2015. In 2015, approximately 41 MMT CO_2e were emitted in Alaska, according to the Alaska Department of Environmental Conservation (ADEC 2018). This is a decrease of approximately 8 percent from 1990 levels and a decrease of approximately 23 percent from the peak emissions in 2005.

The industrial sector, including oil and gas industries, is the major contributor to GHG emissions in Alaska. This is followed by the transportation, the residential and commercial sectors, and the electrical generation sector. The waste, agricultural, and industrial process sectors each contribute less than 1 percent to GHG emissions in Alaska (ADEC 2018). In 2015, Alaska was the 40th U.S. state in terms of total energy-related CO_2 emissions and the 4th highest in terms of per capita emissions (U.S. Energy Information Administration [EIA] 2018). Alaska represented about 0.7 percent of total U.S. GHG emissions in 2015 (EPA 2019) and 0.09 percent of global GHG emissions (IPCC 2014).

The USGS has estimated GHG emissions and carbon sequestration on federal lands for the 10 years from 2005 to 2014 (Merrill et al. 2018). CO_2 emissions associated with the combustion and extraction of fossil fuels from U.S. federal lands increased from 1,362 MMT CO_2e in 2005 to 1,429 MMT CO_2e in 2010; it then decreased to 1,279 MMT CO_2e in 2014. CH_4 and N_2O emissions from federal lands also decreased over the 10-year period. Less than 1 percent of the CO_2 and CH_4 emissions on federal lands was associated with fuel produced in Alaska. When the federal lands fossil fuel extraction and combustion emissions are combined with the ecosystems emissions and sequestration estimates, the net carbon emissions from Alaska range from -14.1 MMT CO_2e to -16.8 MMT CO_2e, indicating a net carbon sequestration from Alaska federal lands.

Total global GHG emissions in 2017 were estimated to be 50,900 MMT CO_2e (Olivier and Peters 2018). This represented an annual growth rate of 1.3 percent from 2016, after 2 years of virtually no growth (0.2 percent in 2015 and 0.6 percent in 2016). Present GHG emissions are approximately 55 percent higher than in 1990 and 40 percent higher than in 2000. CO_2 emissions are the largest source of global GHG emissions, with a share of about 73 percent, followed by CH_4 (18 percent), N_2O (6 percent), and fluorinated gases (3 percent). The U.S. accounts for approximately 13 percent of worldwide emissions. In 2017, the increase in global CO_2 emissions was due to a rise in global consumption of coal and oil and natural gas. In particular, global consumption of oil products and natural gas increased by 1.4 percent and 2.6 percent in 2017.

G.1.6 Projected Climate Trends and Impacts

Snow cover duration in Alaska is expected to drop with a later date of first snowfall and earlier snowmelt (Markon et al. 2012). Models predict that permafrost will continue to thaw, with some models predicting that large parts of Alaska will lose all near-surface permafrost by the end of the century. This will affect rural Alaskan communities by likely disrupting sewage systems and community water supplies.

The increasing trend in the Alaska growing season length is also projected to continue. This change will reduce water storage and increase the risk and extent of wildfires and insect outbreaks in the region. Warmer temperatures, wetland drying, and increased summer thunderstorms have increased the number of wildfires in Alaska. The annual area burned is projected to double by mid-century and triple by the end of the century, releasing more carbon to the atmosphere (Melillo et al. 2014).

Warmer temperatures in the project study area will lead to a deeper active layer, which would affect the surrounding ecosystem. It would allow improved water drainage and the migration of deeper-rooted plant communities farther north. Changes in plant communities would also be driven by the expanded growing season and warmer, drier soils. These vegetation changes would promote soil formation as root development and organic matter in the soil profile increase.

As the active layer deepens, damage from traffic over the surface during non-frozen periods would likely increase, due to accelerated erosion and subsidence of permafrost. Permafrost thawing could also lead to thermokarst, or slumping, resulting in increased nutrient loading and suspended sediment in lakes and rivers. Warmer temperatures may increase the frequency of lake-tapping (sudden drainage), as degrading ice wedges integrate into drainage channels at lower elevation.

Arctic fish species will be affected by increased water temperatures, as air temperatures increase, but this impact is difficult to predict. Arctic bird species will be affected by habitat loss as aquatic and semiaquatic habitats are converted into drier habitats. A reduction in available habitat would likely cause changes in bird distributions, increased competition for resources, and declines in productivity.

Paleontological resources could be adversely affected by climate change, but the impact is difficult to determine. Paleontological sites may more rapidly decompose in a warmer climate, and sites on hillsides, bluff faces, riverbanks, and terraces may be destroyed by mass wasting; however, erosion may lead to increased exposure of known paleontological sites. Many known paleontological sites in the project study area have been exposed due to erosion.

As with paleontological resources, cultural resources in the North Slope could also be affected by mass wasting, warmer temperatures, and erosion. In addition, as the permafrost thaws and the active layer deepens, cultural resources may be incorporated into the active layer. These sites would then be exposed to cryoturbation (frost mixing) and vertical disturbances, which may allow sites at different vertical layers to become mixed. These disturbances can occur in both vertical directions; this is because seasonal frost cracking can cause downward movement, and frost heaving and sorting, ice wedging, and involutions can push fossils upwards.

Climate change may affect the accessibility of mineral material deposits in the North Slope. While the existence and location of these deposits would not be affected, the excavation process may be made easier, due to the thawing permafrost; however, it could become more difficult because developing deposits in areas with thawed permafrost may require water removal or ground excavation in swampy conditions.

G.2 SOCIAL COST OF CARBON

A protocol to estimate what is referred to as the "social cost of carbon" (SCC) associated with GHG emissions was developed by the federal Interagency Working Group on Social Cost of Carbon (IWG). It assists agencies in addressing Executive Order 12866, which requires federal agencies to assess the cost and the benefits of proposed regulations as part of their regulatory impact analyses. The SCC is an estimate of the economic damages associated with an increase in carbon dioxide emissions and is intended to be used as part of an economic cost-benefit analysis for proposed rules. As explained in the Executive Summary of the 2010 SCC Technical Support Document "[t]he purpose of the [SCC] estimates . . . is to allow agencies to incorporate the social benefits of reducing carbon dioxide (CO_2) emissions into cost-benefit analyses of regulatory actions that have small, or 'marginal,' impacts on cumulative global emissions" (IWG 2010). While the SCC protocol was created to meet the requirements for regulatory impact analyses during rulemakings, the BLM has received requests to expand the use of SCC estimates for program and project-level National Environmental Policy Act (NEPA) analyses.

The BLM decided not to expand the use of the SCC protocol for the Integrated Activity Plan action discussed in this environmental impact statement (EIS) for several reasons. Most notably, this action is not rulemaking, for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued EO 13783; among other actions, it directed that the IWG be disbanded and that the technical support documents on which the protocol was based be withdrawn as no longer representative of governmental policy. The EO further directed agencies to ensure that estimates of the SCC and GHGs used in regulatory analyses "are based on the best available science and economics" and are consistent with the guidance contained in Office of Management and Budget Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (EO 13783, Section 5(c)).

In compliance with the Office of Management and Budget Circular A-4, interim protocols have been developed for use in the rulemaking context; however, the circular does not apply to non-rulemaking program or project decisions, so there is no EO requirement to apply the SCC protocol to management planning decisions, such as those in this EIS.

Further, NEPA does not require a cost-benefit analysis (40 CFR 1502.23), although it does require consideration of economic and social effects (40 CFR 1508.8(b)). The economic analysis in the Final IAP/EIS is discussed in Section 3.4.11. Any increased economic activity that is expected to occur with the proposed action is simply an economic impact, rather than an economic benefit. Some people may perceive increased economic activity as a positive impact; whereas another person may view increased economic activity as negative or undesirable due to a potential increase in local population, competition for jobs, and concerns that changes in population will change the quality of the local community. Economic impacts are distinct from economic benefits, as defined in economic theory and methodology (Watson et al. 2007; Kotchen 2011), and the socioeconomic impact analysis required under NEPA is distinct from an economic cost-benefit analysis, which is not required.

Potential climate impacts are analyzed in this IAP. Readers are referred to Section 3.2.1 of the Final IAP/EIS and **Sections G.1.2**, **G.1.4**, and **G.1.6** of this appendix for descriptions of climate change trends in the Arctic and on the North Slope and for a discussion of the potential effects of climate change on the region.

In addition to the qualitative climate change discussions discussed above, the BLM quantified the GHG emissions from production as well as the downstream GHG emissions from refining and consumption associated with the four alternatives (see Final IAP/EIS Section 3.2.1 and **Section G.3** in this appendix). Furthermore, **Section G.1.5** provides an inventory of recent GHG emissions at various geographic scales, in units of million MMT per year. Production and downstream emissions are compared to the MMT per year in Section 3.2.1 of the Final IAP/EIS. This is to provide an estimate of the relative contribution of such emissions under each alternative at various geographic scales.

The BLM referenced climate change trends and potential climate impacts at different scales and calculated production and downstream GHG emissions. It did this because climate change and potential climate impacts, in and of themselves, are often not well understood by the public (Etkin and Ho 2007; NRC 2009); therefore, the BLM has provided data and information in a manner that follows many of the guidelines for effective climate change communication developed by the National Academy of Sciences (NRC 2010) by making the information more readily understood and relatable to the decision-maker and the public. This approach recognizes that there are adverse environmental impacts associated with the development and use of fossil fuels. It discusses potential impacts qualitatively and effectively informs the decision-maker and the public of the potential for GHG emissions and the potential implications of climate change.

Finally, the SCC protocol does not measure the actual incremental impacts of a project on the environment and does not include all damages or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in carbon dioxide emissions, typically expressed as a 1 metric ton increase in a single year. It includes potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results “across models, over time, across regions and impact categories, and across 150,000 scenarios” (Rose et al. 2014). The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions; however, the dollar cost figure is generated in a range and provides little benefit in assisting the BLM Authorized Officer’s decision for program or project-level analyses. This is especially the case, given that there are no current criteria or thresholds that determine a level of significance for SCC monetary values.

G.3 Direct and Indirect Impacts

Emissions of the GHGs, CO_2, CH_4, and N_2O from future NPR-A projects will affect the climate. GHGs have lifetimes of 10 to 100 years or more before they are chemically broken down or otherwise removed from the atmosphere through absorption or deposition. Because GHGs are relatively stable, changes in GHG emissions have long-lasting effects on the climate. Also, because GHGs absorb infrared radiation emitted from the earth’s surface, they block heat from escaping to space and warm the earth’s atmosphere. **Section G.1.1** provides details on the role of GHGs in influencing the climate.

Black carbon, which is a by-product of incomplete combustion, can also influence climate, although it is not a GHG and has a shorter lifetime. As discussed in **Section G.1.1**, black carbon affects the climate by absorption and scattering solar radiation and by influencing cloud properties. Black carbon emitted onto ice and snow can increase melting and worsen warming, and darker and more absorbent land and water surfaces are exposed as a result.

Although there are large uncertainties in the estimates of black carbon’s effect on climate, the 2015 Arctic Monitoring and Assessment Programme Assessment (AMAP 2015) states that there is a “very high probability that black carbon emissions . . . have a positive forcing and warm the climate.” In addition, the IPCC has stated that black carbon emissions must fall by at least 35 percent across all sectors from 2010 levels by 2050 to limit global warming to 1.5°C (Rogelj et al. 2018).

In Alaska’s North Slope, black carbon sources can come from international transportation sources (Matsui et al. 2011; Stohl 2006; Xu et al. 2017), biomass burning (Creamean et al. 2018; Stohl 2006; Xu et al. 2017), shipping (Corbett et al. 2010; Lack and Corbett 2012), oil and gas production activities (Creamean et al. 2018; Stohl et al. 2013), and residential combustion (Stohl et al. 2013). In particular, black carbon emitted from shipping can be deposited directly onto sea ice, and ice breakers can deposit black carbon onto the ice pack itself (Brewer 2015).

GHG emissions are generated by construction and operations of future development activities (production GHG emissions), while downstream GHG emissions are those generated by refining and consumption of the produced and sold oil. With construction in the Arctic, black carbon will be emitted as part of the $PM_{2.5}$[1] emissions from diesel-fired equipment, including engines, boilers, heaters, pumping units, and other equipment, such as aircraft and flares.

It is difficult to quantify the effects of future oil and gas development in the NPR-A on global climate change. Instead, GHG emissions due to these activities are calculated and used as a proxy for understanding the potential impacts of future NPR-A development on climate change.

Black carbon emissions are not explicitly quantified in this assessment of climate impacts. The effect of black carbon on the Arctic climate is complex and is still an active area of research. There are still many uncertainties to be resolved by the scientific community to better understand the complex mechanisms and feedback between black carbon and its effect on Arctic climate; however, black carbon is a component of $PM_{2.5}$ and black carbon emissions are included in the $PM_{2.5}$ emissions that are quantified in the air quality analysis (Section 3.2.2 of the Final IAP/EIS).

Emission metrics facilitate multi-component climate policies by allowing emissions of different GHGs and other climate-forcing agents to be expressed in a common unit (CO_2-equivalent, or CO_2e emissions) (IPCC 2014). The global warming potential (GWP) was introduced in the IPCC First Assessment Report, where it was also used to illustrate the difficulties in comparing components with differing physical properties using a single metric. Each GHG has a GWP that accounts for the intensity of the GHG's heat trapping effect and its longevity in the atmosphere.

The 100-year GWP was adopted by the United Nations Framework Convention on Climate Change (IPCC 2014) and its Kyoto Protocol. In addition, the EPA uses the 100-year time horizon in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017 (EPA 2019). The 100-year GWP is only one of several possible emission metrics and time horizons. The IPCC presented updated 100-year and 20-year GWPs in the Fifth Assessment Report (AR5) (IPCC 2014), which the BLM used in this EIS, as discussed below.

As noted by IPCC (2014), the choice of emission metric and time horizon depends on the type of application and policy context; hence, no single metric is optimal for all policy goals. All metrics have shortcomings, and choices contain value judgments, such as the climate effect considered and the weighting of effects over time (which explicitly or implicitly discounts impacts over time), the climate policy goal, and the degree to which metrics incorporate economic or only physical considerations.

There are significant uncertainties related to metrics, and the magnitudes of the uncertainties differ across metric type and time horizon. In general, the uncertainty increases for metrics along the cause-effect chain from emissions to effects. The weight assigned to non-CO_2 climate forcing agents relative to CO_2 depends strongly on the choice of metric and time horizon (IPCC 2014). GWP compares components based on radiative forcing, integrated up to a chosen time horizon.

In this EIS, all GHG emissions were converted to units of CO_2e for ease of comparison using the two sets of GWP values shown in **Table G-2**. The choice of time horizon considerably affects the weighting of short-lived climate forcing agents, such as methane.

[1] Particulate matter with a diameter of less than 2.5 micrometers.

Table G-2
Global Warming Potentials

Time Horizon	CO_2	CH_4	N_2O	Rationale for Time Horizon
100 years	1	28	265	Used by IPCC in its climate change synthesis report of the AR5 (IPCC 2014)
20 years	1	84	264	Same as above.

Source: IPCC (2014)

The GHG emissions associated with the alternatives are discussed below. Alternative A is the No Action Alternative; Alternative B is more restrictive than Alternative A; Alternatives C, D, and E are less restrictive than Alternative A. For each alternative, there are three reasonably foreseeable development scenarios: low, medium, and high. Emissions were calculated for the low and high development scenarios; emissions for the medium development scenario are expected to be between the low and high scenarios.

Production GHG emissions from construction and operation associated with oil and gas extraction were estimated for the IAP low and high development scenarios. They based on peak barrels of oil per day production for each scenario by scaling emissions from a representative project. The Willow Master Development Plan (BLM 2019) includes such features as five drill pads, a central processing facility, gravel roads, airstrip, pipeline, module transfer island. The BLM assumed it to be representative of a future project in the NPR-A. Note that the Willow project is in the high development potential zone, so its emissions are anticipated to be most representative of development in that zone.

Development in the medium or low development potential zones of the NPR-A could have different production levels, equipment, infrastructure needs, and transportation; all of these would affect the GHG emissions estimates. No information is available to quantitatively assess GHG production emissions for the medium or low development potential zones; however, if development occurs in these areas, GHG production emissions would be greater than they are currently. The peak production from the Willow project and corresponding annual GHG emissions are shown in **Table G-3**. These data were used to estimate production GHG emissions in the hypothetical developments under all alternatives for peak annual production and production over 70 years.

The downstream GHG emissions from refining and consuming oil were estimated by the Bureau of Ocean Energy Management (BOEM) using its greenhouse gas lifecycle model (Wolvovsky and Anderson 2016; BOEM 2019; see Appendix X.1B) updated using 2019 emissions and consumption data. Downstream emissions were estimated for peak annual production and over 70 years. Market effects that would lower the downstream emission estimates were not considered in the calculation of downstream emissions, so the estimated downstream emissions are likely an overestimate.

Table G-3
Peak Production Rate and Corresponding Production Greenhouse Gas Emissions for the Representative Project, Willow, in Thousand Metric Tons/Year

Peak Barrels of Oil Per Day	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
131,000	902.963	0.370	0.0022	913.914	934.646

Source of data: BLM (2019)

Note: Numbers may not add up exactly, due to rounding.

G.3.1 Impacts Common to All Alternatives

Community infrastructure projects, such as roads, power lines, fuel pipelines/infrastructure, and communications systems, may be permitted under all alternatives, with appropriate mitigation measures in areas closed to oil and gas leasing and development. These and other non-oil and gas components discussed in Section 2.2.1 of the Final IAP/EIS could also result in climate change impacts due to GHG release during construction and operation.

G.3.2 Alternative A—No Action Alternative

Under Alternative A, approximately 52 percent (11.8 million acres) of the NPR-A's subsurface would be available for oil and gas leasing, including some lands closest to existing leases centered on the Greater Mooses Tooth and Bear Tooth units and Umiat. Lands near Teshekpuk Lake would be unavailable for oil and gas leasing.

Table G-4 summarizes the peak emission estimates from production for the development scenarios under Alternative A; **Table G-5** summarizes the peak production downstream GHG emissions for the low and high development scenarios under Alternative A; and **Table G-6** provides the 70-year lifetime production GHG emissions for the Alternative A low and high development scenarios; **Table G-7** provides lifetime downstream GHG emissions for the two development scenarios.

Table G-4
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative A

Development Scenario	Peak Production BOPD*	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	61,529	424	0.174	0.0010	429	439
High	256,369	1,767	0.725	0.0043	1,789	1,829

Note: Values for CO_2e may not add up, due to rounding.
*barrels of oil per day

Table G-5
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative A

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	7,239	0.5	0.1	7,268	7,293
High	30,162	1.9	0.3	30,283	30,388

Note: Values for CO_2e may not add up, due to rounding.

Table G-6
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative A

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	322,938,221	6,099	2.50	0.0149	6,172	6,313
High	1,345,575,921	25,410	10.42	0.0619	25,719	26,302

Note: Values for CO_2e may not add up, due to rounding.

Table G-7
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative A

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	104,652	6.5	0.9	105,071	105,437
High	436,050	27.3	3.7	437,798	439,321

Note: Values for CO_2e may not add up due to rounding

G.3.3 Alternative B

Alternative B is more restrictive than Alternative A and provides more specific guidance pertaining to activities unrelated to oil and gas. The same areas that are unavailable for oil and gas leasing under Alternative B would be closed to new infrastructure. The area unavailable for leasing and closed to new infrastructure would be increased from that under Alternative A to account for new resource-related data. **Table G-8** summarizes the peak emission estimates for the development scenarios under Alternative B, while **Table G-9** summarizes the peak production downstream GHG emissions for the low and high development scenarios.

Table G-10 presents the 70-year lifetime production GHG emissions for the Alternative B low and high development scenarios, while **Table G-11** shows the lifetime downstream GHG emissions for the two development scenarios. Production and downstream emissions for Alternative B are approximately 9 percent and 10 percent higher than those for Alternative A, respectively, due to higher projected production rates.

Table G-8
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative B

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	67,026	462	0.189	0.0011	468	478
High	279,275	1,925	0.789	0.0047	1,948	1,992

Note: Values for CO_2e may not add up, due to rounding.

Table G-9
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative B

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	7,949	0.5	0.1	7,980	8,008
High	33,119	2.1	0.3	33,252	33,368

Table G-10
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative B

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	354,598,831	6,696	2.75	0.0163	6,778	6,931
High	1,477,495,129	27,902	11.44	0.0680	28,240	28,881

Table G-11
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative B

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	114,912	7.2	1	115,373	115,774
High	478,800	29.9	4.1	480,719	482,392

G.3.4 Alternative C

Alternative C is less restrictive than Alternative A and would increase the total number of acres open to leasing, compared with Alternatives A and B. This would be accomplished by reducing the areas closed to leasing in the Teshekpuk Lake and Utukok River Uplands Special Areas. Both special areas would retain a core that is unavailable for leasing and closed to new infrastructure. The southern and eastern portions of the Utukok River Uplands Special Area would be available for new infrastructure.

Table G-12 summarizes the peak GHG emission estimates from production for the development scenarios under Alternative C; **Table G-13** summarizes the peak production downstream GHG emissions for the low and high development scenarios; **Table G-14** shows the 70-year lifetime production GHG emissions for the low and high development scenarios under Alternative C; and **Table G-15** provides the lifetime downstream GHG emissions for the two development scenarios.

Production emissions and downstream emissions under Alternative C are approximately 46 percent and 47 percent higher than those for Alternative A, due to higher projected production rates.

Table G-12
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative C

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	90,073	621	0.255	0.0015	628	643
High	375,306	2,587	1.061	0.0063	2,618	2,678

Note: Values for CO_2e may not add up, due to rounding.

Table G-13
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative C

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	10,645	0.7	0.1	10,688	10,725
High	44,356	2.8	0.4	44,534	44,689

Table G-14
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative C

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	474,909,149	8,968	3.68	0.0219	9,077	9,283
High	1,978,788,120	37,369	15.32	0.0911	37,822	38,680

Table G-15
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative C

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	153,900	9.6	1.3	154,517	155,055
High	641,251	40.1	5.5	643,820	646,061

G.3.5 Alternative D

Alternative D would make more land open to leasing and new infrastructure than Alternatives A, B, and C. The management of the Utukok River Uplands, Kasegaluk Lagoon, and Peard Bay Special Areas is the same as that under Alternative C. Under Alternative D, all of the Teshekpuk Lake Special Area would be available for leasing. No pipeline corridors would be needed in there because more areas would be open to new infrastructure.

Leasing management under this alternative would result in higher estimated oil production than Alternatives A, B, and C. **Table G-16** summarizes the peak production and GHG emission estimates from production for the development scenarios under Alternative D, and **Table G-17** summarizes the peak production downstream GHG emissions for the low and high development scenarios.

Table G-16
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative D

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	120,000	827	0.339	0.0020	837	856
High	500,000	3,446	1.413	0.0084	3,488	3,567

Note: Values for CO_2e may not add up, due to rounding.

Table G-17
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative D

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	14,194	0.9	0.1	14,251	14,300
High	59,141	3.7	0.5	59,378	59,585

Table G-18 provides the 70-year lifetime production GHG emissions for the low and high development scenarios in Alternative D, while **Table G-19** lists the lifetime downstream GHG emissions for the two scenarios. Production and downstream emissions for Alternative D are approximately 95 percent and 96 percent higher than those for Alternative A, due to an increase in the hypothetical production rates.

Table G-18
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative D

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	633,212,198	11,958	4.90	0.0291	12,103	12,377
High	2,638,384,159	49,825	20.43	0.1214	50,429	51,573

Table G-19
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative D

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	205,200	12.8	1.7	206,023	206,739
High	855,001	53.5	7.3	858,427	861,414

G.3.6 Alternative E

Alternative E would open the most land to leasing and new infrastructure. The management of the Kasegaluk Lagoon and Peard Bay Special Areas would be the same as that under Alternatives C and D. Under Alternative E, all of the Teshekpuk Lake Special Area would be available for leasing. No pipeline corridors would be needed there under Alternative E because more areas would be open to new infrastructure. Leasing management under this scenario would result in the same amount of estimated oil production as Alternative D.

Table G-20 summarizes the peak production and GHG emission estimates from production for the development scenarios in under Alternative E, and **Table G-21** summarizes the peak production downstream GHG emissions for the low and high development scenarios.

Table G-20
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative E

Development Scenario	Peak Production BOPD	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	120,000	827	0.339	0.0020	837	856
High	500,000	3,446	1.413	0.0084	3,488	3,567

Note: Values for CO_2e may not add up, due to rounding

Table G-21
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Peak Production Under Alternative E

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	14,194	0.9	0.1	14,251	14,300
High	59,141	3.7	0.5	59,378	59,585

Table G-22 provides the 70-year lifetime production GHG emissions for the low and high development scenarios under Alternative E, while **Table G-23** lists the lifetime downstream GHG emissions for the two scenarios. Production and downstream emissions for Alternative E are approximately 95 percent and 96 percent higher than those for Alternative A, due to an increase in the hypothetical production rates.

Table G-22
Production Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative E

Development Scenario	Total Barrels	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	633,212,198	11,958	4.90	0.0291	12,103	12,377
High	2,638,384,159	49,825	20.43	0.1214	50,429	51,573

Table G-23
Downstream Greenhouse Gas Emissions (Thousand Metric Tons per Year) from Lifetime Production Under Alternative E

Development Scenario	CO_2	CH_4	N_2O	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Low	205,200	12.8	1.7	206,023	206,739
High	855,001	53.5	7.3	858,427	861,414

G.4 References

ADEC (Alaska Department of Environmental Conservation Division of Air Quality). 2018. Alaska greenhouse gas emissions inventory: 1990–2015. Internet website: https://dec.alaska.gov/air/anpms/projects-reports/greenhouse-gas-inventory.

AMAP (Arctic Monitoring and Assessment Programme). 2015. AMAP Assessment 2015: Black Carbon and Ozone as Arctic Climate Forcers. Internet website: https://www.amap.no.

_____. 2018. AMAP assessment 2018: Arctic ocean acidification. Tromsø. Internet website: https://www.amap.no.

Ault, A., C. Williams, A. White, P. Neiman, J. Creamean, C. Gaston, F. Ralph, and K. Prather. 2011. "Detection of Asian dust in California orographic precipitation." *Journal of Geophysical Research*. 116: D16205.

BLM (Bureau of Land Management). 2012. National Petroleum Reserve-Alaska (NPR-A). Final Integrated Activity Plan (IAP)/Environmental Impact Statement (EIS). U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

_______. 2019. Draft Environmental Impact Statement: Willow Master Development Plan. Anchorage, Alaska.

BOEM (Bureau of Ocean Energy Management). 2019. Greenhouse Gas Downstream Emissions Estimates for BLM's National Petroleum Reserve-Alaska Project. August 2019.

Bond, T., S. Doherty, D. Fahey, P. Forster, T. Berntsen, B. DeAngelo, M. Flanner, et al. 2013. "Bounding the role of black carbon in the climate system: A scientific assessment." *Journal of Geophysical Research Atmospheres* 118: 5065–5911.

Boone, L. 2012. "Reducing air pollution from marine vessels to mitigate Arctic warming: Is it time to target black carbon?" *Carbon & Climate Law Review* 6: 13–20.

Brewer, T. L. 2015. Arctic Black Carbon from Shipping: A Club Approach to Climate-and-Trade Governance. International Centre for Trade and Sustainable Development.

Cavazos-Guerra C., A. Lauer, and E. Rosenthal. 2017. "Clean air and white ice: Governing black carbon emissions affecting the Arctic." In: *Governing Arctic Change* (K. Keil and S. Knecht editors). Palgrave Macmillan, London, United Kingdom. Pp. 231–256.

Clement, J., J. Bengtson, and B. Kelly. 2013. Managing for the Future in a Rapidly Changing Arctic: A Report to the President. Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska.

Corbett, J., D. Lack, J. Winebrake, S. Harder, J. Silberman, and M. Gold. 2010. "Arctic shipping emissions inventories and future scenarios." *Atmospheric Chemistry and Physics* 10: 9689–9704.

Creamean, J., M. Mahhn, G. de Boer, A. McComiskey, A. Sedlacek, and Y. Feng. 2018. "The influence of local oil exploration and regional wildfires on summer 2015 aerosol over the North Slope of Alaska." *Atmospheric Chemistry and Physics* 18: 555–570.

Derksen, C., R. Brown, L. Mudryk, K. Luojus, and S. Helfrich. 2017. Arctic report card: Terrestrial snow cover. Internet website: https://www.arctic.noaa.gov/Report-Card/Report-Card-2017/ArtMID/7798/ArticleID/696/Terrestrial-Snow-Cover.

Ding, M., B. Tian, T. Zhang, J. Tang, H. Peng, L. Bian, and W. Sun. 2018. "Shipborne observations of atmospheric black carbon aerosol from Shanghai to the Arctic Ocean during the 7th Chinese Arctic Research Expedition." *Atmospheric Research* 210: 34–40.

EIA (US Energy Information Administration). 2018. Energy-Related Carbon Dioxide Emission by State, 2000–2015. Washington, DC.

EPA (US Environmental Protection Agency). 2019. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017, EPA 430-P-19-001, April 2019. Internet website: https://www.epa.gov/ghg emissions/draft-inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017.

Epstein, H., U. Bhatt, M. Raynolds, D. Walker, B. Forbes, T. Horstkotte, M. Macias-Fauria, et al. Arctic Report Card 2017: Tundra Greenness. Internet website: https://www.arctic.noaa.gov/Report-Card/Report-Card-2017/ArtMID/7798/ArticleID/695/Tundra-Greenness.

Etkin, D., and E. Ho. 2007. "Climate change: Perceptions and discourses of risk." *Journal of Risk Research* 10(5): 623–641.

Gunsch, M. J., R. M. Kirpes, K. R. Kolesar, T. E. Barrett, S. China, R. J. Sheesley, A. Laskin, et al. 2017. "Contributions of transported Prudhoe Bay oil field emissions to the aerosol population in Utqiagvik, Alaska." *Atmospheric Chemistry and Physics* 17: 10879–10892.

Ikeda, K., H. Tanimoto, T. Sugita, H. Akiyoshi, Y. Kanaya, C. Zhu, and F. Taketani. 2017. "Tagged tracer simulations of black carbon in the Arctic: transport, source contributions, and budget." *Atmospheric Chemistry and Physics* 17: 10515–10533.

IWG (Interagency Working Group on Social Cost of Carbon). 2010. Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. Released February 2010.

IPCC (Intergovernmental Panel on Climate Change). 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (R. Pachauri and L. Meyers editors). IPCC. Geneva, Switzerland.

Kolesar, K., R. J. Cellini, P. K. Peterson, A. Jefferson, T. Tuch, W. Birmili, A. Wiedensohler, and K. A. Pratt. 2017. "Effect of Prudhoe Bay emissions on atmospheric aerosol growth events observed in Utqiagvik (Barrow), Alaska." *Atmospheric Environment* 152: 146–155.

Kotchen, M. J. 2011. "Cost-benefit analysis." Chapter in: *Encyclopedia of Climate and Weather*, Second edition (S. H. Schneider, editor-in-chief). New York, Oxford University Press. Pp. 312–315.

Lack, D., and J. Corbett. 2012. "Black carbon from ships: A review of the effects of ship speed, fuel quality and exhaust gas scrubbing." *Atmospheric Chemistry and Physics* 12: 3985–4000.

Markon, C., S. Trainor, and S. Chapin. 2012. The United States National Climate Assessment—Alaska Technical Regional Report. Virginia: U.S. Geological Survey.

Matsui, H., Y. Kondo, N. Takegawa, L. Sahu, Y. Zhao, H. Fuelberg, W. Sessions, et al. 2011. "Seasonal variation of the transport of black carbon aerosol from the Asian continent to the Arctic during the ARCTAS aircraft campaign." *Journal of Geophysical Research Atmospheres* 116: D05202.

Melillo, J., T. Richmond, and G. Yohe. 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. Washington, DC: U.S. Global Climate Research Program.

NRC (National Research Council). 2009. *Informing Decisions in a Changing Climate*. Washington DC: The National Academies Press.

_____. 2010. *Informing an Effective Response to Climate Chang*. Washington DC: The National Academies Press.

NOAA (National Oceanic and Atmospheric Administration). 2002. Final Restoration Plan for the M/V Kuroshima Oil Spill Summer Bay, Unalaska. Prepared by National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Alaska Department of Natural Resources, Alaska Department of Law, and Qawalangin Tribe of Unalaska.

_____. No date. Species Descriptions, Marine Mammals. Office of Protected Resources. Internet website: https://www.fisheries.noaa.gov/species/spotted-seal.

_____. 2015. Barrow Atmospheric Baseline Observatory Replacement Project Briefing.

_____. 2019. Barrow Atmospheric Baseline Observatory. Earth System Research Laboratory: Global Monitoring Division. Internet website: https://www.esrl.noaa.gov/gmd/obop/brw/.

North Slope Borough. 2014. Oil and Gas Technical Report: Planning for Oil and Gas Activities in the National Petroleum Reserve-Alaska. Barrow: Department of Planning & Community Services.

Olivier, J. G. J, and J. A. H. W. Peters. 2018. Trends in global CO_2 and total greenhouse gas emissions. December 2018. Internet website: https://www.pbl.nl/sites/default/files/cms/publicaties/pbl-2018-trends-in-global-co2-and-total-greenhouse-gas-emissons-2018-report_3125.pdf.

Perovich, D., W. Meier, M. Tschudi, S. Farrell, S. Hendricks, S. Gerland, C. Haas, et al. 2017. Arctic report card: Sea Ice. Internet website: https://www.arctic.noaa.gov/Report-Card/Report-Card-2017/ArtMID/7798/ArticleID/699/Sea-Ice.

Ramanathan, V., and G. Carmichael. 2008. "Global and regional climate changes due to black carbon." *Nature Geoscience* 1: 221–227.

Richter-Menge, J., J. Overland, J. Mathis, and E. Osborne. 2017. Arctic Report Card 2017. Internet website: http://www.arctic.noaa.gov/Report-Card.

Rogelj, J., D. Shindell, K. Jiang, S. Fifita, P. Forster, V. Ginzburg, C. Handa, et al. 2018. “Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. Geneva, Switzerland: IPCC. Original edition.” *In:* Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty (V. Masson-Delmotte, P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, et al. editors).

Rose, S. K., D. Turner, G. Blanford, J. Bistline, F. de la Chesnaye, and T. Wilson. 2014. Understanding the Social Cost of Carbon: A Technical Assessment. EPRI, Palo Alto, California.

Schuur, E., B. Abbot, W. Bowden, V. Brovkin, P. Camill, J. Canadell, J. Chanton, et al. 2013. “Expert assessment of vulnerability of permafrost carbon to climate change.” *Climate Change* 119: 359–374.

Slater, A., and D. Lawrence. 2013. “Diagnosing present and future permafrost from climate models.” *Journal of Climate* 26: 5608–5623.

SNAP (Scenarios Network for Alaska and Arctic Planning). 2018. North Slope climate analysis. Fairbanks: International Arctic Research Center. Internet website: https://www.snap.uaf.edu/projects/north slope-climate.

Stohl, A. 2006. “Characteristics of atmospheric transport into the Arctic troposphere.” *Journal of Geophysical Research Atmospheres* 111: D11306.

Stohl, A., Z. Klimont, S. Eckhardt, K. Kupiainen, V. Shevchenko, V. Kopeikin, and A. Novigatsky. 2013. “Black carbon in the Arctic: The underestimated role of gas flaring and residential combustion emissions.” *Atmospheric Chemistry and Physics* 13: 8833–8855.

Urban, F. E., and G. D. Clow. 2018. DOI/GTN-P Climate and Active-Layer Data Acquired in the National Petroleum Reserve-Alaska and the Arctic National Wildlife Refuge, 1998–2016. U.S. Geological Survey Data Series 1092 (Supersedes USGS Data Series 1021). Internet website: https://doi.org/10.3133/ds1092.

Voigt, C., M. E. Marushchak, R. E. Lamprecht, M. Jackowicz-Korczyński, A. Lindgren, M. Mastepanov, L. Granlund, et al. 2017. “Increased nitrous oxide emissions from Arctic peatlands after permafrost thaw.” *Proceedings of the National Academy of Sciences* 114: 6238–6243.

Watson, P., J. Wilson, D. Thilmany, and S. Winter. 2007. “Determining economic contributions and impacts: What is the difference and why do we care?” *The Journal of Regional Analysis and Policy* 37(2): 140–146.

Wolvovsky, E., and W. Anderson. 2016. OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon. BOEM OCS Report 2016-065. Internet website: https://www.boem.gov/ocs-oil-and-natural-gas.

World Meteorological Organization. 2019. WMO Statement on the State of the Global Climate in 2018. Report # WMO-No. 1233. ISBN 978-92-63-11233-0.

Xu, J.-W., R. V. Martin, A. Morrow, S. Sharma, L. Huang, W. R. Leaitch, J. Burkart, et al. 2017. “Source attribution of Arctic black carbon constrained by aircraft and surface measurements.” *Atmospheric Chemistry and Physics* 17: 11971–11989.

Attachment G-1. Greenhouse Gas Downstream Emissions Estimates for the BLM's National Petroleum Reserve-Alaska IAP/EIS

G-1.1 Overview

The IAP/EIS for the NPR-A includes an analysis on climate change that has been drafted with support from BOEM. The BLM used the BOEM model, the Greenhouse Gas Lifecycle Model (GHG Model) to help estimate carbon emissions from the consumption of the oil expected to be produced under the Final IAP/EIS. This attachment provides a comparison of the mid- and downstream emissions from the Final IAP/EIS alternatives.

The analysis for the Final IAP/EIS is limited to the mid- and downstream emissions associated with the processing and consumption of the oil from the project. This analysis does not include any estimated emissions from the actual production of resources (upstream, or what this paper refers to as on-site emissions) related to the NPR-A Final IAP/EIS.

G-1.2 GHG Model

The GHG Model was developed to estimate emissions that could be anticipated from the consumption of newly produced offshore oil and natural gas. For the NPR-A Final IAP/EIS, the BLM used the GHG Model to estimate emissions from oil refining and consumption. The full GHG Model documentation is entitled OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon.[2]

G-1.2.1 Adaptation of the GHG Model

The GHG Model calculates the impacts of consumption of oil, gas, and coal and is not specific to the domestic onshore, domestic offshore, or imports of the fuel consumed. As such, it is appropriate for calculating the GHG emissions from the consumption of oil and gas from the NPR-A Final IAP/EIS.

To reiterate, on-site emissions associated with the production of oil are not calculated in this analysis. To estimate these on-site emissions, a separate model would be required, designed to analyze GHG emissions from the onshore equipment and facilities.

Since publishing the above-cited technical documentation, the annual emissions from refineries and natural gas processing and storage systems have been updated, along with updates to reflect oil and gas consumption patterns in the U.S. as of 2019. In addition, the BLM is using GWPs recommended by the Intergovernmental Panel on Climate Change Fifth Assessment, where CH_4 has 28 times the GWP of CO_2, and N_2O has 265 times the GWP of CO_2.

[2]E. Wolvovsky and W. Anderson. 2016. OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon. BOEM OCS Report 2016-065. Internet website: https://www.boem.gov/OCS-Report-BOEM-2016-065/.

G-1.2.2 GHG Model Results

The GHG Model estimates only the emissions from the mid- and downstream activities for the Final IAP/EIS alternatives. The results of the GHG Model are shown in **Table G-1-1**.

Table G-1-1
Mid- and Downstream GHG Emissions for the NPR-A Alternatives

Alternatives	Scenario	Program				Peak Year			
		CO_2e	CO_2	CH_4	N_2O	CO_2e	CO_2	CH_4	N_2O
A	High	437,798	436,050	27	3	30,283	30,162	2	—
	Low	105,071	104,652	7	1	7,268	7,239	—	—
B	High	480,719	478,800	30	4	33,251	33,119	2	—
	Low	115,373	114,912	7	1	7,980	7,949	—	—
C	High	643,820	641,251	40	5	44,534	44,356	3	—
	Low	154,451	153,900	10	1	10,688	10,645	1	—
D/E	High	858,427	855,001	53	7	59,378	59,141	4	1
	Low	206,022	205,200	13	2	14,250	14,194	1	—

Note: Emissions estimates in thousands of metric tons; an em dash represents values greater than 0 but less than 500 metric tons.

Appendix H

Air Quality

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
µg	microgram
AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
AAQS	ambient air quality standards
ADEC	Alaska Department of Environmental Conservation
AEGLs	acute exposure guideline levels
AERMOD	American Meteorological Society and U.S. EPA Regulatory Model
ANC	acid-neutralizing capacity
AQRV	air quality related value
BLM	Bureau of Land Management
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
CAA	Federal Clean Air Act
CAP	criteria air pollutant
CFR	Code of Federal Regulations
CO	carbon monoxide
CPAI	ConocoPhillips Alaska Inc.
dv	deciview
DVC	current design values
DVF	future-year design values
EIS	environmental impact statement
EPA	Environmental Protection Agency
FLM	federal land manager
ha	hectare
HAP	hazardous air pollutant
IAP	integrated activity plan
IMPROVE	Interagency Monitoring of Protected Visual Environments
kg	kilogram
kg N/ha-yr	kilograms nitrogen per hectare per year
kg S/ha-yr	kilograms sulfur per hectare per year
kg/ha-yr	kilograms per hectare per year
m^3	cubic meters
MACT	Maximum Achievable Control Technology

MDA8	maximum daily 8-hour average
MDP	master development plan
mg	milligram
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NEPA	National Environmental Policy Act of 1969
NH_4^-	ammonium
NO_2	nitrogen dioxide
NO_3^-	nitrates
NO_x	nitrogen oxides
NPR-A	National Petroleum Reserve in Alaska
NPS	National Park Service
NTN	National Trends Network
O_3	ozone
Pb	lead
PM	particulate matter
PM_{10}	particulate matter with diameters 10 micrometers or less
$PM_{2.5}$	particulate matter with diameters 2.5 micrometers or less
ppb	parts per billion
ppm	parts per million
PSD	prevention of significant deterioration
REL	reference exposure level
RfC	reference concentration for chronic inhalation
RFD	reasonably foreseeable development
RHR	Regional Haze Rule
ROP	required operating procedure
RRF	relative response factor
SO_2	sulfur dioxide
SO_4^{2-}	sulfates
TO	toxic organic
TUV	Tropospheric Ultraviolet Visible
U.S.	United States
VOC	volatile organic compound
WRF	water research and forecasting
yr	year

Appendix H. Air Quality

H.1 Supplemental Information for Affected Environment

H.1.1 Standards for Criteria Air Pollutants (CAPs)

The Environmental Protection Agency (EPA) has defined the National Ambient Air Quality Standards (NAAQS) as required under the Clean Air Act (CAA) for six common pollutants referred to as criteria air pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). The NAAQS for PM are defined separately for PM with diameters 2.5 micrometers or less ($PM_{2.5}$) and PM with diameters 10 micrometers or less (PM_{10}). The CAA authorizes the EPA to delegate authority to states, and states often adopt the federal CAA by reference or establish more stringent standards. In Alaska, the EPA has delegated authority to the Alaska Department of Environmental Conservation (ADEC) for the implementation and enforcement of the Alaska Air Quality Control Regulations (18 Alaska Administrative Code [AAC] 50) through an EPA-approved state implementation plan. The Alaska Ambient Air Quality Standards (AAAQS) were promulgated in 18 AAC 50.010. The NAAQS and the AAAQS are provided in **Table H-1**.

Table H-1
National and Alaska Ambient Air Quality Standards

Pollutant [a]	Averaging Time	NAAQS [b]		AAAQS [c, d, e]	Form
		Primary [e]	Secondary		
CO	8 hours	9 ppm (10,000 μg/m^3)	--	10 mg/m^3 (10,000 μg/m^3)	Not to be exceeded more than once per year
	1 hour	35 ppm (40,000 μg/m^3)	--	40 mg/m^3 (40,000 μg/m^3)	Not to be exceeded more than once per year
NO_2	1 hour	100 ppb (188 μg/m^3)	--	188 μg/m^3	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Annual	53 ppb (100 μg/m^3)	53 ppb (100 μg/m^3)	100 μg/m^3	Annual mean, not to be exceeded
O_3	8 hours	0.070 ppm (137 μg/m^3)	0.070 ppm (137 μg/m^3)	0.070 ppm (137 μg/m^3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
$PM_{2.5}$	Annual	12 μg/m^3	15 μg/m^3	12 μg/m^3	Annual mean, averaged over 3 years
	24 hours	35 μg/m^3	35 μg/m^3	35 μg/m^3	98th percentile, averaged over 3 years
PM_{10}	24 hours	150 μg/m^3	150 μg/m^3	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	1 hour	75 ppb (196 μg/m^3)	--	196 μg/m^3	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	3 hours	--	0.5 ppm (1,300 μg/m^3)	1300 μg/m^3	Not to be exceeded more than once per year
	24 hours	--	--	365 μg/m^3	Not to be exceeded more than once per year
	Annual	--	--	80 μg/m^3	Annual mean, not to be exceeded

Notes:
a. Lead is not shown due to it not being a pollutant of concern in the National Petroleum Reserve in Alaska (NPR-A).
b. Source: 40 Code of Federal Regulations (CFR) 50
c. Source: 18 AAC 50.010
d. All AAAQS are primary, except for 3-hour SO_2
e. ppm = parts per million; ppb = parts per billion; μg/m^3 = microgram/cubic meters; mg/m^3 = milligram/cubic meters

The EPA designates geographic areas demonstrating compliance with the NAAQS as "unclassifiable/attainment," while areas that exceed the NAAQS are designated as "nonattainment." If there are insufficient data to designate an area as "attainment" or "nonattainment," the area will be designated as "unclassifiable." The National Petroleum Reserve in Alaska (NPR-A) is designated as "unclassifiable/attainment" for all CAPs.

H.1.2 Hazardous Air Pollutants (HAPs)

The CAA also mandates that the EPA regulate 187 air toxics, also known as hazardous air pollutants, that are known or suspected to cause serious health effects or adverse environmental effects (42 United States Code 7412). The EPA established national emission standards for hazardous air pollutants to regulate specific categories of stationary sources that emit one or more HAPs (40 CFR 63). National emission standards for hazardous air pollutants define maximum achievable control technology (MACT) standards that are technology-based standards for each regulated source category. MACT is applicable to all major sources (potential to emit more than 10 tons per year of a single HAP or 25 tons per year of any combination of HAPs) and to some area sources (any stationary source of HAPs not classified as a major source) in specific source categories.

The EPA compiled reference exposure levels (RELs) for use in risk assessments, which are developed by the California EPA. **Table H-2** shows the RELs. Acute RELs are defined as concentrations at, or below which, no adverse health effects are expected based on 1-hour exposures. No RELs are available for ethylbenzene or n-hexane. For those chemicals, acute exposure guideline levels (AEGLs) are used as thresholds that indicate mild (AEGL-1) or moderate (AEGL-2) effects. The AEGLs reported in **Table H-2** are based on an exposure time of 8 hours. AEGL-1 values for the other chemicals are listed also. RELs and exposure guidelines were obtained from the EPA's Air Toxics Database (EPA 2018a).

Table H-2
Air Toxic Acute and Reference Exposure Levels[1]

Select HAPs	Acute REL (mg/m^3)	AEGLs (mg/m^3)
Benzene	0.027	29[3]
Toluene	37	250[3]
Ethyl benzene	--[2]	140[3]
Xylene	22	560[3]
n-Hexane	--[2]	10,000[4]
Formaldehyde	0.055	1.1[3]

[1]EPA Acute Dose-Response Values for Screening Risk Assessments - Table 2 (EPA 2018a)
[2]No REL is available for these HAPs. Values shown are from acute exposure guideline levels for mild or moderate effects (EPA 2018a).
[3]Mild effects (AEGL -1)
[4]Moderate effects (AEGL-2)

Noncarcinogenic reference concentrations for chronic inhalation (RfCs) are shown in **Table H-3** (EPA 2018b). A RfC is defined by the EPA as the threshold at which no long-term adverse health effects are expected. Cancer risks are calculated and assessed against a one-in-one million cancer threshold. The threshold range was determined from the Superfund National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300.430), which states that "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response." The thresholds 10^{-4} and 10^{-6} correspond to a level of 1-in-10,000, and 1-in-1 million, respectively.

Table H-3
Air Toxic Noncarcinogenic Chronic Reference Concentrations

Select HAPs	Noncarcinogenic Chronic RfC (mg/m^3)[1]
Benzene	0.03
Toluene	5.0
Ethyl benzene	1.0
Xylenes	0.1
n-Hexane	0.7
Formaldehyde	0.0098

[1]EPA Prioritized Chronic Dose-Response Values for Screening Risk Assessments - Table 1 (EPA 2018b)

Cancer inhalation risk due to long-term exposure to a carcinogenic air toxic is calculated by multiplying the annual modeled concentration of the pollutant by its cancer unit risk factor. The cancer unit risk factors are shown in **Table H-4**. The calculations assume a 70-year exposure period even though the Willow project, which is used as a surrogate to model the HAPs concentrations, assumed an exposure period of 30 years. While 30 years may be a reasonable project lifetime for a single development project like Willow, residents in nearby communities could potentially be exposed to emissions from multiple projects in the NPR-A over their lifetime. The risk calculations represent two assessments: the maximum exposed individual and the maximum likelihood estimate. Assuming that most residents of Nuiqsut would stay in the area long term, the maximum likelihood estimate would be the same as the maximum exposed individual. The maximum annual concentrations from all modeled meteorological years were used to calculate the cancer inhalation risk. The calculated cancer risk is compared with a risk range of one in a million (EPA 2006).

Table H-4
Cancer Unit Risk Factors for Select HAPs

Pollutant	Cancer Unit Risk Factors ($1/(\mu g/m^3)$)[1]
Benzene	7.8E-06
Ethylbenzene	2.5E-06
Formaldehyde	1.3E-05

[1]Values referenced from EPA 2018b

It is possible that cancer risks due to the individual carcinogens emitted (benzene, ethylbenzene, and formaldehyde) may compound and overlap during specific meteorological conditions. A cumulative carcinogenic assessment can be performed, which includes calculating a total cancer risk (for comparison with the one-in-one million threshold), as well as the following calculations:

1. For each of the three carcinogenic pollutants (benzene, ethylbenzene, and formaldehyde), the maximum modeled annual concentration over the 5 years modeled at the Nuiqsut receptor was determined.
2. The individual cancer risk for each of the three pollutants was obtained by multiplying the maximum concentration by the pollutant's respective unit risk factors (found in **Table H-4**).
3. The individual cancer risks from each pollutant were added to estimate the total cancer risk.

This assessment conservatively takes the highest modeled impact over 5 years' worth of meteorology data; however, it is important to remember that it is uncertain how cancer risks associated with multiple carcinogens would actually compound (i.e., combine). As is standard practice in human health risk assessments, it is assumed that they would be additive.

H.1.3 Prevention of Significant Deterioration (PSD) Increments

The prevention of significant deterioration provisions of the New Source Review program of the CAA protect and preserve air quality in geographic areas designated as "attainment/unclassifiable" by requiring that new major sources or major modifications at existing sources do not result in a violation of the NAAQS or exceed maximum allowable increases in air quality over baseline concentrations (PSD increments) (40 CFR 52.21). PSD includes special protections for specific national parks and wilderness areas, known as Class I areas. The PSD increments are defined separately for Class I and Class II areas with the Class I PSD increments being more stringent.

There are no Class I areas within 186 miles of the NPR-A. The closest Class I area is Denali National Park, which is located more than 435 miles to the south of the Reserve. All the areas in Alaska that are not classified as Class I areas are Class II areas (18 AAC 50.015). **Table H-5** presents the Class II PSD increments. A PSD increment analysis is applicable to individual new major sources or major modifications at existing individual sources. Thus, a PSD increment analysis is not relevant to disclosing impacts or decision-making in this integrated activity plan (IAP); therefore, a PSD increment analysis is not presented in the NPR-A Final IAP/Environmental Impact Statement (EIS).

Table H-5
Prevention of Significant Deterioration Increments for Class II Areas

Pollutant	Averaging Time	PSD Increment (μg/m³)	Form
NO_2	Annual	25	Annual mean, not to be exceeded
SO_2	3 hours	512	Not to be exceeded more than once per year
	24 hours	91	Not to be exceeded more than once per year
	Annual	20	Annual mean, not to be exceeded
$PM_{2.5}$	24 hours	9	Not to be exceeded more than once per year
	Annual	4	Annual mean, not to be exceeded
PM_{10}	24 hours	30	Not to be exceeded more than once per year
	Annual	17	Annual mean, not to be exceeded

Source: 40 CFR 52.21

H.1.4 Air Quality Related Values (AQRVs)

AQRVs are resources that may be affected by a change in air quality (NPS 2011). The CAA gives federal land managers (FLMs) the responsibility to protect AQRVs in Class I areas from the adverse impacts of air pollution (40 CFR 51.166). The Federal Land Managers' Air Quality Related Values Work Group identifies AQRVs as "visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the FLM for a particular area" (FLAG 2010).

Visibility is a measure of how far and well we can see into the distance and is sensitive to changes in air quality. Visibility impairment, or haze, occurs when sunlight is absorbed or scattered by tiny particles (e.g., sulfates [SO_4^{2-}], nitrates [NO_3^-]), and gases [e.g., NO_2]; EPA 2017a). The absorption and scattering of light impairs visibility conditions (i.e., visual range, contrast, and coloration). Haze-causing pollutants can be directly emitted or can be formed through the reaction of precursor gases emitted into the atmosphere (e.g., formation of SO_4^{2-} from SO_2). The Regional Haze Rule (RHR) was promulgated in 1999 to improve and protect visibility in Class I areas (40 CFR 51.308). The RHR defines reasonable progress goals to improve visibility on the most impaired days and to ensure no degradation on the least impaired days with the goal of attaining natural conditions (i.e., estimated visibility conditions in the absence of human-made air pollution) in each Class I area by 2064. Under the RHR, visibility is quantified using the deciview (dv) haze index, which is derived from light extinction. An incremental change in dv corresponds to a uniform and incremental change in visual perception for the entire range of visibility conditions. Single source impacts on visibility are assessed by comparing the 98th percentile of the source contribution to the haze index to defined thresholds. A source that exceeds 0.5 dv (approximate 5 percent change in light extinction) is considered to contribute to visibility impairment, while a source that exceeds 1.0 dv (approximate 10 percent change in light extinction) is considered to cause visibility impairment (FLAG 2010).

Atmospheric deposition is the transfer of pollutants from the atmosphere to soil, vegetation, water, and other surfaces via dry or wet processes. Deposition can negatively affect ecosystems and other AQRVs. Dry deposition is continuous while wet deposition can only occur in the presence of precipitation (e.g., rain or snow). Potential deposition impacts include, but are not limited to, acidification of soils and waterbodies and nutrient enrichment (FLAG 2010). Wet or dry deposition of acidic pollutants formed from emitted SO_2 and nitrogen oxides (NO_x) is referred to as acid rain (EPA 2017b).

There are currently no federal standards for atmospheric deposition, but FLMs use critical loads and deposition analysis thresholds for assessing both cumulative impacts and source-specific impacts, respectively, from new or modified PSD sources. A critical load is the level of deposition below which no harmful effects on an ecosystem are expected. The critical load values for Alaska for the tundra ecoregion are in the range of 1.0 to 3.0 kilograms per hectare per year (kg/ha-yr; NPS 2018). Deposition analysis thresholds are screening thresholds that define the additional amount of deposition within an FLM area below which impacts are considered negligible. The National Park Service (NPS) and United States (U.S.) Fish and Wildlife Service established deposition analysis thresholds of 0.005 kg/ha-yr for nitrogen and sulfur deposition for western FLM areas (FLAG 2010). The deposition analysis thresholds are applicable to individual projects.

Air quality related values are assessed in this EIS at three federally managed areas (three “assessment areas”); these are the Gates of the Arctic National Park and Preserve, and Noatak National Preserve near the southern boundary of the NPR-A, and the Arctic National Wildlife Refuge to the east (see **Figure H-1**).

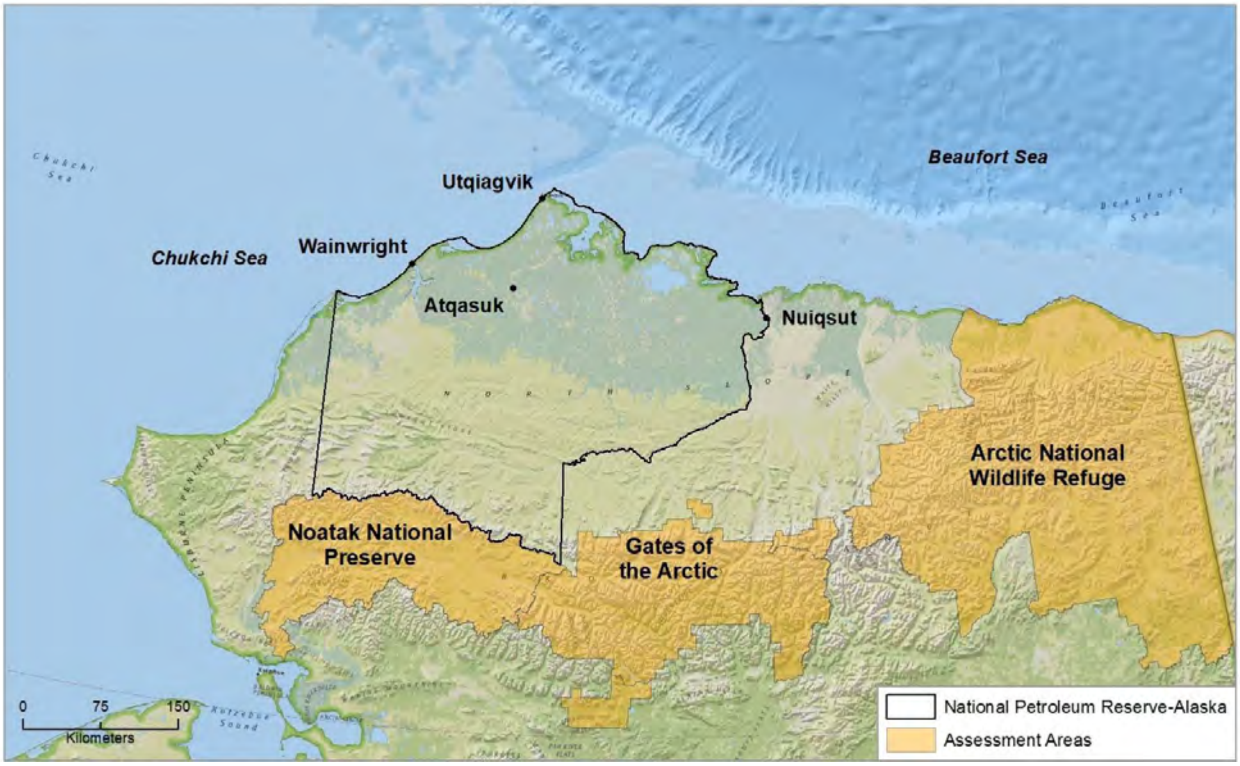
H.1.5 Characterization of Existing Air Quality in the NPR-A

Regional air quality is affected by a variety of factors, including climate, meteorology, and the magnitude and location of sources of air pollutants. This section provides descriptions of the regional climate and meteorology and existing regional sources of air pollution that affect air quality in the Reserve. Existing air quality in the NPR-A is assessed through a review of recent ambient monitoring data of air quality and AQRVs.

Climate and Meteorology

Several monitoring stations were used to characterize climate and meteorology in the NPR-A. A detailed description of climate and meteorological data in the NPR-A is provided in the Climate Appendix.

Figure H-1. National Petroleum Reserve in Alaska and Assessment Areas for Air Quality Related Values

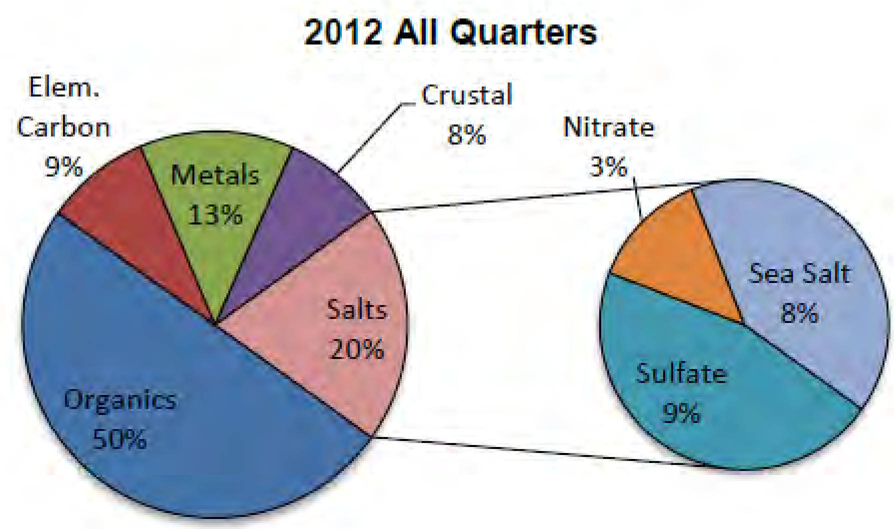


Existing Regional Sources of Air Pollution

A summary of existing regional emissions for the North Slope and adjacent waters (Beaufort Sea and Chukchi Sea planning areas) is available from the Bureau of Ocean Energy Management (BOEM) Arctic Air Quality Modeling Study (Fields Simms et al. 2014) and the Bureau of Land Management (BLM) Willow Master Development Plan Environmental Impact Statement (hereafter, Willow Draft EIS) (BLM 2019). Existing emissions from onshore sources (e.g., oil and gas production and exploration, airports, pipelines, and non-oil and gas-related stationary and mobile sources) comprise the majority of the total existing emissions; emissions from offshore sources (e.g., drilling rigs, survey/drilling vessels and aircraft, and commercial vessels) are small in comparison (Fields Simms et al. 2014). Overall, onshore oil and gas sources comprise the largest fraction of existing emissions for all CAPs except for PM from unpaved roads (Fields Simms et al. 2014).

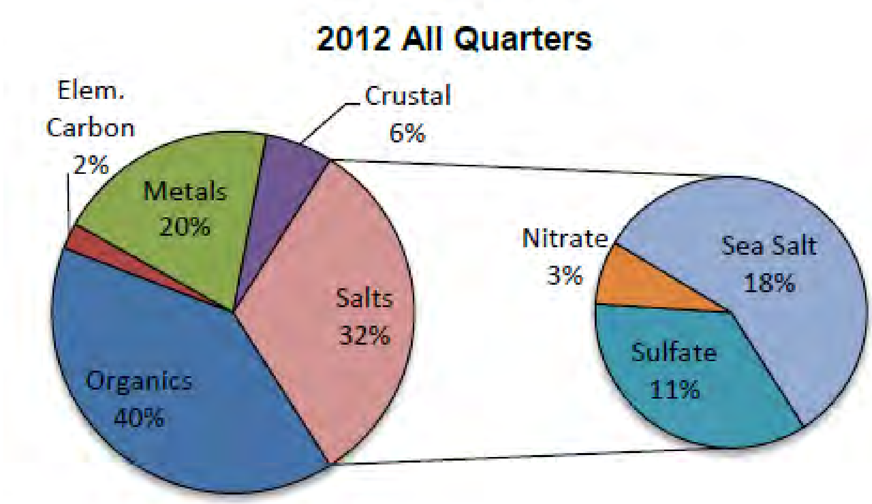
It has been found that regional unpaved road emissions from the BOEM Air Quality Modeling Study are overestimated by approximately a factor of 10 relative to soil measurements collected at Deadhorse and Wainwright (Ramboll 2019). Estimates of the magnitude of road dust emissions were highly uncertain in the BOEM study emissions inventory due mainly to the necessary use of nonlocal data for estimating emissions (Fields Simms et al. 2014). Based on a comparison of the 2012 base case model results to speciated dust measurements collected at Deadhorse and Wainwright in 2012, it was determined that modeled ground-level dust concentrations due to the BOEM regional unpaved road dust emissions were considerably overestimated by approximately a factor of 10 or more. Speciated measurements collected at Deadhorse and Wainwright are presented below in **Figure H-2** and **Figure H-3**. As a result of reducing the dust emissions by a factor of 10, the model performance improved considerably. The major existing sources of HAPs in the region are onshore

Figure H-2. Annual Chemical Contribution to Total Annual $PM_{2.5}$ at Deadhorse



(Source: SLR 2013a)

Figure H-3. Annual Chemical Contribution to Total Annual $PM_{2.5}$ at Wainwright



(Source: SLR 2013b)

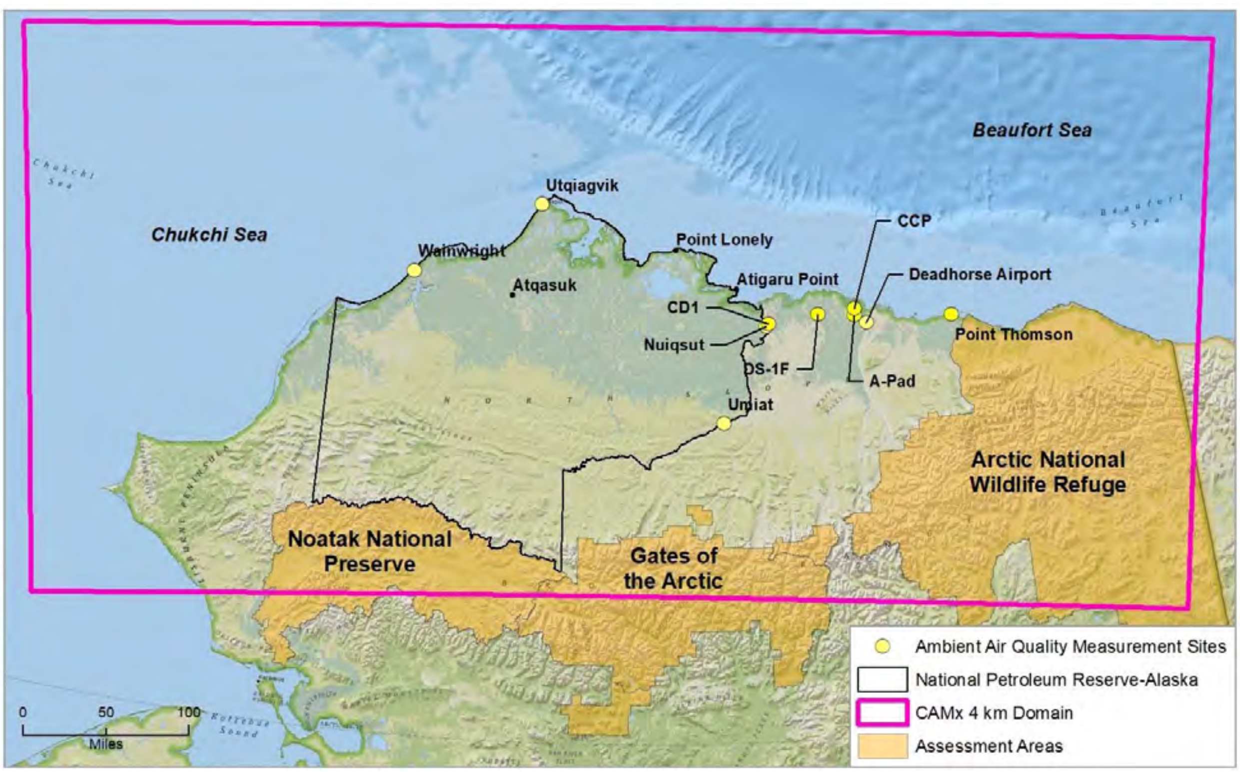
oil and gas development, other non-road vehicles and equipment (i.e., snowmobiles, all-terrain vehicles, recreational marine activities, and construction equipment [rollers, graders, off-highway trucks, tractor/loaders/backhoes, and dumpers/tenders]), on-road vehicles, and waste incineration, landfills, and other combustion sources.

Air Quality Monitoring

Criteria Air Pollutants

There are no state or federal air quality monitoring stations in or near the NPR-A. ConocoPhillips Alaska Inc. (CPAI) operates a long-term ambient monitoring station on the northern end of the Native village of Nuiqsut (see **Figure H-4**). This station has operated at Nuiqsut since 1999 and was originally installed as a State of Alaska permit condition for the Alpine field. The station measures $PM_{2.5}$, PM_{10}, CO, O_3, SO_2, and NO_x. The data are collected and used for various permit applications. The station is privately owned and operated. In addition, there are multiple other industry-owned air monitoring stations on the North Slope. The stations might only collect a subset of criteria pollutants, operated only for a defined period, or are considered maximum impact locations within the industrial area. These stations include Alpine CD1, DS-1F, A-Pad, CCP, Deadhorse, Point Thompson, Umiat, Utqiagvik, and Wainwright. There is no monitoring for lead in the North Slope.

Figure H-4. Ambient Air Quality Measurement Sites in Proximity to the National Petroleum Reserve in Alaska



ADEC provided available monitoring data from the various stations operated by industry in the North Slope. The data are summarized in **Table H-6** through **Table H-12**.[1] At all locations and times, the monitored concentrations of all CAPs in the form of the standard are well below the NAAQS. For some locations, summaries of the monitored data in the form of the standard are not available, and highest concentrations (i.e., more stringent than the standard) are shown instead.

Table H-6
Measured Criteria Air Pollutant Concentrations at the CPAI Nuiqsut Monitor

Pollutant (units)	Averaging Period	Rank	2015	2016	2017	Avg.	NAAQS/ AAAQS	Below NAAQS/ AAAQS
CO (ppm)	1 hour	2nd highest daily max	1	1	1	1	35	Yes
	8 hours	2nd highest daily max	1	1	1	1	9	Yes
NO_2 (ppb)	1 hour	98th percentile of daily max	23.6	18.0	27.4	23.0	100	Yes
	Annual	Annual average	2	1	2	2	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily max	1.2	3.2	3.5	2.6	75	Yes
	3 hours	2nd highest daily max	1.2	3.4	3.5	2.7	500	Yes
	24 hours	2nd highest	1.1	3.1	3.4	2.5	140	Yes
	Annual	Average	0.1	0.8	0.9	0.6	30	Yes
PM_{10} (µg/m^3)	24 hours	2nd highest	98.5	128.8	48.8	92.1	150	Yes
$PM_{2.5}$ (µg/m^3)	24 hours	98th percentile	10.0	5.5	6.9	7.5	35	Yes
	Annual	Average	2.8	1.3	1.6	1.9	12	Yes
O_3 (ppb)	8 hours	4th highest daily max	46	43	45	44	70	Yes

NAAQS/AAAQS for O_3 were converted from parts per million (ppm) to parts per billion (ppb), and the 24-hour and annual SO_2 AAAQS were converted from µg/m^3 to parts per billion.

Table H-7
Measured Criteria Air Pollutant Concentrations at the CPAI Wainwright Monitor

Pollutant (units)	Averaging Period	Rank	11/08–11/09	9/09–12/10	2012	NAAQS/ AAAQS	Below NAAQS/ AAAQS
CO (ppm)	1 hour	2nd highest daily max	0.92[1]	0.7[1]	N/A	35	Yes
	8 hours	2nd highest daily max	0.83[1]	0.7[1]	N/A	9	Yes
NO_2 (ppb)	1 hour	98th percentile of daily max	35[1]	32[1]	N/A	100	Yes
	Annual	Annual average	0	N/A	N/A	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily max	N/A	5[1]	N/A	75	Yes
	3 hours	2nd highest daily max	7[1]	4[1]	N/A	500	Yes
	24 hours	2nd highest	4[1]	2[1]	N/A	140	Yes
	Annual	Average	0	N/A	N/A	30	Yes
PM_{10} (µg/m^3)	24 hours	2nd highest	114	N/A		150	Yes
	24 hours	98th percentile	12[2]	N/A	6.8	35	Yes

[1]Deanna Huff, ADEC, Juneau office engineer, email to Courtney Taylor, Ramboll Managing Consultant, and Krish Vijayaraghavan, Ramboll Principal, on November 1, 2018, regarding industrial data summary.

Pollutant (units)	Averaging Period	Rank	11/08–11/09	9/09–12/10	2012	NAAQS/ AAAQS	Below NAAQS/ AAAQS
$PM_{2.5}$ (μg/m^3)	Annual	Average	N/A	N/A	4.3	12	Yes
O_3 (ppb)	8 hours	4th highest daily max	48[1]	45[1]	N/A	70	Yes

[1]Highest daily maximum
[2]Highest daily average

Table H-8
Measured Criteria Air Pollutant Concentrations at the CPAI DS-1F (Kuparuk) and CD1 (Alpine) Monitors

Pollutant (units)	Averaging Period	Rank	DS-1F 2012–2013	CD1 2012–2013	CD1 2013–2014	NAAQS/ AAAQS	Below NAAQS/ AAAQS
CO (ppm)	1 hour	2nd highest daily max	0.3	2	2	35	Yes
	8 hours	2nd highest daily max	0.2	1	2	9	Yes
NO_2 (ppb)	1 hour	98th percentile of daily max	21	50.9	48.4	100	Yes
	Annual	Annual average	2	9	7	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily max	2.3	2.8	1.8	75	Yes
	3 hours	2nd highest daily max	2	3	2	500	Yes
	24 hours	2nd highest	1.1	2	1.1	140	Yes
	Annual	Average	0.1	0.4	0.3	30	Yes
PM_{10} (μg/m^3)	24 hours	2nd highest	39	121	48	150	Yes
$PM_{2.5}$ (μg/m^3)	24 hours	98th percentile	7	15	15.2	35	Yes
	Annual	Average	2.8	4.6	3.7	12	Yes
O_3 (ppb)	8 hours	4th highest daily max	51	51	45	70	Yes

Table H-9
Measured Criteria Air Pollutant Concentrations at BP Exploration Alaska, Inc. A-Pad (Prudhoe Bay) Monitor from 2011 to 2016

Pollutant (units)	Averaging Period	Rank	2011	2012	2013	2014	2015	2016	NAAQS/ AAAQS	Below NAAQS/ AAAQS
NO_2 (ppb)	1 hour	98th percentile of daily max	42	27	38	33.3	36.4	24.8	100	Yes
	Annual	Annual average	3	2	3	3	3	2	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily max	3.0	2.5	3.8	4.3	4.3	3.3	75	Yes
	3 hours	2nd highest daily max	4	3	4	5	4	0	500	Yes
	24 hours	2nd highest	2.5	1.5	1.7	1.7	2.1	0	140	Yes
	Annual	Average	N/A	4	1	5	1	0	30	Yes
O_3 (ppb)	8 hours	4th highest daily max	52	42	53	51	44	43	70	Yes

Table H-10
Measured Criteria Air Pollutant Concentrations at BP Exploration Alaska, Inc. (BPXA) CCP (Prudhoe Bay) Monitor from 2011 to 2016

Pollutant (units)	Averaging Period	Rank	2011	2012	2013	2014	2015	2016	NAAQS/ AAAQS	Below NAAQS/ AAAQS
CO (ppm)	1 hour	2nd highest daily max	N/A	N/A	N/A	1	1	1	35	Yes
	8 hours	2nd highest daily max	N/A	N/A	N/A	1	1	1	9	Yes
NO_2 (ppb)	1 hour	98th percentile of daily max	78.0	61.4	76.4	84.0	78.0	89.0	100	Yes
	Annual	Annual average	9	6	9	9	10	11	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily max	8.0	9.5	10	10	8.7	9.3	75	Yes
	3 hours	2nd highest daily max	8	10	20	10	9	0	500	Yes
	24 hours	2nd highest	6	8.5	8.8	8.6	7.7	10	140	Yes
	Annual	Average	6	0.5	0.8	1.2	3.4	10	30	Yes
O_3 (ppb)	8 hours	4th highest daily max	50	43	52	54	42	42	70	Yes
PM_{10} (µg/m^3)	24 hours	2nd highest	30	20	20	30	60	40	150	Yes
$PM_{2.5}$ (µg/m^3)	24 hours	98th percentile	10[1]	7.1	8.8	11	9	16	35	Yes
	Annual	Average	3.2	2.6	3.1	3.7	3.2	3.0	12	Yes

[1]Highest daily maximum

Figure H-2 and **Figure H-3**, above, show the speciated $PM_{2.5}$ measurements collected at Deadhorse and Wainwright, respectively. At Deadhorse, organic carbon contributes 50 percent annually to total $PM_{2.5}$. The remaining annual $PM_{2.5}$ consists of salts (sulfate, sea salt, and nitrate), metals, elemental carbon, and crustal material in descending order of importance. Compounds that contribute to $PM_{2.5}$ at Wainwright are similar; however, organic carbon is 40 percent of $PM_{2.5}$; sea salt and metals are more important than they are at Deadhorse, while elemental carbon is less important.

Hazardous Air Pollutants

Since 2014, SLR International Corporation has been involved in studying potential volatile organic compound (VOC) concentrations near Nuiqsut. An initial short-term study that commenced in February 2014 was extended through March 2019. VOC samples were collected adjacent to the Nuiqsut monitoring station as well as two additional sites close to Nuiqsut and a site in Anchorage. The samples, collected in Summa canisters, were sent to a laboratory for analysis to determine VOC (including HAP) content. **Table H-13** provides a summary of historical HAP concentrations measured at Nuiqsut, and additional details are available in SLR 2019. In general, the concentrations shown in **Table H-13** represent 2- to 3-hour measurements. Although there were many more VOC samples collected at Nuiqsut, the HAP concentrations were only above detectable levels for the number of samples presented in **Table H-13**. Note that the measured HAP concentrations are well below acute reference exposure levels.

Table H-11
Measured Criteria Air Pollutant Concentrations at Exxon-Mobil's Point Thompson and Linc Energy's Umiat Monitors

Pollutant (units)	Averaging Period	Rank	Point Thompson 2009–2010	Point Thompson 2010–2011	Point Thompson 201–2017	Umiat 2013–2014	NAAQS/ AAAQS	Below NAAQS/ AAAQS
CO (ppm)	1 hour	2nd highest daily max	1.9	N/A	1	1[1]	35	Yes
	8 hours	2nd highest daily max	1	N/A	0	0	9	Yes
NO_2 (ppb)	1 hour	98th percentile of daily max	N/A	70	14	32	100	Yes
	Annual	Annual average	N/A	4	1	1	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily max	29[1]	N/A	1	2	75	Yes
	3 hours	2nd highest daily max	20	N/A	0	2	500	Yes
	24 hours	2nd highest	9	N/A	0	1.9	140	Yes
	Annual	Average	1	N/A	0	0.1	30	Yes
PM_{10} (µg/m^3)	24 hours	2nd highest	66.5[2]	N/A	20	20	150	Yes
$PM_{2.5}$ (µg/m^3)	24 hours	98th percentile	13	N/A	9	7	35	Yes
	Annual	Average	2.6	N/A	2.8	2.3	12	Yes
O_3 (ppb)	8 hours	4th highest daily max	43[1]	47[1]	46	50	70	Yes

[1]Highest daily maximum
[2]Highest daily average

Table H-12
Measured Criteria Air Pollutant Concentrations in 2012 at Utqiagvik and Deadhorse

Pollutant (units)	Averaging Period	Rank	Utqiagvik	Deadhorse	NAAQS/ AAAQS	Below NAAQS/ AAAQS
$PM_{2.5}$ (µg/m^3)	24 hours	98th percentile	N/A	8.5	35	Yes
	Annual	Average	N/A	5.7[1]	12	Yes
O_3 (ppb)	8 hours	4th highest daily max	42.1	N/A	70	Yes

[1]Calculated using non-missing data on 53 days

Table H-13
Monitored HAP Data at the Nuiqsut Location

Pollutant	Measured concentrations at Nuiqsut during 2014–2019 (μg/m^3)		Acute REL (μg/m^3)	AEGL (μg/m^3)
	Number of samples above detectable limit	Maximum of measurements*		
Benzene	2	0.89	27	-
Ethylbenzene	1	0.78	-	140,000[a]
Formaldehyde	0	N/A	55	-
n-hexane	1	1.27	-	10,000,000[b]
Toluene	2	6.41	37,000	-
Xylene	3	3.47	22,000	-

Source: SLR 2019
*Values converted from ppb to μg/m^3 at standard temperature and pressure
N/A = Not available
Benzene and ethylbenzene measurements reported from toxic organic (TO) method TO-12; n-hexane by TO-15 method; toluene by TO-12 method; Xylene measurement reported = sum of o-xylene and m/p-xylene by TO-12 method
[a]AEGL-1 (mild effect)
[b]AEGL-2 (moderate effect)

Visibility

Visibility and air pollutant concentration data are collected by Interagency Monitoring of Protected Visual Environments (IMPROVE) at monitoring sites close to Class I areas across the country. The two closest monitors to the NPR-A with available data are Gates of the Arctic National Park and Preserve (a Class II area), and Denali National Park (a Class I area) (**Figure H-5**). Data from these two monitors are presented in **Figure H-6** and **Figure H-7**. Data are shown for the 20 percent haziest and 20 percent clearest days. The 20 percent haziest days include anthropogenic and natural influences following the algorithm of EPA (2003) as revised by IMPROVE in December 2019 and may be influenced by natural emission sources such as wildfires. At Gates of the Arctic, the haze index on the haziest days shows a consistent downward trend (through the years of the plot available from IMPROVE) that is near estimated natural visibility conditions[2] of 7.7 dv (visual range[2] of approximately 129 miles), while the haze index on the clearest days has been consistently between 3 and 4 dv which is slightly above estimated natural conditions of 2.8 dv (visual range of approximately 217 miles). At Denali National Park, the haze index shows generally decreasing trends for both the haziest days and the clearest days, but the haziest days have some outlier years most notably 2004 likely due to wildfires. Estimated natural conditions[2] at Denali National Park are 7.3 dv (visual range of approximately 130 miles) and 1.8 dv (visual range of approximately 224 miles) for the haziest and clearest days, respectively, and in recent years the haze index values approach those estimated natural conditions.

Atmospheric Deposition

The National Trends Network (NTN) of the National Atmospheric Deposition Program (NADP) has monitoring stations throughout the U.S. that monitor precipitation chemistry and measure wet deposition (NADP 2018). The closest active monitoring stations to the NPR-A are Gates of the Arctic National Park and Preserve (NTN Site AK06), Poker Creek (NTN Site AK01), and Denali National Park (NTN Site AK03). As shown in **Figure H-5**, below, AQRV monitoring site locations are quite far from the NPR-A. The Denali

[2]http://vista.cira.colostate.edu/IMPROVE/Data/NaturalConditions/nc2_12_2019_2p.csv

Figure H-5. Air Quality Related Value Measurement Locations Near the NPR-A

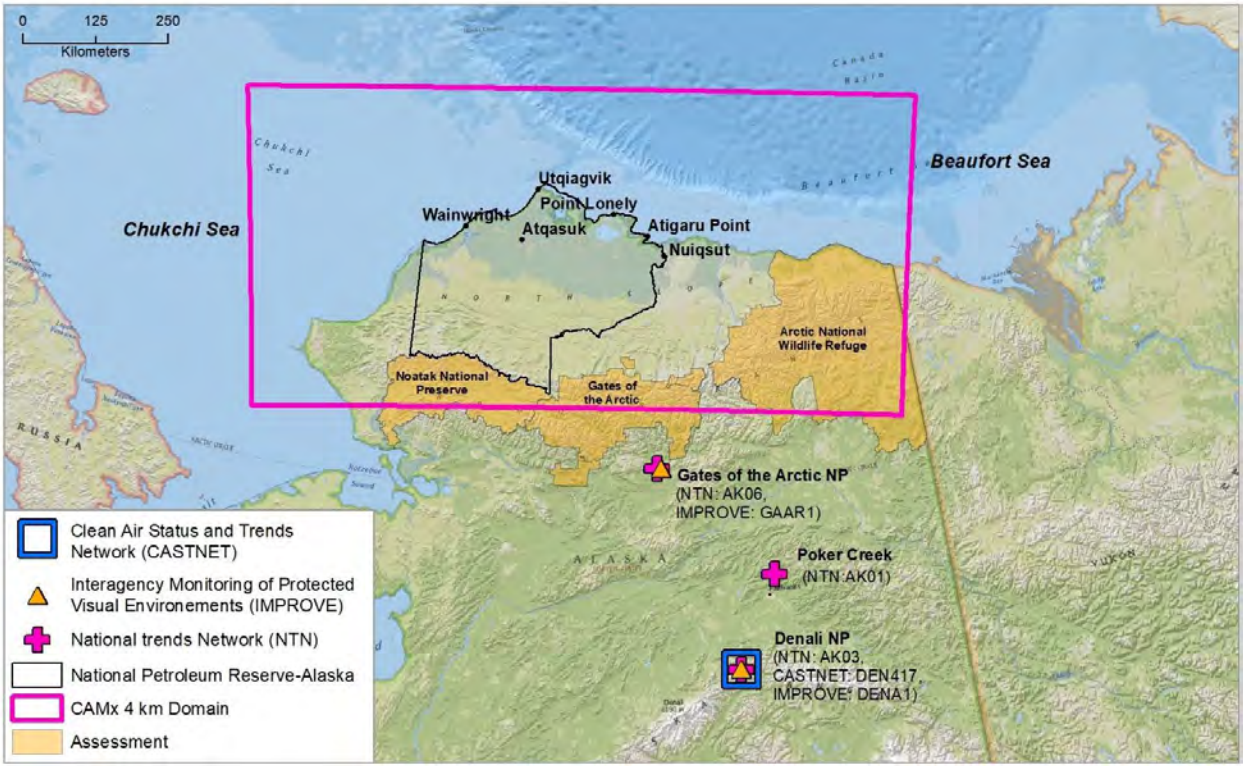
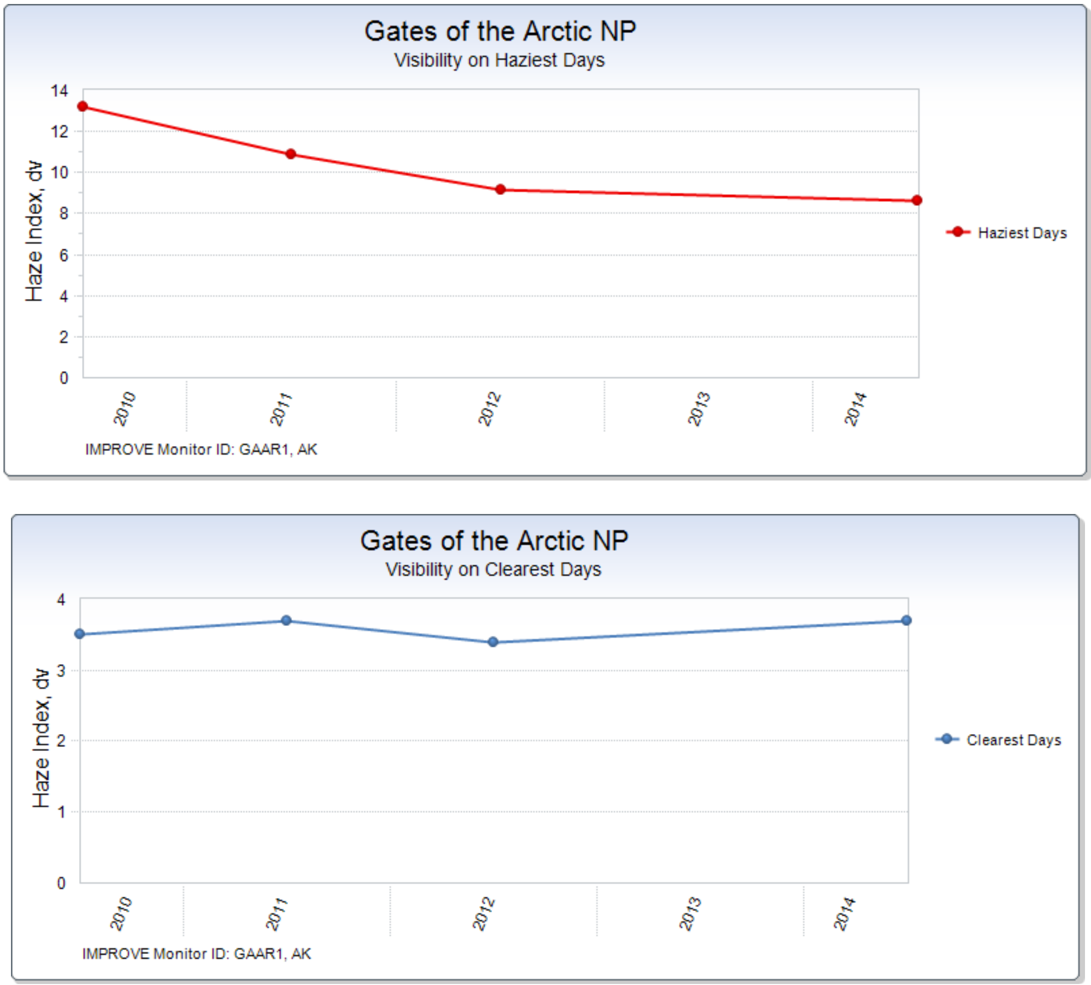


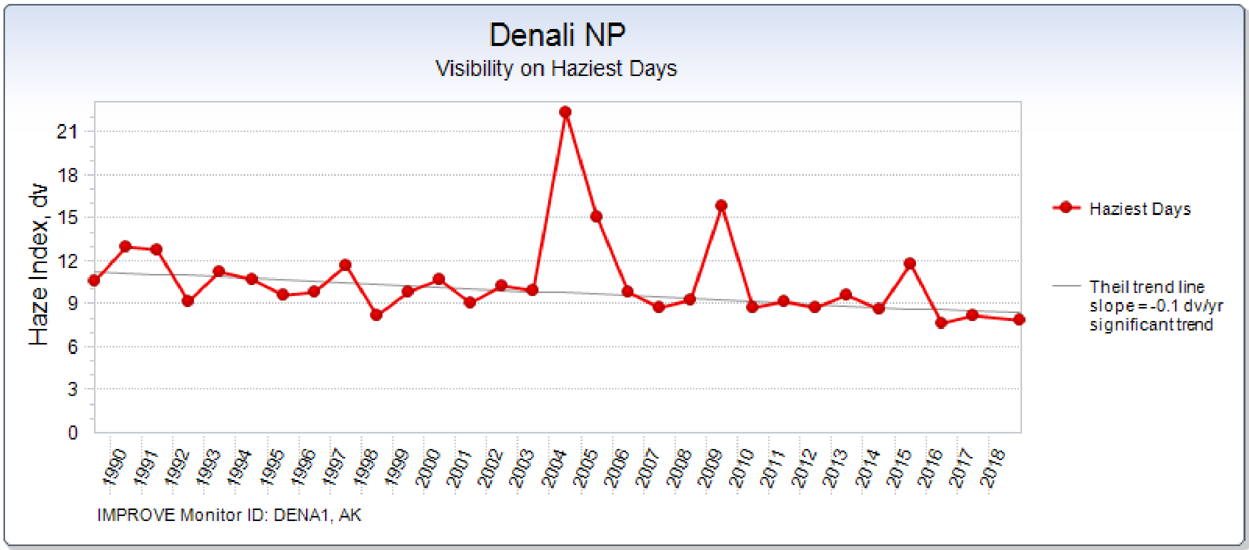
Figure H-6. Visibility Data for Gates of the Arctic National Park and Preserve

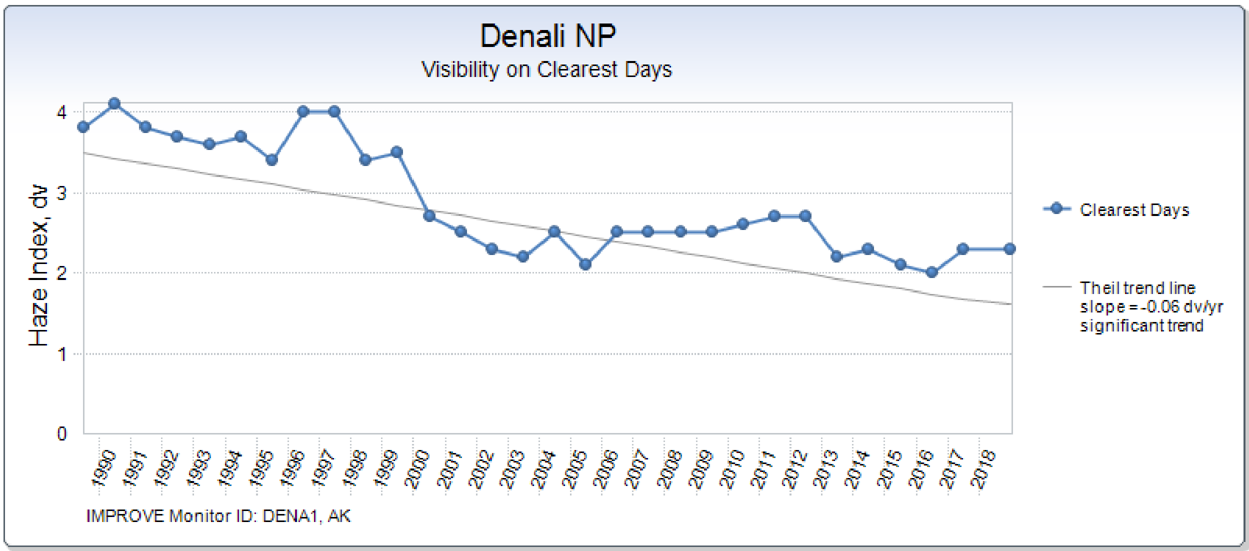


Source: Colorado State University 2020[3]

[3] http://views.cira.colostate.edu/fed/SiteBrowser/Default.aspx?appkey=SBCF_VisSum

Figure H-7. Visibility Data for Denali National Park





Source: Colorado State University 2020[3]

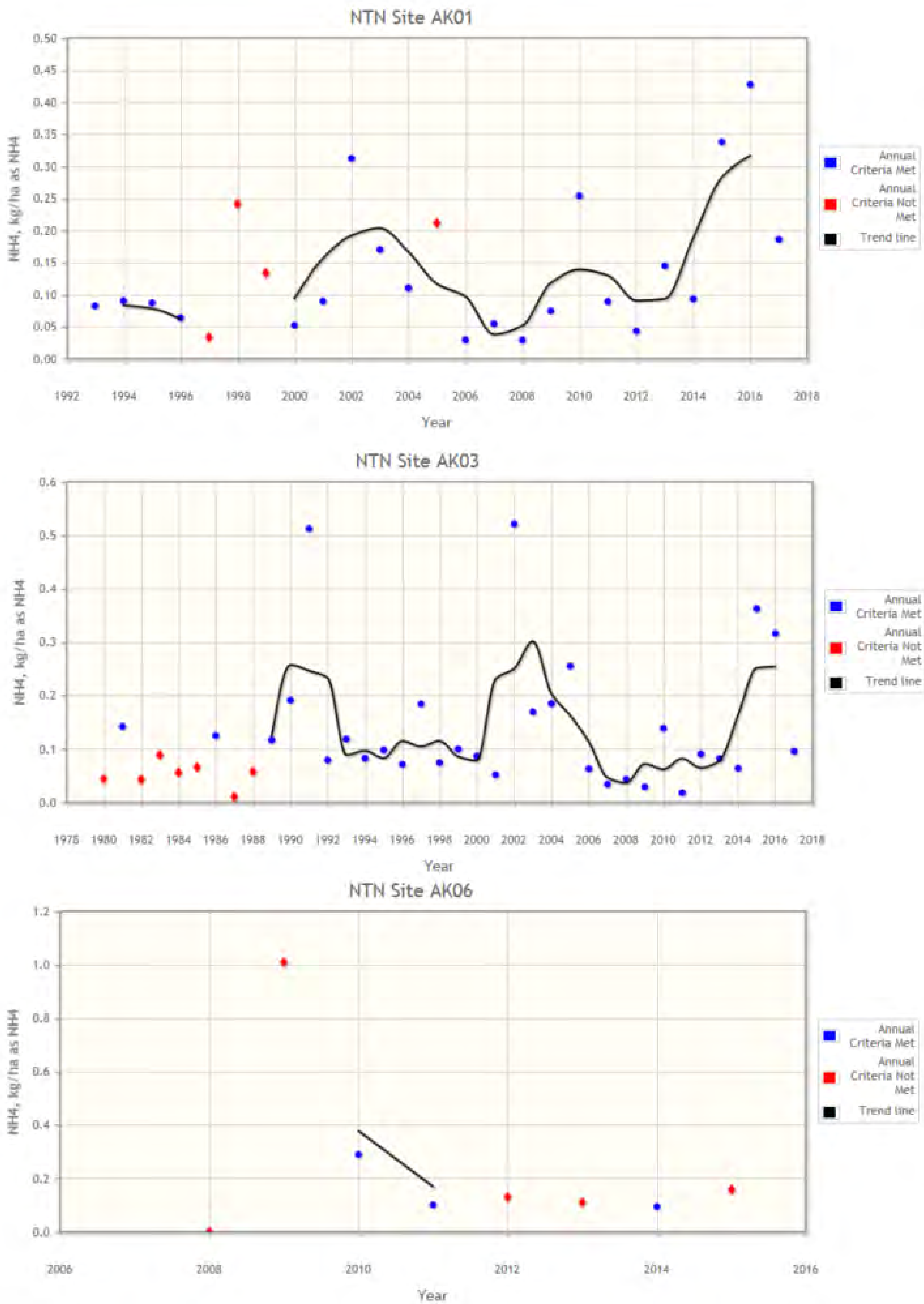
National Park monitoring station is located at the park headquarters near Healy, Alaska, which is approximately 400 miles south of the NPR-A. The Gates of the Arctic National Park and Preserve monitoring station is located on the south side of the Brooks Range in Bettles, Alaska, which is approximately 200 miles south of the NPR-A. Poker Creek is located 24 miles from Fairbanks, Alaska, and approximately 300 miles south of the NPR-A. Due in part to the large distance between the NPR-A and available AQRV measurements, AQRV measurements are in a different airshed than the NPR-A. As a result, the AQRV conditions and trends in the NPR-A could differ from results reported for Denali, Gates of the Arctic National Park and Preserve, and Poker Creek. This analysis includes data measured from these sites due to the long-term measurement record.

Trends in monitored wet deposition fluxes of ammonium (NH_4^-), NO_3^-, and sulfate SO_4^{2-}at each of the sites where data are available are provided in **Figure H-8**, **Figure H-9**, and **Figure H-10**, respectively. The blue dots on the graphs indicate yearly concentrations that had met the annual completeness criteria while the red dots indicate yearly concentrations that had not met the annual completeness criteria. Trend lines are also shown in black, which represent a 3-year moving average where the minimum data completeness criteria are met for that 3-year period. The wet deposition fluxes of NH_4^-, NO_3^-, and SO_4^{2-} are small at all monitors (most annual values below 1.0 kg/ha-yr) with no apparent trend in most cases. The wet deposition fluxes of NH_4^- at Poker Creek and Denali National Park, and NO_3^- at Denali National Park have shown an upward trend in recent years. As discussed previously, these sites are in a different airshed, so observed trends may or may not be representative of conditions in the NPR-A.

In addition to long-term deposition monitoring, the Toolik Field Station (NTN Site AK96) began collecting deposition data in 2017. The wet deposition of NH_4^-, NO_3^-, and SO_4^{2-} are 0.04, 0.19, and 0.24 kg/ha-yr, respectively, in 2017 and 0.167, 0.764, and 0.487 kg/ha-yr, respectively, in 2018.

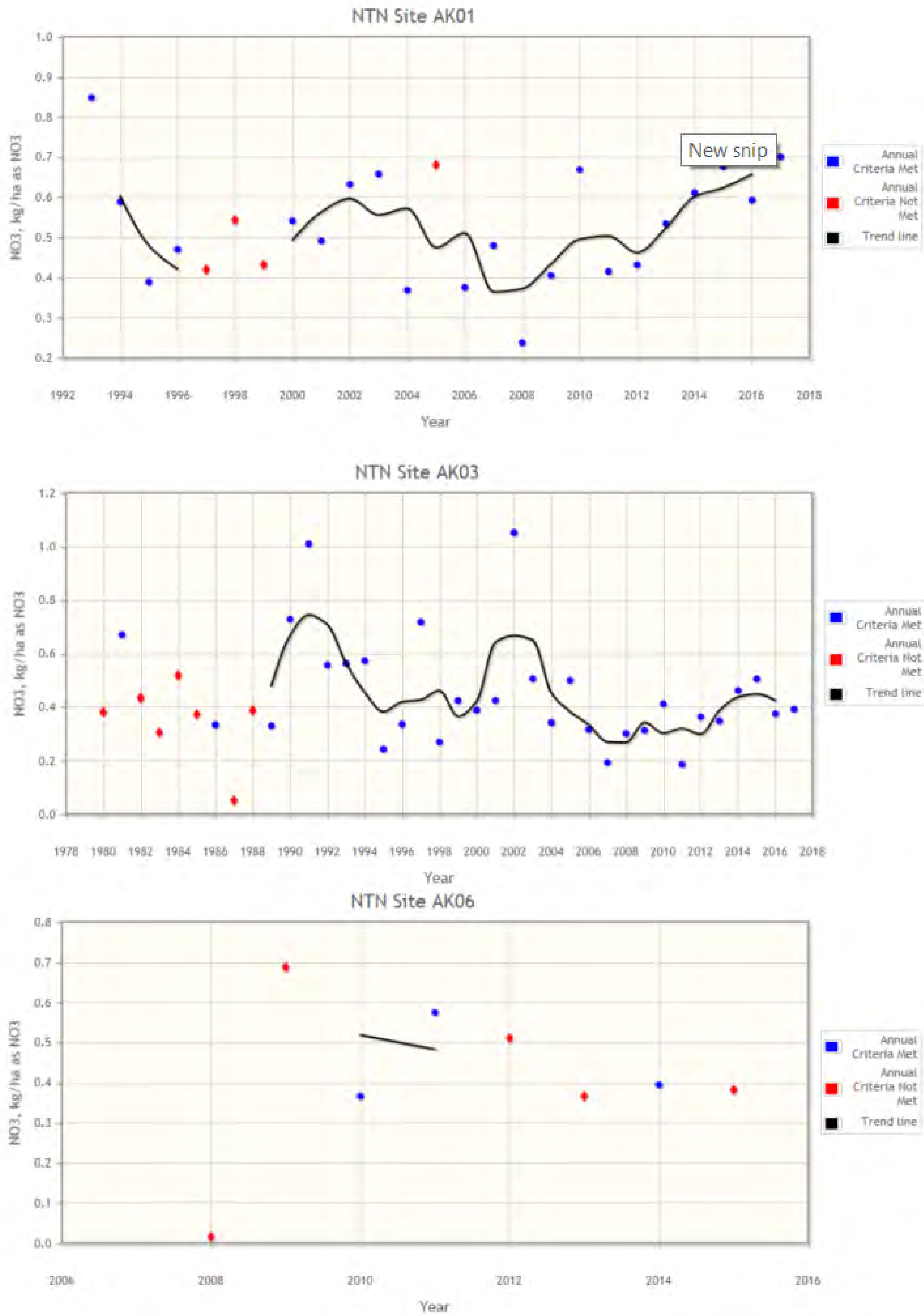
The NADP also provides estimates of total (wet and dry) sulfur and nitrogen deposition for critical load analysis and other ecological studies using a hybrid approach with modeled and monitoring data (NADP 2014). Wet deposition data from NTN, along with air concentration data from networks such as the Clean Air Status and Trends Network, are used (EPA 2018c). **Figure H-11** provides the estimated total deposition flux of nitrogen and sulfur in for Denali National Park for 1999–2017, which is the only monitor in Alaska with recent Clean Air Status and Trends Network data. The highest monitored total deposition fluxes of nitrogen and sulfur occurred in 2002; they were 0.741 kilograms nitrogen per hectare per year (kg N/ha-yr) and 0.601 kilograms sulfur per hectare per year (kg S/ha-yr). The mean deposition fluxes of nitrogen and sulfur are 0.285 kg N/ha-yr and 0.287 kg S/ha-yr, respectively. The total deposition flux of nitrogen was well below critical load for atmospheric deposition defined by the FLMs for the tundra ecoregion of Alaska (1.0–3.0 kg N/ha-yr) in all years (NPS 2018).

Figure H-8. Trends in Wet Deposition of Ammonium at Poker Creek (NTN Site AK01), Denali National Park (NTN Site AK03), and Gates of the Arctic National Park and Preserve (NTN Site AK06)



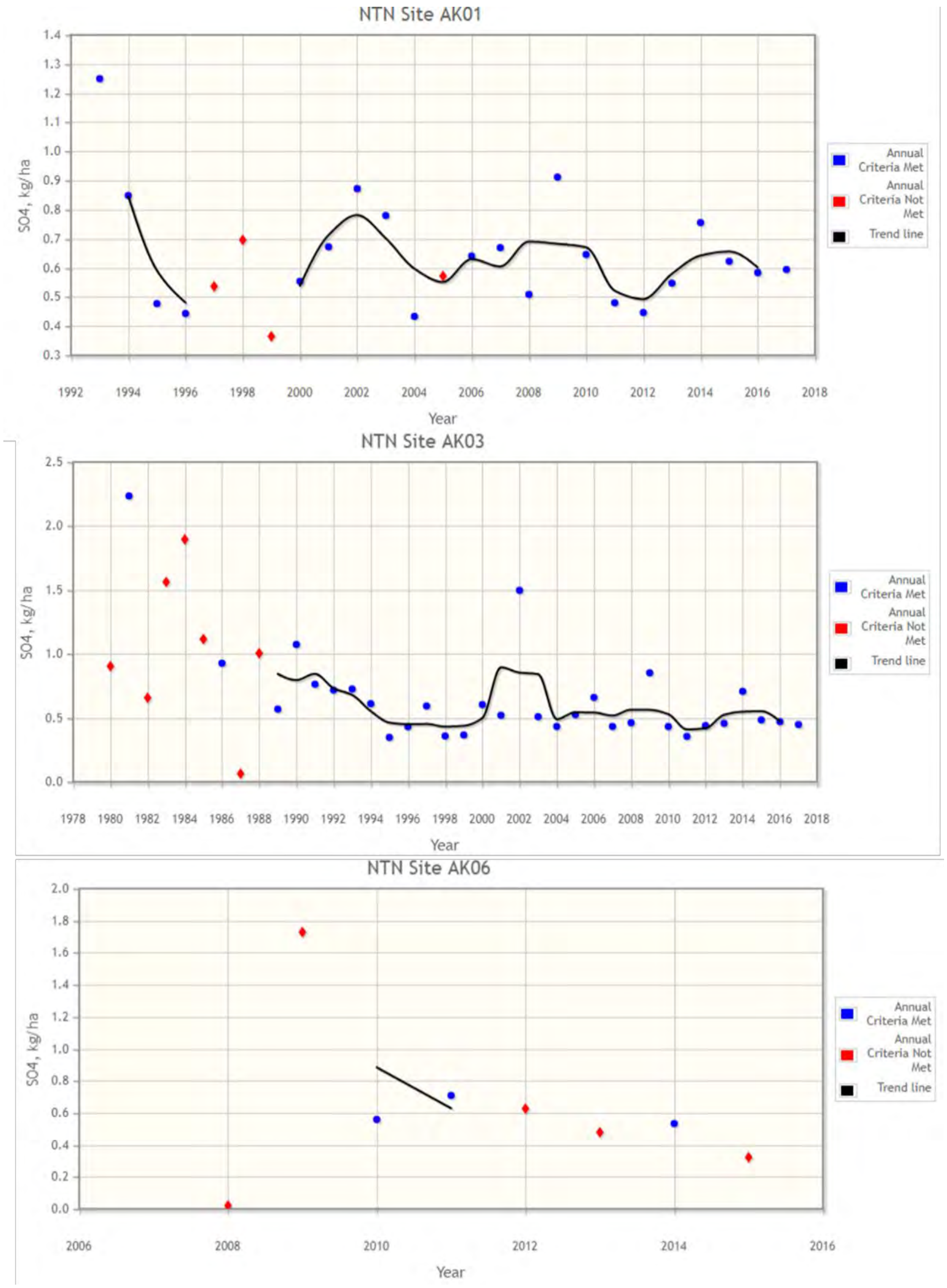
Source: NADP 2018

Figure H-9. Trends in Wet Deposition of Nitrate at Poker Creek (NTN Site AK01), Denali National Park (NTN Site AK03), and Gates of the Arctic National Park and Preserve (NTN Site AK06)



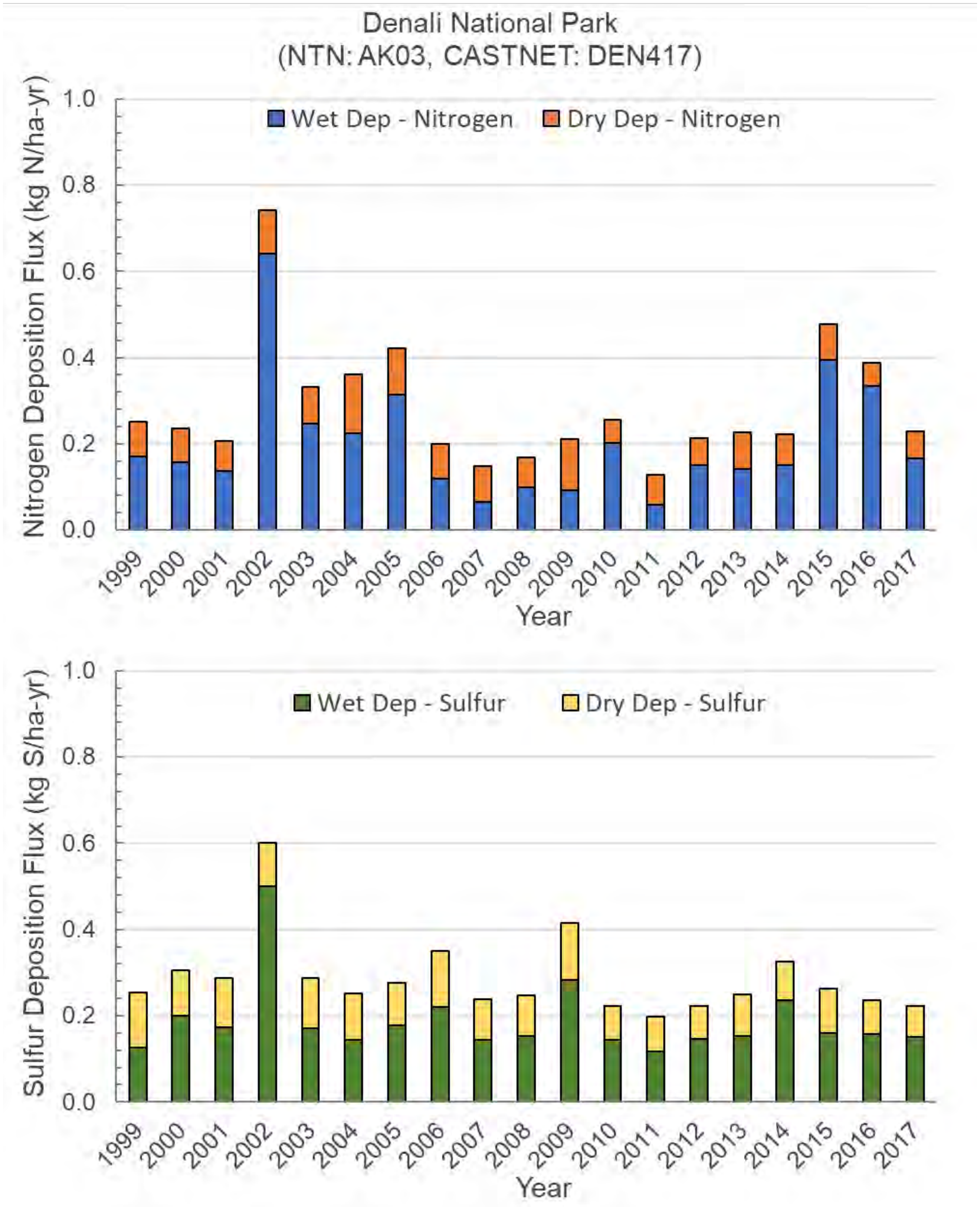
Source: NADP 2018

Figure H-10. Trends in Wet Deposition of Sulfate at Poker Creek (NTN Site AK01), Denali National Park (NTN Site AK03), and Gates of the Arctic National Park and Preserve (NTN Site AK06)



Source: NADP 2018

Figure H-11. Total Nitrogen and Sulfur Deposition Flux at Denali National Park



Source: EPA 2018c

H.2 SUPPLEMENTAL INFORMATION FOR ASSESSMENT

H.2.1 Modeling Objective

The objective of this analysis is to estimate the potential air quality and ARQV impacts of reasonably foreseeable development (RFD) sources for each alternative and other cumulative sources. Air quality and AQRV impacts were assessed within the vicinity of a hypothetical future development, at discrete sensitive receptor locations, and for the three assessment areas. These assessment areas have been selected for analysis based on public scoping and previous EISs in the area. Specifically, the air quality modeling includes:

- An assessment of air quality impacts for CAPs, including O_3, $PM_{2.5}$, PM_{10}, NO_2, SO_2, and CO
- HAP impact assessment of benzene, toluene, ethylbenzene, xylene (collectively referred to as BTEX), n-hexane, and formaldehyde
- An AQRV analysis to assess changes in visibility and atmospheric deposition.

The near-field impact assessment is conducted with the American Meteorological Society and U.S. Environmental Protection Agency Regulatory Model (AERMOD) model to assess criteria pollutants (excluding ozone and lead) and the HAPs listed above within 31 miles of a hypothetical future development. The regional impact assessment is conducted with the CAMx modeling system to assess criteria pollutants (except lead) and AQRVs in the NPR-A and the three aforementioned assessment areas. The regional impact assessment is conducted only for the Alternative D high development scenario. Alternative D has the same annual production rates as Alternative E and higher production rates than Alternatives A, B, and C. Therefore, modeling the high development scenario in Alternative D provides conservative (upper bound) estimates of regional impacts that are expected to be comparable with the high development scenario of Alternative E and higher than impacts from other alternatives and development scenarios.

H.2.2 Applicable Air Quality Standards and Hazardous Air Pollutant Thresholds

Modeling results were compared with applicable NAAQS and AAAQS, collectively referred to as ambient air quality standards (AAQS) (shown in **Table H-1**). AAQS represent the total concentrations of a given pollutant allowed to protect public health. **Table H-1** does not include AAQS for lead and ammonia because the developments are not anticipated to emit ammonia and very little lead (apart from some lead emissions from aircraft); hence, these pollutants are not issues of concern. Pollutants analyzed are based on the form of the AAQS or HAPs thresholds, as shown in **Table H-1** through **Table H-4**.

Air Quality Related Values

Atmospheric deposition and visibility impairment were assessed.

Visibility

Cumulative visibility impacts were assessed relative to baseline visibility conditions. More background information is provided in Appendix H.1 *Supplemental Information for Affected Environment*.

Deposition

Cumulative nitrogen deposition impacts were compared with critical load of atmospheric nitrogen deposition thresholds for Alaskan tundra, which range from 1.0 to 3.0 kg/ha-yr (Sullivan 2016). More background information is provided in Appendix H.1, *Supplemental Information for Affected Environment*.

H.2.3 Effectiveness of Stipulations and Required Operating Procedures

As discussed in **Section 3.2.2**, stipulations and required operating procedures (ROP) listed in **Chapter 2** have the potential to influence air quality. ROPs that could potentially affect air quality are listed in **Table H-14** alongside a description of their effectiveness and possible impact.

H.2.4 Analysis Methods

AERMOD was used to assess the near-field impacts for the following criteria pollutants and averaging periods:

- CO for 1-hour and 8-hour averaging periods
- NO_2 for 1-hour and annual averaging periods
- $PM_{2.5}$ for 24-hour and annual averaging periods
- PM_{10} for 24-hour and annual averaging periods
- SO_2 for 1-hour, 3-hour, 24-hour, and annual averaging periods.

While the regional modeling analysis conducted with CAMx included estimates of all emissions sources, including naturally occurring emissions, the near-field modeling analysis conducted with AERMOD evaluated only anthropogenic emissions sources within 31 miles of an IAP RFD activity. The AERMOD model was configured to assess IAP RFD activities for various alternatives in combination with existing emissions sources. For routine activities anticipated to extend into the future for typical operations, the modeling analysis included emissions from all other oil and gas projects within the modeling domain in addition to representative IAP RFD sources. Other oil and gas project emissions sources are described below in *Cumulative Impacts*.

To estimate total ambient air quality conditions with AERMOD, modeled impacts are added to representative background concentrations. The background concentrations representative of an IAP RFD area are discussed in the Air Pollutant Concentrations section. Ozone impacts and secondary $PM_{2.5}$ ($PM_{2.5}$ formed in the atmosphere from chemical reactions) impacts are assessed with the CAMx model. These pollutants are not assessed using the AERMOD model. This is because the model does not include the necessary chemical reactions to estimate concentrations of pollutants not directly emitted from sources. In order to estimate the contribution of secondary $PM_{2.5}$ to near-field impacts, results from the regional CAMx model were used. The secondary $PM_{2.5}$ concentrations from CAMx were derived by removing chemical species that are primary emissions sources. The secondary $PM_{2.5}$ calculated here are the total $PM_{2.5}$ without the contributions of primary organic aerosol, fine crustal particulate matter, fine other primary particulate matter with a diameter less than 2.5 microns, and primary elemental carbon. This methodology likely provides an overestimate of secondary $PM_{2.5}$ since some species included as completely secondary $PM_{2.5}$, like sulfate, can be emitted directly as primary $PM_{2.5}$.

The estimated secondary $PM_{2.5}$ concentrations resulting from IAP RFD emissions were derived from the CAMx regional modeling for the Willow Draft EIS (BLM 2019) and added to the near-field AERMOD modeled PM_{10} and $PM_{2.5}$ concentrations for total air concentrations.

Emissions for benzene, toluene, ethylbenzene, xylenes, n-hexane, and formaldehyde were modeled for a 1-hour average to compare with the acute reference exposure limits (RELs) shown in **Table H-3**; 8-hour average to compare with the acute exposure guideline levels (AEGLs) shown in **Table H-3;** and an annual average period to compare with the non-cancer RfC shown in **Table H-3** and chronic carcinogenic exposure to

Table H-14
Best Management Practices' (BMPs') and ROPs' Effects on Air Quality

Section Alternative A–E	Requirement/ Standard – Alternative A	Requirement/ Standard – Alternatives B, C, D	Requirement/ Standard – Alternative E	Description of Impact Level and Effectiveness
Alternative A: BMP A-2 Alternatives B–D: ROP A-2 Alternative E: ROP A-2	All organic/putrescible waste shall be incinerated, backhauled, or composted	Similar to Alternative A	Similar to Alternative A	Possibly substantial and temporary increased impact on air quality resulting from emissions from incineration or transportation, or both, of organic/putrescible waste. Impacts would be localized to the area of incineration and transportation.
Alternative A: BMP A-3 Alternatives B–D: ROP A-3 Alternative E: ROP A-3	Contingency plan for cleanup in event of hazardous substance spill	Similar to Alternative A	Similar to Alternative A	Possibly substantial, although temporary, reduced impact on air quality depending on spill cleanup methodology. Impacts would be localized in the area of the spill.
Alternative A: BMP A-4 Alternatives B–D: ROP A-4 Alternative E: ROP A-4	Spill prevention, control, and countermeasure plan in event of fuel, crude oil, or other liquid chemical spill	Similar to Alternative A	Similar to Alternative A	Possibly substantial, although temporary, reduced impact on air quality depending on the plan.
Alternative A: BMP A-9 Alternatives B–D: N/A Alternative E: N/A	All oil and gas operational equipment that burns diesel fuel must use ultra-low sulfur diesel.	No similar requirement	No similar requirement	No additional effect on air quality. This stipulation is now redundant with State and federal requirements.

Section Alternative A–E	Requirement/ Standard – Alternative A	Requirement/ Standard – Alternatives B, C, D	Requirement/ Standard – Alternative E	Description of Impact Level and Effectiveness
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	The project proponent 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, including reasonably foreseeable air pollutant emissions of CAPs, VOCs, HAPs, and greenhouse gases estimated for each year for the life of the project. The BLM would use this estimated emissions inventory to identify pollutants of concern and to determine the appropriate level of air analysis to be conducted for the proposed project.	Similar to Alternative A	Similar to Alternative A	Emissions inventory development could inform modeling and decision-making that help reduce impacts.
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	The BLM may require a minimum of 1 year of baseline air monitoring following ADEC and EPA monitoring standards prior to initiation of National Environmental Policy Act of 1969 (NEPA) analysis, if no representative data are available.	Similar to Alternative A	The BLM may require up to 1 year of baseline air monitoring following ADEC and EPA monitoring standards prior to initiation of NEPA analysis, if no representative data are available.	Possibly substantial and sustained reduction of impacts in the future if air monitoring is used to identify the need for additional measures, if any, to reduce impacts.
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	The BLM may require air quality modeling for purposes of analyzing project direct, indirect, or cumulative impacts on air quality. The BLM would determine the information required for a project-specific modeling analysis through a modeling protocol for each analysis, and would consult with appropriate federal, State, and/or local agencies regarding modeling to inform the modeling decision and avoid duplication of effort.	Similar to Alternative A	The BLM may require air quality modeling for purposes of analyzing project direct, indirect, or cumulative impacts on air quality, AQRVs, and HAPs, should no recent modeling analysis be available as a proxy. Similar to Alternative A for the modeling protocol requirement.	Possibly substantial and sustained reduction of impacts in the future if air modeling is used to identify the need for additional measures, if any, to reduce impacts.

Section Alternative A–E	Requirement/ Standard – Alternative A	Requirement/ Standard – Alternatives B, C, D	Requirement/ Standard – Alternative E	Description of Impact Level and Effectiveness
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	The modeling shall compare predicted impacts on all applicable local, State, and federal air quality standards and increments, as well as other scientifically defensible significance thresholds, such as impacts on AQRVs and incremental cancer risks. If ambient air monitoring indicates that project-related emissions are causing or contributing to impacts that would cause unnecessary or undue degradation of the lands, cause exceedances of NAAQS, or fail to protect health, the BLM may require changes in activities at any time to reduce these emissions to comply with the NAAQS and/or to minimize impacts on AQRVs. Within the scope of the BLM's authority, the BLM may require additional emission control strategies to minimize or reduce impacts on air quality. The BLM may require air quality mitigation measures and strategies within its authority (and in consultation with local, State, federal, and tribal agencies with responsibility for managing air resources), in addition to regulatory requirements and proponent-committed emission reduction measures, and for emission sources not otherwise regulated by ADEC or EPA, if the air quality analysis shows potential future impacts on NAAQS or AAAQS or impacts above specific levels of concern for AQRVs.	All projects and permitted uses will comply with all applicable NAAQS/AAAQS and ensure AQRVs are protected. If ambient air monitoring or air quality modeling indicates that project-related emissions cause or contribute to impacts, unnecessary or undue degradation of the lands, or exceedances of the NAAQS/AAAQS, or if it fails to protect health, then the BLM may require changes or additional emission control strategies. To reduce or minimize emissions from proposed activities to comply with the NAAQS/AAAQS or to minimize impacts on AQRVs, the BLM shall consider air quality mitigation measures within its authority, in addition to regulatory requirements and proponent-committed emission reduction measures, and also for emission sources not otherwise regulated by ADEC or the EPA.	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, AQRVs, and HAPs levels, then the BLM may require the permittee to change their proposal or may propose mitigation to reduce impacts, or comply with the NAAQS/AAAQS.	Possibly substantial and sustained reduction of impacts if effective mitigation or emissions reduction measures are implemented.

Section Alternative A–E	Requirement/ Standard – Alternative A	Requirement/ Standard – Alternatives B, C, D	Requirement/ Standard – Alternative E	Description of Impact Level and Effectiveness
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	The BLM may require the proponent to provide an emissions reduction plan that includes a detailed description of operator-committed measures to reduce project-related air pollutant emissions, including, but not limited to, greenhouse gases and fugitive dust.	Similar to Alternative A, but also includes description of operator-committed measures to reduce emissions of CAPs, heavy metals, and mercury.	Similar to Alternative A, but also includes description of operator-committed measures to reduce emissions of CAPs, HAPs, heavy metals, and mercury.	Possibly substantial and sustained reduction of impacts if effective emissions reduction measures are implemented.
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	The BLM may require monitoring for the life of the project, depending on the magnitude of potential air emissions from the project; the proximity to a Class I area, sensitive Class II area, or population center; location within or proximity to a nonattainment or maintenance area; meteorological or geographic conditions; existing air quality conditions; the magnitude of existing development in the area; or issues identified during the NEPA process.	Similar to Alternative A except that it does not include “sensitive Class II areas.”	The BLM may require monitoring, depending on the magnitude of potential air emissions from the project, meteorological or geographic conditions, the magnitude of existing development in the area, and issues identified during the NEPA process. 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.	Monitoring during the project could inform subsequent decision-making that helps reduce impacts. The effectiveness would vary depending on magnitude of subsequent measures.
Alternative A: BMP A-10 Alternatives B–D: ROP A-10 Alternative E: ROP A-10	Publicly available reports on air quality baseline monitoring, emissions inventory, and modeling results developed in conformance with this BMP shall be provided by the project proponent to the North Slope Borough and to local communities and tribes in a timely manner.	Air monitoring or air modeling reports will be provided to the BLM, federal land managers; federal, State, local community, or tribal governments; and other interested parties, as appropriate.	Air monitoring or air modeling reports will be provided to the BLM.	Potentially substantial and intermittent because reporting could provide information on the current status, effectiveness of current measures, and future measures required.

Section Alternative A–E	Requirement/ Standard – Alternative A	Requirement/ Standard – Alternatives B, C, D	Requirement/ Standard – Alternative E	Description of Impact Level and Effectiveness
Alternative A: N/A Alternatives B–D: ROP A-13 Alternative E: ROP A-13	No similar requirement	To prevent the release of poly- and perfluoroalkyl substances associated with the use of aqueous film-forming foam, use fluorine-free foam unless other regulations require aqueous film-forming foam.	To prevent the release of poly- and perfluoroalkyl substances associated with the use of aqueous film-forming foam, use fluorine-free foam unless otherwise approved in a State or federally required plan.	Possibly substantial and sustained increased impact on air quality depending on fire magnitude. Impacts would be localized in the area of the fire.
Alternative A: N/A Alternatives B–D: ROP A-14 Alternative E: ROP A-14	No similar requirement	Power off vehicles not in use, and permanent camps have vehicle plug-ins for engine block heaters.	Similar to Alternatives B–D except in the case of extremely cold temperatures (vehicle-dependent).	Substantial and sustained decreased impacts on air quality due to reduced idling emissions.
Alternative A: BMP C-2 Alternatives B–D: ROP C-2 Alternative E: ROP C-2	Restrictions on winter tundra off-road travel	Similar to Alternative A	Similar to Alternative A	Likely minor, but sustained, reduction in air quality impacts. Effectiveness would vary based on the magnitude and location of restrictions.
Alternative A: BMP E-4 Alternatives B–D: N/A Alternative E: N/A	All pipelines should be designed, constructed, and operated under an Authorized Officer-approved quality assurance/quality control plan to detect and minimize leaks.	No similar requirement; the State of Alaska enforces pipeline design and construction standards to minimize the potential for leaks.	No similar requirement; the State of Alaska enforces pipeline design and construction standards to minimize the potential for leaks.	Possibly substantial and sustained decreased impacts on air quality. Effectiveness can vary depending on the specifics of how this ROP is implemented.
Alternative A: BMP E-5 Alternatives B–D: ROP E-5 Alternative E: ROP E-5	Facilities shall be designed and located to minimize the development footprint.	Similar to Alternative A	Similar to Alternative A	Possibly substantial and sustained decreased impacts on air quality. Effectiveness can vary depending on the specifics of how this ROP is implemented.

Section Alternative A–E	Requirement/ Standard – Alternative A	Requirement/ Standard – Alternatives B, C, D	Requirement/ Standard – Alternative E	Description of Impact Level and Effectiveness
Alternative A: N/A Alternatives B–D: ROP M-5 Alternative E: ROP M-5	No similar requirement for Alternative A	Reduction of areas of bare soil	Similar to Alternatives B–D	Substantial and sustained decreased impacts on air quality due to reduced windblown dust emissions.

compare with the one-in-one million risk threshold. Based on analysis of the HAP emissions inventory, HAP emissions from construction and drilling activities are substantially lower than operations. Therefore, impacts on HAPs are only assessed for the routine operations scenario.

Emissions Development Method

The Willow Master Development Plan (MDP) is an example of a large future development in the NPR-A. The emissions inventory developed for the Willow MDP, including emissions developed for an Module Transfer Island, was used to approximate emissions from hypothetical development. Emissions were scaled to be representative of each alternative in this IAP by using a combination of the maximum production from the Willow MDP in barrels of oil per day (131,000 barrels of oil per day) and the peak barrels of oil per day expected under each alternative and development scenario. Each alternative was considered under three development scenarios (low, medium, and high), and emissions were scaled for all scenarios in each alternative.

Far-field Assessment Method

The far-field impact assessment is conducted with the CAMx modeling system to assess criteria pollutants (except lead) and AQRVs. The far-field impacts are modeled only for the Alternative D high development scenario; the other alternative/scenario combinations are discussed qualitatively.

Meteorological Data

The BOEM Arctic study meteorological data were used for this modeling assessment. Water research and forecasting (WRF) v3.6.1 was used for the 2.5-mile and 7.5-mile domains; both these grids were defined on a polar secant stereographic projection centered at 70°N, 155°W with true latitudes at 70°N. As stated in Brashers et al. (2016), version 3.6.1 of WRF was developed to improve the arctic modeling capabilities. The model performance of the BOEM Arctic WRF simulation was evaluated using the METSTAT tool for both onshore and offshore analyses during 2009–2013 at a 2.5-mile resolution (Brashers et al. 2016). Onshore modeling for wind direction and humidity performed very well for all months. Onshore modeling for wind speed and temperature performed well for most months.

The WRF model output files were processed in the BOEM study using WRFCAMx v4.4 processor to generate CAMx model-ready meteorological data (Brashers et al. 2016). This IAP used the same meteorological data. Some of the key updates in WRFCAMx v4.4 are the KV patch method that improves the surface layer ozone and an option to process sub-grid clouds.

Regional Emissions

An emissions inventory for all sources within the modeling domain is required for the CAMx regional modeling. This section provides a brief overview of the regional emissions for the far-field CAMx modeling. The SMOKE (Sparse Matrix Operator Kerner Emissions) model was used to prepare and process emissions inputs into the format required by CAMx. A complete emissions inventory for photochemical modeling includes point sources, area sources, non-road and on-road mobile sources, as well as sea salt, dust, biogenic emissions, lightning-related emissions, and fire emissions.

Regional emissions for the CAMx far-field modeling for sources other than the IAP developments are based on the BOEM 2020 modeling platform (Fields Simms et al. 2018; Stoeckenius et al. 2017) with revisions for the Willow Draft EIS (BLM 2019) to account for known future projects. Windblown dust emissions are not included in the BOEM modeling platform (and therefore also for this analysis) or in other typical regional photochemical applications. Not including windblown dust emissions might ordinarily have a potential to result in an underestimation in model results; however, this is unlikely because, as noted by Ramboll (2019), soil (dust) concentrations are still overestimated in the model, as discussed below. The BOEM modeling platform sea salt and regional unpaved road dust emissions were revised for this modeling due to observable overestimates noted in the BOEM study; other revisions were performed, as discussed in the Willow Draft EIS Draft Air Quality Technical Support Document (Ramboll 2019).

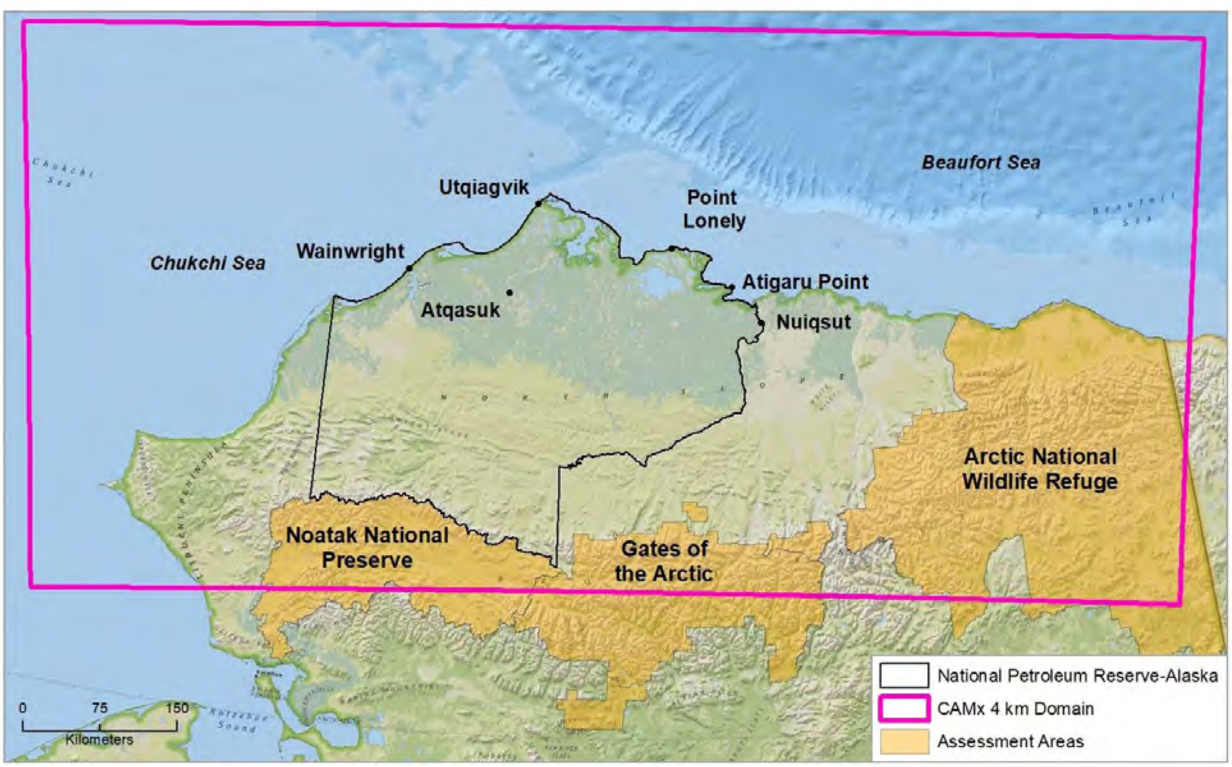
Modeling Approach

The CAMx modeling system was used to estimate the potential regional air quality and AQRV impacts from the Alternative D high development scenario in the assessment areas, as well as the overall 2.5-mile resolution domain (**Figure H-12**). For purposes of modeling, the future developments were assumed to occur at five locations, all in the area of high hydrocarbon potential in the NPR-A. Modeling was performed for the Alternative D high development scenario, which has a total peak production rate of 500,000 barrels of oil per day. One-fourth of this production (125,000 barrels of oil per day) was assigned each to potential developments at Smith Bay, Teshekpuk Lake, and Umiat. One-eighth of the production (62,500 barrels of oil per day) was assigned each to developments at Willow North and South, which would potentially function as satellite developments to Willow.

Model-predicted concentrations were post-processed in the form of the NAAQS for multiple pollutants and for visibility impairment from particulate matter and nitrogen and sulfur deposition. The modeled hourly values were averaged to the appropriate time range for comparison with standards and criteria.

CAMx simulation outputs were processed to analyze the air quality impacts with respect to the NAAQS and AQRV metrics. Presented below is the description for each analysis.

Figure H-12. Regional Modeling Domain



Impacts for the assessment areas shown in **Figure H-12** were derived using a geographical information system and by intersecting the assessment areas with the modeling domain to extract the 2.5-mile model grid-cells that lie in these areas. The impacts are predicted for each assessment area by considering the air quality impacts from these modeling grids.

Figure H-12 shows the regional (far-field) air quality modeling domain that is used for CAMx modeling. The domain has a 2.5-mile horizontal resolution and encompasses all of the NPR-A and parts of the three additional assessment areas (Arctic National Wildlife Refuge, Gates of the Arctic National Park and Preserve, and Noatak National Preserve; **Table H-15**).

Table H-15
Assessment Areas Considered for Air Quality Related Value Analysis

Area	Administrative Agency
Arctic National Wildlife Refuge	U.S. Fish and Wildlife Service
Gates of the Arctic National Park and Preserve	NPS
Noatak National Preserve	NPS

Model Configuration

Table H-16 summarizes the CAMx model setup options for this modeling assessment. Impacts of reasonably foreseeable developments within the NPR-A are estimated using the difference between the cumulative future year simulation and the cumulative 2012 base scenario simulation. The impacts derived using this approach are referred as using the "brute force" method. The only purpose of the cumulative 2012 base scenario simulation is to derive those impacts; no other modeling results from that simulation are reported here.

Table H-16
CAMx Model Setup Configuration and Description

Science Option	Configuration	Description
Gas phase chemistry	CB6r4	Updated isoprene chemistry; heterogeneous hydrolysis of organic nitrates; active methane chemistry and ECH4 excess methane tracer species (Ruiz and Yarwood 2013).
Aerosol phase chemistry	SOAP2.1+ISORROPIA	Updated photolysis rates in SOAP2.1
Photolysis rate	Tropospheric Ultraviolet Visible (TUV) V4.8 preprocessor	Clear-sky photolysis rates based on day-specific Total Ozone Mapping Spectrometer data; CAMx in-line adjustment based on modeled aerosol loading
Horizontal diffusion	Explicit horizontal diffusion	Spatially varying horizontal diffusivities determined based on the methods of Smagorinsky (1963)
Vertical diffusion	K-theory 1st-order closure	Vertical diffusivities from WRFCAMx and KVPATCH; land use-dependent minimum diffusivity (minimum vertical eddy diffusivity = 0.1 to 1.0 square meters/second)

Science Option	Configuration	Description
Dry deposition	ZHANG03	Dry deposition scheme by Zhang et al. (2001, 2003)
Wet deposition	CAMx-specific formulation	Scavenging model for gases and aerosols (Seinfeld and Pandis 1998)

The initial and lateral boundary conditions for the 2.5-mile modeling domain for all scenarios were derived from the three-dimensional model outputs of corresponding 7.5-mile simulations. Note that for the 2.5-mile base year scenario, the initial and lateral boundary conditions are derived from the corresponding 7.5-mile 2012 simulation, while the future year simulations are derived from a 7.5-mile 2020 simulation. The hourly varying boundary conditions for the 2.5-mile domain are generated for each day in the modeling period. The CAMx simulations were conducted by splitting the runs into four quarters and initializing the runs with a 10-day spin-up period, as is conventionally done.

The day-specific ozone column data were based on the Total Ozone Mapping Spectrometer data measured using the Ozone Monitoring Instrument satellite. The in-line photolysis rates were calculated using a TUV v4.8 preprocessor to generate day-specific lookup tables. The cloud cover and aerosol loadings effects on photolysis rates are crucial, so CAMx was configured to use in-line TUV with these adjustments. The same clear-sky rates were used for both base and future years.

Model Performance Evaluation

A model performance evaluation was conducted on the 2012 base scenario in the 2.5-mile domain. The model data were compared with the ambient observational data at the monitoring sites available in the 2.5-mile domain. As mentioned in previous reports (ADEC 2011; BOEM 2017), the ambient data available near the Arctic region are very limited and sparse.

Table H-17 lists the air monitoring sites in the 2.5-mile domain and the chemical species that were evaluated. The locations of the monitoring sites can be seen in **Figure H-4**. The sites are in coastal portions of the North Slope and were originally established to satisfy PSD permitting requirements for new major sources. The monitoring data at these sites are from the BOEM study (BOEM 2017); additionally, Nuiqsut, Deadhorse, and Wainwright sites have been included in the analysis.

Table H-17
Monitoring Sites Used in Model Performance Evaluation

Site Name	Site ID	Source	Lat	Lon	Species
APAD	02185APAD	Alaska permit data	70.26611	-148.7563	O_3
DS1F	02185DS1F	Alaska permit data	70.29917	-149.6847	O_3
BRW	02185XBRW	National Oceanic and Atmospheric Administration	71.323	-156.6114	O_3
CCP	02185XCCP	Alaska permit data	70.31936	-148.5166	O_3, $PM_{2.5}$
Nuiqsut	–	BLM (2019)	70.22361	-150.9996	$PM_{2.5}$
Deadhorse	–	BLM (2019)	70.22201	-148.4223	$PM_{2.5}$ components (NO_3, SO_4, elemental carbon, organic carbon, and NH_4)

Site Name	Site ID	Source	Lat	Lon	Species
Wainwright	–	BLM (2019)	70.64111	-160.007	$PM_{2.5}$ components (NO_3, SO_4, elemental carbon organic carbon, and NH_4)

Source: AK Permit Data from ADEC air quality permit files as supplied for use in BOEM study (Fields Simms et al. 2018) by the ADEC; NOAA ESRL published data for the Barrow Atmospheric Baseline Observatory (http://www.esrl.noaa.gov/gmd/obop/brw/).

The CAMx model data were spatially and temporally paired with the monitoring data. As performed in the BOEM study, the model data were averaged over the 9-grid cell block centered on the individual monitoring site and were used to conduct the site-by-site comparison. The paired model and observational data were used to calculate the normalized mean bias, normalized mean error, fractional bias, and fractional error statistical metrics. These metrics were compared with the photochemical modeling performance goals and criteria standards for ozone and $PM_{2.5}$ (Emery et al. 2017) to understand the model performance. These goals and criteria standards are developed mainly for model applications within the continental U.S., but as no other information exists, the same standards were applied to this Arctic region. Additional details on how the model performance evaluation was conducted can be found in the Willow Draft EIS Draft Air Quality Technical Support Document (Ramboll 2019).

Overall, the model performs reasonably well, particularly for ozone, and is a relatively poor predictor of crustal soil concentrations. Specifically, the annual normalized mean bias for ozone falls within the goal range listed in Emery et al. (2017) of ±5 percent; the annual mean normalized bias for $PM_{2.5}$ is within the recommended range of ±30 percent. However, the model tends to underpredict ozone and $PM_{2.5}$ in the colder months and overpredict concentrations in the warmer months. For $PM_{2.5}$ species, the model performs best for nitrate and ammonium while crustal soil is generally overpredicted in the year. Organic carbon is systematically biased low. In summary, the model performs reasonably well, excluding difficulties reproducing very low observational data and systematic biases for organic carbon and soil.

Emissions Processing

Regional emissions are based on data developed in the BOEM Arctic study (Fields Simms et al. 2014), and the data sources for the regional emissions and natural emissions are summarized in **Table H-18**. As described in Fields Simms et al. (2014), the future year emissions are representative of full build-out scenarios that are based on the projections of anticipated development. The BOEM emissions were adjusted to reduce sea salt and unpaved road dust and to incorporate additional emissions for future onshore development.

The SMOKE system (version 3.6) was used to generate model-ready emissions for the regional emissions shown in Section 2.3.2 "Regional Emissions Inventories" to develop hourly, speciated, and gridded CAMx-ready emission inputs.

Table H-18
Data Sources for BOEM Emissions Inventory Platform

Emission Sector	Data Source
North Slope Borough, Chukchi, and Beaufort Sea anthropogenic emissions	BOEM Arctic air quality study developed for onshore and offshore sources
Anthropogenic emissions for Canada	U.S. EPA 2011-based modeling platform v6.2
Anthropogenic emissions outside the U.S. and Canada	GEOS-Chem global model (retrospective inventory and EDGAR inventory)
Biogenic	Model of Emissions of Gases and Aerosols from Nature (MEGAN) version 2.03

Emission Sector	Data Source
Fire	Day-specific Fire Inventory (FINN) from the National Center for Atmospheric Research (NCAR) processed using Emissions Processing System version 3 (EPS3) model
Sea salt emissions	The sea salt emissions are processed using revised sea salt v3.3 processor.
Lightning emissions	In-line lightning emissions derived from Community Multiscale Air Quality (CMAQ) model using the convective precipitation rate from meteorological data

NAAQS and AAAQS

The regional air quality impacts were calculated from the CAMx modeling results for the criteria pollutants CO, O_3, $PM_{2.5}$, PM_{10}, NO_2, and SO_2; they were compared with the NAAQS primary and secondary standards and the AAAQS. The primary NAAQS protect public health, including sensitive populations, and the secondary NAAQS protect public welfare. The photochemical grid model provides hourly concentrations for multiple pollutants at each grid cell in the modeling domain. To provide model predictions consistent with the NAAQS and AAAQS, these model results are post-processed and summarized in tables. The criteria pollutants concentrations for each grid cell in the modeling domain are compared with the respective species' AAQS standard to evaluate the impacts under each alternative.

For ozone, there is one averaging period to evaluate, and the level of the standard is identical for both primary and secondary NAAQS and the AAAQS. The following steps were conducted to process model results for comparison with the ozone standard. First, the maximum daily 8-hour average (MDA8) is calculated for each day in the annual simulation; then the fourth-highest concentration (H4MDA8) is determined for each grid cell in the modeling domain. Finally, the total air quality values reported for each assessment area correspond to the maximum H4MDA8 from the collection of modeling grid cells that lie in these areas.

Impacts of the RFD scenario with maximum production (Alternative D, high scenario) are derived using the brute force method. For ozone, this is performed by calculating the difference between the total air quality H4MDA8 values from the cumulative CAMx modeling and the modeling excluding this production. Note that the difference is performed over the maximum H4MDA8 without matching total air quality values in either space (different cells) or time (different days).

For CO, there are two averaging times to evaluate for comparison with NAAQS and AAAQS; both averaging periods are primary standards. The 8-hour standard is calculated from the hourly concentrations using non-overlapping 8-hour averages (three values for each day). After this averaging is performed, the second-highest value for the annual simulations is saved for each grid cell in the modeling domain. The 1-hour standard is calculated by first keeping the 1-hour maximum for each day and then selecting the second-highest value for the annual simulations for each grid cell in the modeling domain. Finally, the total air quality values reported for each assessment area correspond to the maximum value for each standard for those model grid cells that lie in these areas.

For NO_2, there are two averaging times to evaluate for comparison with NAAQS and AAAQS: a 1-hour averaging time, which is a primary NAAQS, and an annual averaging time, which is both a primary and secondary NAAQS. The 1-hour standard is calculated by first calculating the 1-hour maximum for each day and then selecting the eight-highest value for the annual simulations (equivalent to the 98th percentile) for each grid cell in the modeling domain. The annual standard is calculated from the annual average of hourly concentrations for each grid cell in the modeling domain. Finally, the total air quality values reported for each assessment area correspond to the maximum value for each standard for those model grid cells that lie in these areas.

For $PM_{2.5}$, there are two averaging times to evaluate for comparison with NAAQS and AAAQS: a 24-hour averaging time, which is both a primary and secondary NAAQS, and an annual averaging time, which has two separate NAAQS. The primary annual $PM_{2.5}$ NAAQS is 12 $\mu g/m^3$ and the secondary annual $PM_{2.5}$ NAAQS is 15 $\mu g/m^3$. The annual average results are compared with the annual average of hourly concentrations for each cell in the domain. The 24-hour average results are calculated from the hourly concentrations by first producing daily 24-hour averages and then selecting the eighth-highest value (equivalent to the 98th percentile) for each grid cell in the modeling domain. Finally, the total air quality values reported for each assessment area correspond to the maximum value for each standard for those model grid cells that lie in these areas.

For PM_{10}, the averaging period to evaluate and the level of the standard are identical for both primary and secondary NAAQS and the AAAQS. The 24-hour average results are calculated from the hourly concentrations by first producing daily 24-hour averages and then selecting the second-highest value for each grid cell in the modeling domain. Finally, the total air quality values reported for each assessment area correspond to the maximum value for each standard for those model grid cells that lie in these areas.

For SO_2, there are four averaging periods to evaluate for comparison with NAAQS and AAAQS: a 1-hour averaging time, which is a primary NAAQS; a 3-hour averaging time, which is a secondary NAAQS; a 24-hour averaging time, which is only an AAAQS; and an annual averaging time, which is only an AAAQS. The 1-hour average results are calculated by first keeping the 1-hour maximum for each day and then selecting the fourth-highest value for the annual simulations (equivalent to the 99th percentile) for each modeling grid cell. The 3-hour average results are calculated from the hourly concentrations using non-overlapping 3-hour averages (eight values for each day). After this averaging is performed, the second-highest value over the full annual simulation is reported for each cell in the modeling domain. For the AAAQS, the 24-hour average results are calculated by selecting the second-highest value from the daily 24-hour averages, while the annual average results are calculated from the annual average of hourly concentrations for each cell in the modeling domain. Finally, the total air quality values reported for each assessment area correspond to the maximum value for each standard for those model grid cells that lie in these areas.

Visibility

Visibility impairment due to an individual development in the NPR-A (i.e., Willow) was modeled by the BLM (2019) and was found to be below the 0.5 and 1.0 dv thresholds (FLAG 2010). The cumulative visibility methodology is discussed in the Cumulative Assessment Methods section below.

Deposition

Model-predicted fluxes of total sulfur (S) and nitrogen (N) compounds were used to estimate the deposition impacts at the three assessment areas for this IAP. Total deposition includes the sum of wet and dry deposition fluxes for all modeled sulfur- and nitrogen-containing compounds presented in **Table H-19**. Total nitrogen and sulfur deposition model estimates are derived by adding the hourly model output to annual totals for each individual grid cell in the computational domain. This study reports both the maximum and the average total deposition from all the cells in a given assessment area. Previous modeling performed for the Willow EIS (BLM 2019) showed that sulfur and nitrogen deposition impacts due to an individual development (Willow) were below the deposition analysis thresholds.

Table H-19
List of Modeled Species Included in Calculation of Total Nitrogen and Sulfur Deposition

Deposition	Species Included
Nitrogen	NO: Nitric oxide
	NO_2: Nitrogen dioxide
	PAN: Peroxyacetyl nitrate
	NO_3: Nitrate radical
	N_2O_5: Dinitrogen pentoxide
	PNA: Peroxynitric acid
	HONO: Nitrous acid
	HNO_3: Nitric Acid
	NTR1: Simple organic nitrate
	NTR2: Multifunctional organic nitrates
	PANX: C_3 and higher peroxyacyl nitrate
	NH_3: Ammonia
	OPAN: Peroxyacyl nitrate (PAN compound) from peroxyacyl radical from Aromatic ring opening product (unsaturated dicarbonyl)
	PNH_4: Particulate ammonium
	PNO_3: Particulate nitrate
Sulfur	SO_2: Sulfur dioxide
	SULF: Sulfur acid (gaseous)
	PSO_4: Particulate sulfate

Acid-neutralizing Capacity

Previous studies in the region, such as the Greater Mooses Tooth-2 and the Willow EIS, did not include an analysis of the effect on the acid-neutralizing capacity (ANC) of sensitive lakes due to the lack of ANC data. Since the necessary ANC data are not available for sensitive lakes in the region, the change in ANC was not calculated for this study.

Near-field Assessment Method

The Willow MDP is located in the NPR-A "high development potential zone." It is also the most current and comprehensive example of a hypothetical project in the NPR-A. The IAP/EIS is analyzing impacts from a hypothetical future development, and the Willow Draft EIS proposal is still representative of a potential development in the NPR-A. Thus, the near-field air quality modeling conducted for the Willow Draft EIS was used as a surrogate to represent a hypothetical future development in the NPR-A. Any new development in the NPR-A will have phased construction in support of delineation and development drilling leading to production. Infrastructure may consist of an airstrip and multiple satellite pads that are connected by infield roads and pipelines to a central processing facility. A single, larger-diameter pipeline will lead from the central processing facility to market. Operations will be dependent on a gravel source, construction materials, oversized modules, and transportation to the project location. Willow, with five production pads each containing up to 50 wells, is therefore a conservative estimate of potential future developments that could be authorized under the new IAP. Near-field air quality impacts from a hypothetical development in the NPR-A are expected to be comparable with, or less than, the near-field impacts from the Willow MDP in all alternatives. Note that any future proposed development would still need to be assessed quantitatively using project-specific information.

The AERMOD was used to assess near-field impacts within 31 miles of a hypothetical development in the NPR-A. AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain (Cimorelli et al. 2005; Perry et al. 2005; Gibson et al. 2013; EPA 2019). AERMOD model results are added to background ambient air concentrations from existing emissions sources to calculate the total air quality concentrations. Total air quality concentrations are compared with the applicable air quality standards (both the NAAQS and AAAQS) and averaging periods are shown in **Table H-1** to assess impacts for criteria pollutants.

The hazardous air pollutants benzene, toluene, ethylbenzene, xylenes, n-hexane, and formaldehyde are assessed with the AERMOD model. Model results are compared with non-cancer acute and chronic pollutant-specific threshold levels shown in **Table H-3** and **Table H-4**, respectively. Chronic cancer risk is calculated for the analyzed HAPs that have published cancer risk factors, and risk from the project is compared with a one-in-one million risk threshold.

The near-field impact assessment method, data, and results are detailed in the following sections. **Tables 3.2.2-1** through **3.2.2-3** show the modeled impacts of the hypothetical development on air quality and HAPs. Impacts on air quality and HAPs are below all applicable standards and thresholds.

Emissions Inventory for Near-field Assessment

This section presents a summary of the emissions inventory from the Willow Draft EIS that was used as a hypothetical future development project for this analysis. Any actual proposed development would need to consider a project-specific emissions inventory for a near-field assessment.

Criteria pollutant, VOCs, HAP, and greenhouse gas emissions are emitted during construction, drilling, and routine operation project phases. Emissions would result from activities such as well installation, development, and operation; operation of engines and boilers; and vehicle transportation of equipment and service crews in the project area. Project emission sources would include nonmobile combustion sources, mobile on-road and non-road tailpipe combustion sources, fugitive dust sources, fugitive leak sources, venting sources, ships, and aircraft sources. The hypothetical future development project model consists of four development scenarios, which were analyzed for near-field impacts: construction, predrilling activities, development drilling, and routine operations. The emissions that are expected to come from these activities were estimated for CAPs, VOCs, and HAPs. Details on the emissions from each of these project phases can be found in the Willow Draft EIS.

Modeling Approach

Dispersion Model

The most recent version of AERMOD available at the time these estimations were made (Ramboll 2019) was used for the near-field analysis. As of October 4, 2018, the AERMOD version was 18081.

Meteorological Data

Meteorological data for the AERMOD modeling system were prepared using the AERMET meteorological processor applied to representative surface and regional upper air observations. EPA modeling guidance recommends either 5 years of National Weather Service hourly surface observations or at least 1 year of on-site/site-specific meteorological observations. As such, 5 years (2013–2017) of available meteorological data from the Nuiqsut monitoring station, and upper data from Utqiagvik, Alaska, were processed with AERMET and were used for the near-field modeling analysis. At this time, these represent the most recent 5-year dataset for Nuiqsut that has been approved by ADEC. This 5-year dataset is a more recent time period than was used for the GMT2 SEIS, which used the 2011–2015 data.

NO_2 Modeling Approach

For modeling NO_2, the Ozone Limiting Method is used to estimate the NO_x to NO_2 conversion. The hourly ozone data measured at Nuiqsut are used for the same calendar years as the meteorological data presented above. An equilibrium ratio of 0.9 was used for all sources and, unless noted, the in-stack ratios were derived from data contained in a spreadsheet available from ADEC with approved in-stack ratio values (ADEC 2013). In the absence of any available data, the EPA default value of 0.5 was used (EPA 2011). Data were averaged over all loads available for similar equipment to what would be used in the proposed Willow MDP project.

Receptors

An ambient air boundary and receptor grid was developed consistent with the Willow MDP to assess near-field impacts for each modeling scenario (Ramboll 2018). Receptors were placed around the ambient air boundaries, extending up to 31 miles. An additional discrete modeling receptor was placed at a representative nearby community, to characterize impacts on sensitive receptors for both criteria pollutant impacts and the six selected HAPs. All receptors were in the UTM NAD83 Zone 5N coordinate system. The village of Nuiqsut is treated as a nearby representative community, as it was explicitly modeled in the Willow MDP Draft EIS. Nuiqsut is approximately 24.9 miles from the Willow project.

Impacts on Local Communities

Likely near-field impacts from potential development were assessed at three local communities (Atqasuk, Nuiqsut, and Utqiagvik). These local communities are near the Willow MDP project that is used as a surrogate for a representative project in the impact analysis. The relative impacts under each alternative were determined by assessing the amount of land surrounding each community that was open or closed to fluid mineral leasing. It was assumed that if more land surrounding the community was open to fluid mineral leasing in a given alternative, the near-field impacts on the community under that alternative would likely be greater. In addition, as discussed above, modeling conducted previously for the Willow Draft EIS was incorporated by reference to estimate near-field impacts due to a potential development in the NPR-A.

Near-field impacts at the nearby representative community (Nuiqsut) for the Willow project are shown in Tables 3-3 through 3-5 of the Final IAP/EIS. The impacts are all well below the air quality standards for the CAPs and well below risk thresholds for the HAPs. There may be variations in results arising from meteorological and topographical differences between future proposed developments/sensitive receptor areas and the Willow project and Nuiqsut communities used as surrogates in this analysis. For example, the AERMOD modeling was conducted assuming flat terrain for all receptors because the area surrounding the Willow project is generally flat on a local scale. If the topography in an area considered for proposed future development is more complex, sensitive neighboring communities could be at a higher elevation and experience higher concentrations given the same meteorological conditions. However, the complex terrain would likely have offsetting effects on meteorology (e.g., higher wind speeds and more turbulence) that would result in lower concentrations. Differences in impacts could also occur depending on the distance between the proposed development and neighboring communities. Nuiqsut is approximately 24.9 miles from the Willow project. To the extent that a different community is closer or farther away from oil and gas development in the NPR-A, air quality impacts would correspondingly be higher or lower. These project-specific local effects would need to be examined in detail during a site-specific NEPA analysis at the time a development application is submitted.

Cumulative Assessment Methods

Regional Emissions

Regional emission sources were added to the emissions inventory for the CAMx regional modeling to assess cumulative air quality impacts. A summary of all other cumulative source emissions in the 2.5-mile CAMx modeling domain is provided in Ramboll 2019. The cumulative emissions inventory was developed by combining these regional emissions with the IAP Alternative D high development RFD scenario emissions that were described in Section 3.2.2.

Modeling Approach

As discussed above, the CAMx modeling system was used to estimate the potential cumulative air quality and AQRV impacts from Alternative D in the assessment areas in **Figure H-12** as well as the overall 2.5-mile domain. CAMx simulation outputs were processed to analyze the cumulative air quality impacts with respect to the NAAQS and AQRV metrics. For details on these analysis methods, see the Far-field Assessment Method section above.

Visibility

Particulate matter concentrations in the atmosphere contribute to the visibility degradation by both scattering and absorption of visible light. The combined effect of scattered and absorbed light is called light extinction. Changes in the light extinction for each modeling scenario were calculated at the assessment areas shown in **Figure H-12**. The visibility metric used in this analysis is called Haze Index (HI), which is measured in dv units and is defined as follows:

$$HI = 10 \text{ x } \ln [b_{ext}/10]$$

Where b_{ext} is the atmospheric light extinction measured in inverse megameters (Mm^{-1}) and is calculated primarily from atmospheric concentrations of particulates.

For this analysis, cumulative visibility design values are assessed using the Software for Model Attainment Test- Community Edition (SMAT-CE) version 1.2 (Wang et al. 2015). SMAT-CE provides model-adjusted visibility design values that are consistent with the EPA's "Modeling Guidance for Demonstrating Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze" (EPA 2018). Photochemical models are affected by biases (i.e., model results are a simplification of natural phenomena and, as such, model results tend to over- or underestimate particulate matter concentrations). The use of SMAT-CE aids in mitigating model bias for visibility calculations by pairing model estimates with actual measured concentrations.

SMAT-CE calculates baseline and future-year visibility levels for both the 20 percent best and 20 percent most impaired days for each of the 156 Class I areas. To do this, SMAT-CE adjusts the modeled air quality concentrations based on measured air quality concentrations to account for possible model bias utilizing the relative response factor approach described below. Within SMAT-CE, model-predicted concentrations of chemical compounds that scatter or absorb light are converted to estimates of light extinction using the IMPROVE equation (Hand and Malm 2006). The IMPROVE equation reflects empirical relationships derived between measured mass of PM components and measurements of light extinction at IMPROVE monitoring sites in Class I areas. The IMPROVE equation calculates light extinction as a function of relative humidity for large and small particulate matter. As a final step in SMAT-CE, light extinction values are converted into dv, a measure for describing the ability for the human eye to perceive changes in visibility.

The EPA guidance for estimating future-year visibility levels recommends using the photochemical grid model results in a relative sense to scale the visibility current design values (DVC). The visibility DVCs are based on a 5-year average of monitored IMPROVE data centered on the typical modeling year. For this analysis, the typical year is 2012, so the 5-year period centered on 2012 is 2010 through 2014.

Scaling factors, called relative response factors (RRFs), are calculated from the modeling results. RRFs are applied to the DVC to predict future-year design values (DVF) at a given monitoring location using the following equation:

$$DVF = DVC \times RRF$$

RRFs are the ratio between the model-predicted concentrations in the future-year modeling scenario and the typical year modeling scenario. RRFs are calculated for each individual chemical component that contributes to light extinction based on the model grid cells surrounding a monitoring site.

SMAT-CE depends on IMPROVE monitors to assess visibility impacts. Note that there are no Class I areas within the 2.5-mile computational domain. So, the Denali National Park IMPROVE monitor was selected for this analysis. The following steps indicate how the analysis was performed for each assessment area in the study:

1. Hourly concentrations of modeled particulate matter were averaged to daily values for each component of the IMPROVE equation for all the grid cells in the 2.5-mile domain. This step is performed for both the 2012 base scenario and the corresponding cumulative alternative scenario modeling results.
2. Modeled concentrations from step 1 were extracted for a 3x3 matrix centered around the corresponding assessment area centroid. The centroid was determined by the area left within the 2.5-mile domain using geographic information system.
3. The latitude and longitude values that correspond to the IMPROVE monitor at Denali and the surrounding 3x3 points at a 2.5-mile distance to the monitor were assigned to the modeled concentrations in step 2.

The files in step 3 were used as the model input for SMAT-CE Denali National Park data.

All the steps described above are applied to all the assessment areas for this study.

SMAT-CE was configured using the settings provided in **Table H-20** and was run with the modeling results for Alternative D modeling scenario. These setting include the changes from SMAT-CE defaults and other changes necessary to accurately incorporate the model year selected for the typical year and other data that are dependent on the typical year.

Deposition

Cumulative deposition impacts are estimated using model-predicted fluxes of total sulfur (S) and nitrogen (N) compounds. The cumulative assessment is performed by comparing the modeled predictions for total nitrogen deposition from all sources with critical loads derived by the NPS. A critical load is the level of deposition below which no harmful effects are expected to an ecosystem. The critical load values for nitrogen deposition for Alaska (Sullivan 2016) are protective of the tundra ecoregion and range from 1.0 to 3.0 kg/ha-yr.

Table H-20
SMAT-CE Configuration Settings

Option	Main Category	Setting	Default	This Study
Desired Output	Scenario Name	Name		
	Forecast	Temporally adjust visibility levels at Class 1 area	Yes	Yes
		Improve algorithm	Use new version	Use new version
		Use model grid cells at monitors	Yes	Yes
		Use model grid cells at Class 1 area centroid	No	No
	Actions on run completion	Automatically extract all selected output files	Yes	Yes
Data Input	Monitor data	File name	Class1areas_NEWIMPROVEALG_2000to2015_2017feb13_TOTAL.csv	Class1areas_NEWIMPROVEALG_2000to2015_2017april27_IMPAIRMENT.csv[a]
	Model data	Baseline file	SMAT.PM.Large.12.SE_US2.2011eh.camx.grid.csv	Willow base output 2012[b]
		Forecast file	SMAT.PM.Large.12.SE_US2.2017eh.camx.grid.csv	
	Using model data	Temporal adjustment at monitor	3x3	3x3
Filtering	Choose visibility data years	Start monitor year	2009	2010[c]
		End monitor year	2013	2014[c]
		Base model year	2011	2012[c]
	Valid visibility monitors	Minimum years required for valid monitor	3	3

[a]Monitor data that select the 20 percent most impaired days are used instead of the 20 percent worst days
[b]Baseline file changed from default (2011) to the year (2012) base modeling year.
[c]The values for the start, end, and base model years are set to reflect a year centered on the base year (2012) and to perform the current deciview calculation with the 5-year period surrounding this year (2010 to 2014).

Near-field Air Quality

Similar to the near-field assessment method described above, the EPA regulatory air dispersion model, AERMOD, was used to assess near-field cumulative impacts within 31 miles of a hypothetical development in the NPR-A. The cumulative assessment is distinct only in that AERMOD was modeled for the routine operations scenario of the development as well as other oil and gas projects. Cumulative air quality concentrations are compared with the applicable air quality standards (both the NAAQS and AAAQS) and averaging periods shown in **Table H-1** to assess cumulative impacts for criteria pollutants.

H.3 EMISSIONS

Emissions were developed for each RFD scenario and alternative by scaling Willow project emissions, which are considered typical of a large future development in the NPR-A IAP.[4] The Willow Alternative B (BLM 2019) was used for this analysis because development in this alternative was fully connected by roads, and future developments in the NPR-A are more likely to have access roads than roadless components. The peak year maximum Willow barrels of oil per day was used to scale emissions for all alternatives in this IAP, using the barrels of oil per day of each alternative under a low, medium, and high development scenario. The emissions for each alternative and development scenario can be seen in **Table H-21** through **Table H-25**.

Table H-21
Annual Emissions due to Development under Alternative A

Barrels of Oil per Day (peak production)	Low Development Scenario	Medium Development Scenario	High Development Scenario
	61,529	**107,675**	**256,369**
	Total emissions (ton/year)	**Total emissions (ton/year)**	**Total emissions (ton/year)**
NO_x	358.2	626.8	1,492.5
CO	331.3	579.8	1,380.4
VOC	338.8	592.9	1,411.6
SO_2	24.8	43.3	103.2
PM_{10}	120.3	210.5	501.2
$PM_{2.5}$	44.7	78.2	186.2
Total HAPs[a]	39.0	68.3	162.5
Benzene	0.4	0.8	1.8
Toluene	1.3	2.2	5.2
EthylBenzene	6.1	10.6	25.3
Xylene	12.0	21.0	50.0
n-Hexane	18.3	32.0	76.1
Formaldehyde	1.0	1.7	4.1

[a]Total HAPs represent the total of the six individual HAPs listed above.

[4]Note that the Willow project is located in the NPR-A "high development potential zone" and, therefore, the emissions from the Willow project are anticipated to be most representative of development that occurs in the high development potential zone. Development that occurs in the medium or low development potential zones of the NPR-A could have different production levels, equipment, infrastructure needs, and transportation. All of those would affect the greenhouse gas emissions estimates. No information is available to quantitatively assess emissions for the medium or low development potential zones; however, if development occurs in these areas, emissions would be greater than they are currently.

Table H-22
Annual Emissions due to Development under Alternative B

Barrels of Oil Per Day (peak production)	Low Development Scenario	Medium Development Scenario	High Development Scenario
	67,026	**117,295**	**279,275**
	Total emissions (ton/year)	**Total emissions (ton/year)**	**Total emissions (ton/year)**
NO_x	390.2	682.8	1,625.8
CO	360.9	631.6	1,503.8
VOC	369.1	645.9	1,537.7
SO_2	27.0	47.2	112.4
PM_{10}	131.0	229.3	545.9
$PM_{2.5}$	48.7	85.2	202.9
Total HAPs[a]	42.5	74.4	177.0
Benzene	0.5	0.8	2.0
Toluene	1.4	2.4	5.7
EthylBenzene	6.6	11.6	27.6
Xylene	13.1	22.9	54.4
n-Hexane	19.9	34.8	82.9
Formaldehyde	1.1	1.9	4.4

[a]Total HAPs represent the total of the six individual HAPs listed above.

Table H-23
Annual Emissions due to Development under Alternative C

Barrels of Oil Per Day (peak production)	Low Development Scenario	Medium Development Scenario	High Development Scenario
	90,073	**157,629**	**375,306**
	Total emissions (ton/year)	**Total emissions (ton/year)**	**Total emissions (ton/year)**
NO_x	524.4	917.7	2,184.9
CO	485.0	848.8	2,020.9
VOC	496.0	867.9	2,066.5
SO_2	36.2	63.4	151.0
PM_{10}	176.1	308.1	733.7
$PM_{2.5}$	65.4	114.5	272.6
Total HAPs[a]	57.1	99.9	237.9
Benzene	0.6	1.1	2.7
Toluene	1.8	3.2	7.6
EthylBenzene	8.9	15.6	37.1
Xylene	17.6	30.7	73.2
n-Hexane	26.7	46.8	111.4
Formaldehyde	1.4	2.5	6.0

[a]Total HAPs represent the total of the six individual HAPs listed above.

Table H-24
Annual Emissions due to Development under Alternative D

Barrels of Oil Per Day (peak production)	Low Development Scenario	Medium Development Scenario	High Development Scenario
	120,000	210,000	500,000
	Total emissions (ton/year)	Total emissions (ton/year)	Total emissions (ton/year)
NO_x	698.6	1,222.5	2,910.8
CO	646.1	1,130.8	2,692.3
VOC	660.7	1,156.3	2,753.1
SO_2	48.3	84.5	201.2
PM_{10}	234.6	410.5	977.4
$PM_{2.5}$	87.2	152.5	363.2
Total HAPs[a]	76.1	133.1	317.0
Benzene	0.8	1.5	3.5
Toluene	2.4	4.3	10.2
EthylBenzene	11.9	20.7	49.4
Xylene	23.4	40.9	97.5
n-Hexane	35.6	62.3	148.4
Formaldehyde	1.9	3.3	8.0

[a]Total HAPs represent the total of the six individual HAPs listed above.

Table H-25
Annual Emissions due to Development under Alternative E

Barrels of Oil Per Day (peak production)	Low Development Scenario	Medium Development Scenario	High Development Scenario
	120,000	210,000	500,000
	Total emissions (ton/year)	Total emissions (ton/year)	Total emissions (ton/year)
NO_x	698.6	1,222.5	2,910.8
CO	646.1	1,130.8	2,692.3
VOC	660.7	1,156.3	2,753.1
SO_2	48.3	84.5	201.2
PM_{10}	234.6	410.5	977.4
$PM_{2.5}$	87.2	152.5	363.2
Total HAPs[a]	76.1	133.1	317.0
Benzene	0.8	1.5	3.5
Toluene	2.4	4.3	10.2
EthylBenzene	11.9	20.7	49.4
Xylene	23.4	40.9	97.5
n-Hexane	35.6	62.3	148.4
Formaldehyde	1.9	3.3	8.0

[a]Total HAPs represent the total of the six individual HAPs listed above.

H.4 IMPACTS COMMON TO ALTERNATIVES A, B, C, AND E

There was no new near-field or far-field modeling conducted for Alternatives A, B, C, and E. Modeling for Alternative D, described below, is applicable to Alternative E. All impacts for these alternatives are discussed in the EIS **Section 3.2.2**.

H.5 ALTERNATIVE D

H.5.1 Far-field Impacts

The far-field (regional) impacts for Alternative D are discussed below.

The cumulative Alternative D impacts were below the NAAQS and AAAQS standards for criteria pollutants and averaging periods everywhere in the air quality analysis area, including the three assessment areas and the communities of Atqasuk, Nuiqsut, and Utqiagvik. The nitrogen cumulative deposition impacts were compared with the critical loads value of 1.0–3.0 kg/ha-yr (Sullivan 2016) and were found to be below or within this range at all three assessment areas. As discussed above, cumulative visibility impairment was compared qualitatively with respect to baseline conditions, as there are no thresholds.

H.5.2 NAAQS and AAAQS Analysis

Table H-26 shows the maximum project impacts for select criteria pollutants in terms of the standards. The Alternative D impacts for all pollutants are well below the NAAQS and AAAQS standards and show negligible contribution to the cumulative air quality concentrations.

Table H-26
Modeled Cumulative Concentrations under Alternative D with AAQS

	CO		NO_2		O_3	$PM_{2.5}$		PM_{10}	SO_2			
	8-hour	1-hour	1-hour	Annual	8-hour	Annual	24-hour	24-hour	1-hour	3-hour	24-hour	Annual
	mg/m³	mg/m³	µg/m³	µg/m³	ppb	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
AAQS	10	40	188	100	70	12	35	150	196	1300	365	80
Modeled Concentrations												
Full Domain	3.4	1.0	136.1	41.6	55.5	10.1	31.4	121.3	151.8	149.2	90.2	24.4
Nuiqsut	0.2	0.2	33.8	5.0	35.8	2.0	5.5	10.8	2.5	2.3	1.3	0.3
Atqasuk	0.2	0.2	12.8	0.9	37.1	1.7	4.1	9.8	0.6	0.7	0.6	0.1
Utqiagvik	0.2	0.2	22.6	3.7	39.5	3.6	12.4	85.8	2.8	2.9	1.2	0.4
ANWR[a]	0.7	0.5	39.5	2.9	55.5	2.5	7.3	30.5	1.9	5.4	1.8	0.3
GAAR[b]	0.2	0.2	2.3	0.4	53.4	1.4	3.9	9.9	1.8	2.3	1.5	0.2
NOAT[c]	3.4	1.0	24.4	0.9	46.8	2.6	8.8	105.6	8.3	26.2	6.2	0.2

[a]Arctic National Wildlife Refuge
[b]Gates of the Arctic National Park and Preserve
[c]Noatak National Preserve

H.6 CUMULATIVE IMPACTS

Cumulative far-field and near-field (routine operations scenario) modeling include current and future sources, including oil and gas and other developments. Other oil and gas projects located within the near-field study area (defined as being within 31 miles) were included in the near-field analysis. Other oil and gas projects located within the 2.5-mile resolution far-field model domain are included in the cumulative far-field modeling if the project was not already included as part of the BOEM regional emissions database used for this IAP RFD. Existing sources that have planned modifications and other oil and gas projects that are not subject to this IAP, but were included in cumulative modeling, are:

- TDX Deadhorse Power Plant
- ExxonMobil Point Thomson Facility Expansion[5]
- Nanushuk Pad
- Nanushuk Drill site 2
- Nanushuk Drill site 3
- Nanushuk Operations Center
- Eni Nikaitchuq Development
- Pioneer Oooguruk Development
- BPXZ Liberty
- CPAI GMT1
- CPAI GMT2
- Mustang Pad
- Greater Willow Potential Drill Site #1
- Greater Willow Potential Drill Site #2

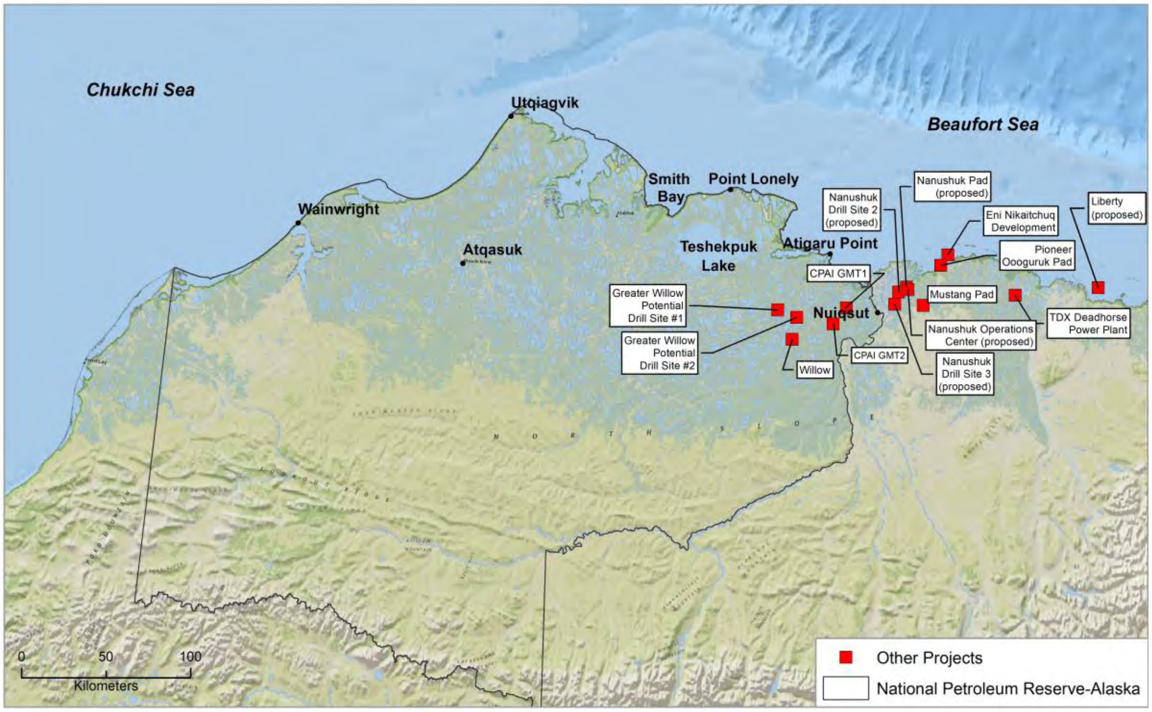
The locations of the RFDs included in the cumulative far-field and near-field modeling are shown in **Figure H-13**.

A summary of the ambient air quality concentrations from the cumulative far-field Alternative D scenario is provided in **Table H-26** for all criteria pollutants at all assessment areas. In the modeling domain, the air quality concentrations for all criteria pollutants are below the NAAQS and AAAQS everywhere in the modeling domain, including at the communities of Atqasuk, Nuiqsut, and Utqiagvik and at the three assessment areas.

Table H-26 presents a comparison of cumulative modeled concentrations due to the proposed action in the form of the AAQS. The impacts in the Alternative D high development scenario are lower than the AAQS for all pollutants and averaging periods anywhere in the modeling domain and, in particular, at all three assessment areas and at the communities of Nuiqsut, Atqasuk and Utqiagvik. Overall, the comparison indicates that the Alternative D high scenario will not result in exceedances of ambient air quality standards (NAAQS and AAAQS). Impacts due to other alternatives and development scenarios would be equivalent or lower because their production rates and emissions are equivalent or lower.

[5]The ExxonMobil Point Thomson Facility Expansion was included based on the information available at the time cumulative far-field modeling was performed. Inclusion of this source leads to a conservative estimate of cumulative air quality impacts.

Figure H-13. Locations of Other Oil and Gas Projects



Ozone NAAQS Comparison

Figure H-14 shows the ozone concentration from the Alternative D high scenario and the cumulative impacts in the form of the NAAQS. All concentrations are below the NAAQS with ozone impacts. This is because the Alternative D high scenario is predicted to be less than 1 ppb.

$PM_{2.5}$ NAAQS Comparison

Figure H-15 and **Figure H-16** show the spatial distribution of $PM_{2.5}$ concentrations from the Alternative D high scenario and cumulative impacts in the form of the AAQS. All concentrations are below the AAQS.

PM_{10} NAAQS Comparison

Figure H-17 and **Figure H-18** show the spatial distribution of PM_{10} concentrations from the Alternative D high scenario and cumulative impacts in the form of the AAQS. All concentrations are below the AAQS.

CO Comparison

Figure H-19 and **Figure H-20** present the spatial distribution of CO concentrations from the Alternative D high scenario and cumulative impacts in the form of the AAQS. All concentrations are below the AAQS.

Figure H-14. Cumulative and Alternative D Ozone Impacts

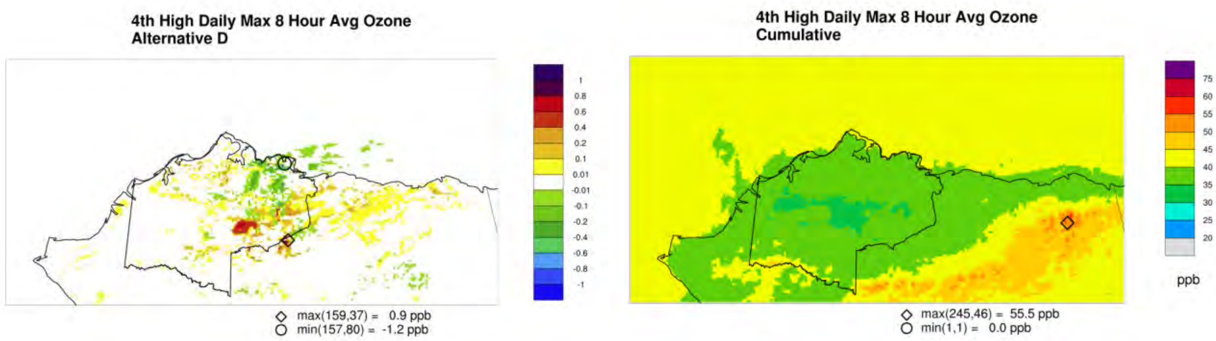


Figure H-15. Cumulative and Alternative D 24-hour $PM_{2.5}$ Impacts

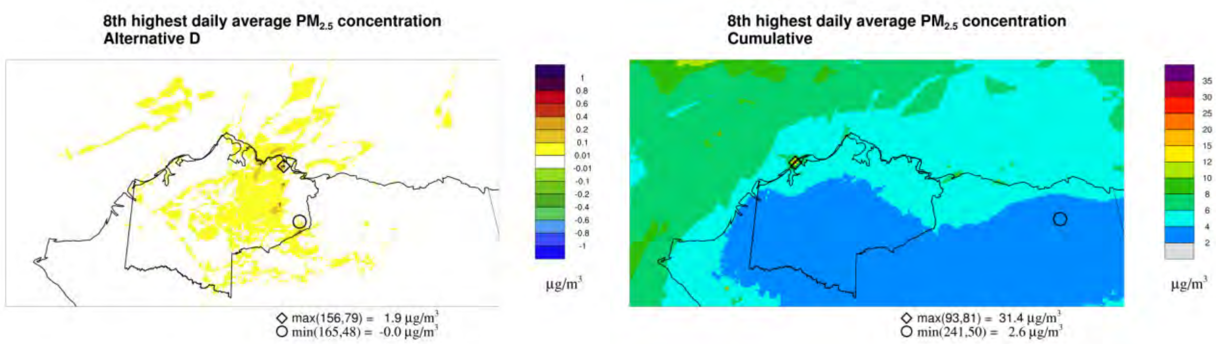


Figure H-16. Cumulative and Alternative D Annual $PM_{2.5}$ Impacts

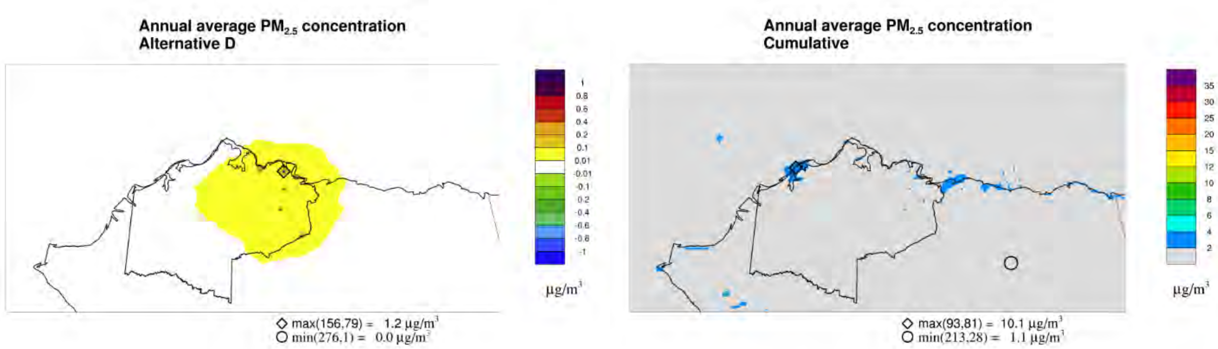


Figure H-17. Cumulative and Alternative D 24-hour PM_{10} Impacts

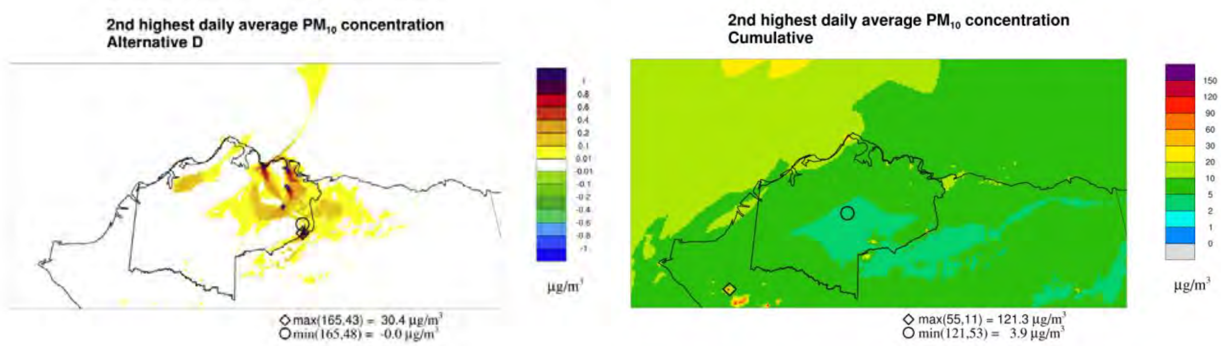


Figure H-18. Cumulative and Alternative D Annual PM_{10} Impacts

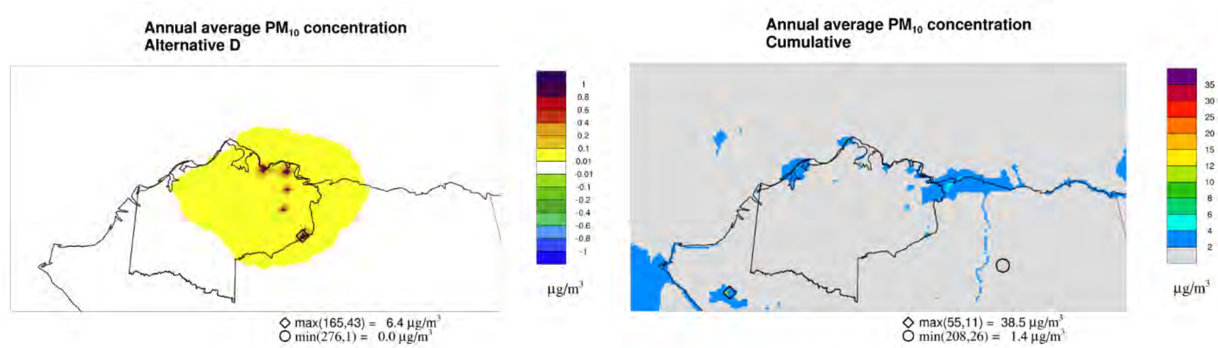


Figure H-19. Cumulative and Alternative D 1-hour CO Impacts

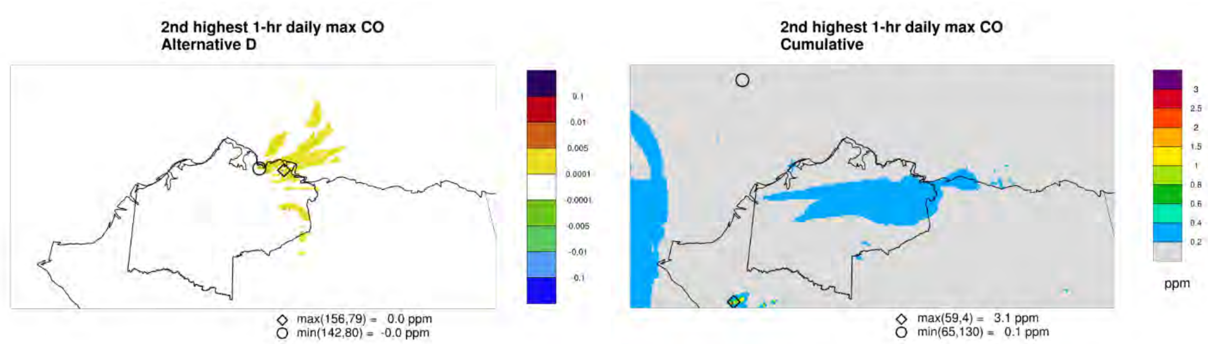
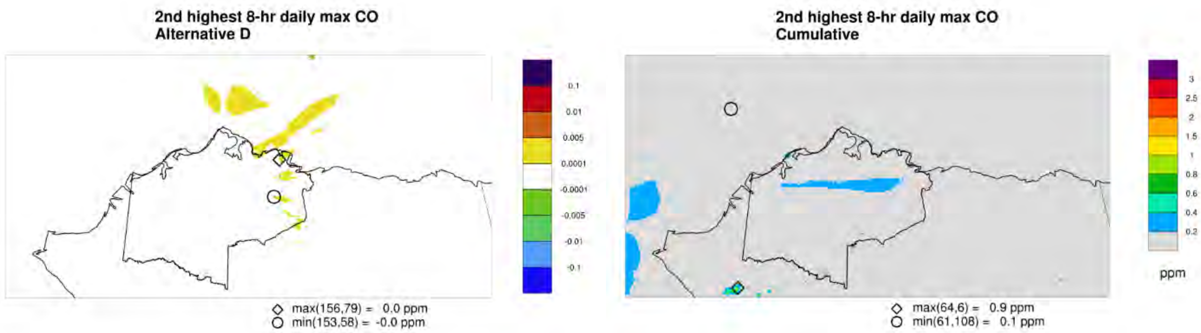


Figure H-20. Cumulative and Alternative D 8-hour CO Impacts



NO_2 Impacts

Figure H-21 and **Figure H-22** show the spatial distribution of NO_2 concentrations from the Alternative D high scenario and cumulative impacts in the form of the AAQS. All concentrations are below the AAQS.

Figure H-21. Cumulative and Alternative D 1-hour NO_2 Impacts

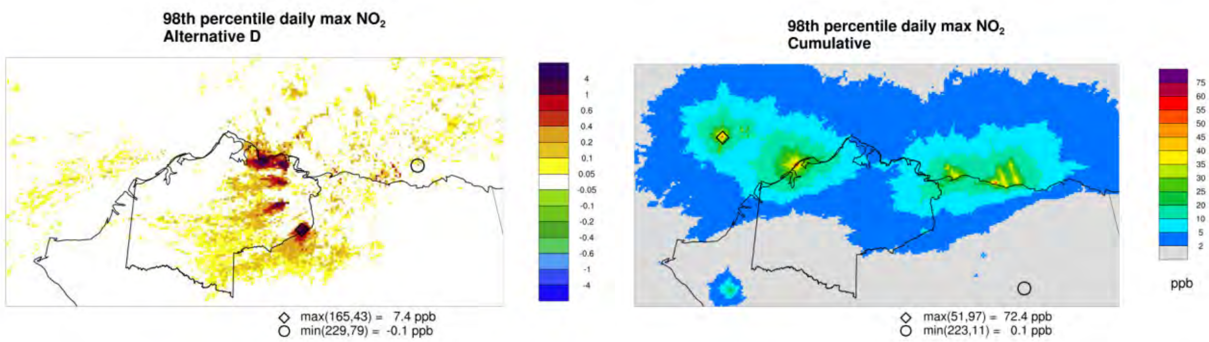
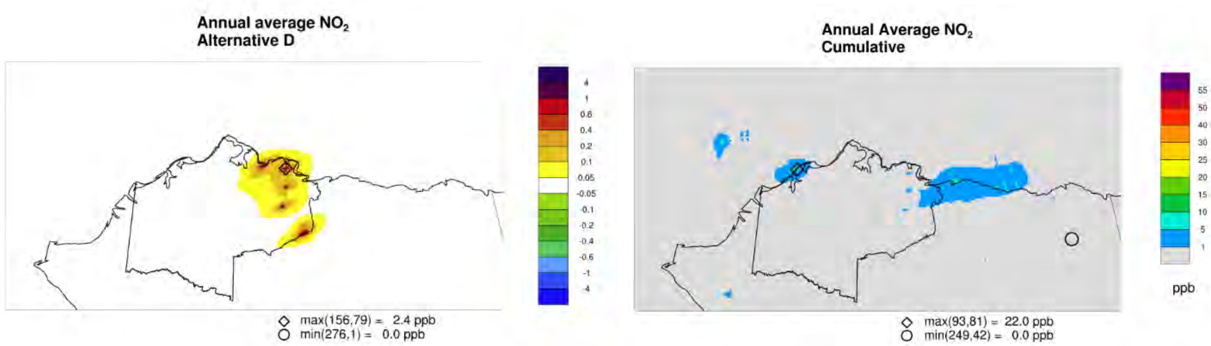


Figure H-22. Cumulative and Alternative D Annual NO_2 Impacts



SO_2 Impacts

Figure H-23 through **Figure H-26** show the spatial distribution of SO_2 concentrations due to the Alternative D high scenario and cumulative impacts in the form of the AAQS. All concentrations are below the AAQS.

Figure H-23. Cumulative and Alternative D 1-hour SO_2 Impacts

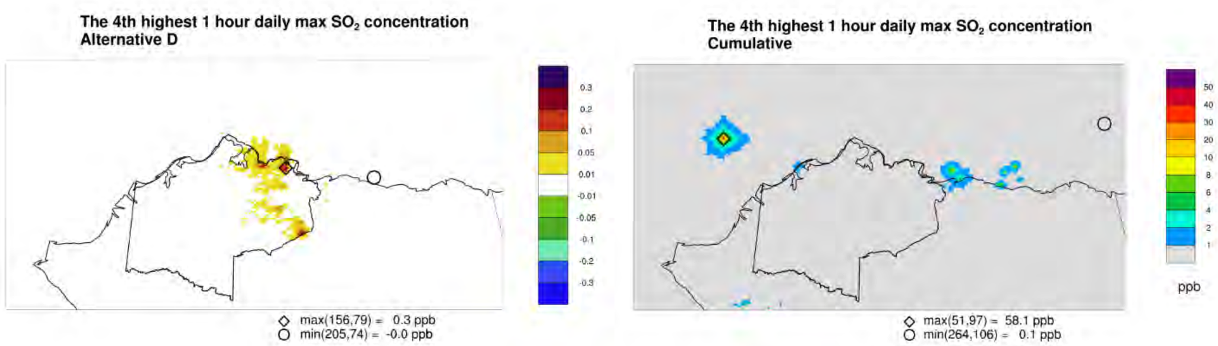


Figure H-24. Cumulative and Alternative D 3-hour SO_2 Impacts

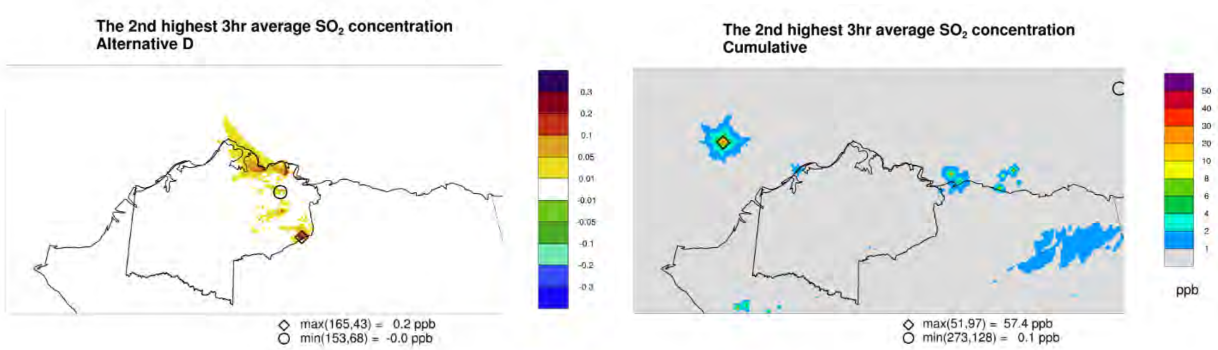


Figure H-25. Cumulative and Alternative D 24-hour SO_2 Impacts

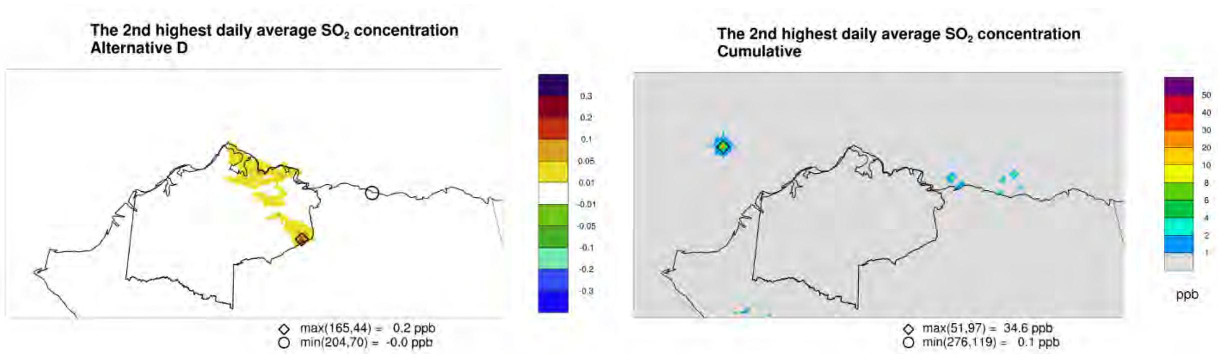
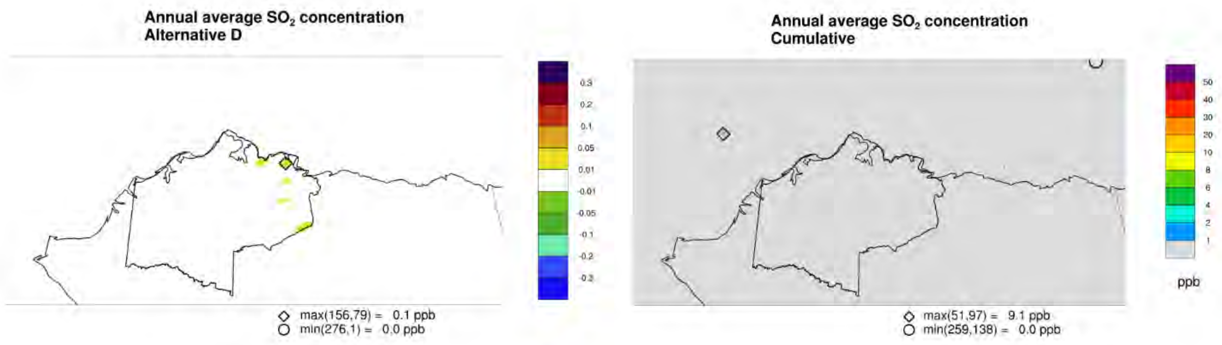


Figure H-26. Cumulative and Alternative D Annual SO_2 Impacts



H.6.1 Visibility Analysis

The analysis of the effects on visibility from this project follows the approaches explained in detail in Section H.2.1 *Analysis Methods*. The cumulative impacts on visibility were calculated using the SMAT-CE tool, while project impacts are assessed following the FLAG (2010) screening method.

Table H-27 shows the cumulative visibility (deciviews) estimated for the Alternative D high scenario at each of the three assessment areas. As described in Section H.2.1 *Analysis Methods*, these values are derived from the monitoring data at Denali National Park; therefore, the base year design value is unchanged among all the areas. For both the 20 percent best and the 20 percent most impaired days, the cumulative visibility will slightly degrade from current values at all assessment areas. The area with the worst future year cumulative visibility during the 20 percent best days is Noatak National Preserve, while Gates of the Arctic National Park and Preserve has the worst future year cumulative visibility during the 20 percent most impaired days.

Table H-27
Alternative D: Base (2012) and Future (2025) Cumulative Visibility Impacts for the 20 Percent Best and Most Impaired Days

Assessment Area	Deciviews (20 Percent Best Days [dv])		Deciviews (20 Percent Most Impaired Days [dv])	
	Base Year	Future Year	Base Year	Future Year
Arctic National Wildlife Refuge	2.671	2.682	7.245	7.249
Gates of the Arctic National Park and Preserve		2.686		7.286
Noatak National Preserve		2.744		7.263

Note that the cumulative visibility assessment with the SMAT tool is based on changes in total atmospheric concentrations of particulates between the base and future year. Total atmospheric concentrations are the sum of the IAP RFD sources' contributions, contributions from all other emissions sources in the modeling domain, and contributions from outside the model domain that are transported into the domain through model boundary conditions, which may be important in this analysis since the assessment areas are located close to the model boundaries. Thus, the SMAT visibility assessment reflects not only the IAP RFD sources' contributions but also changes (increases or decreases) between the base and future year of all other regional emissions sources. Visibility impacts due to a single large hypothetical development is lower than the delta dv threshold of 0.5 and 1.0, indicating that a single large development has visibility impacts below 0.5 and 1.0 thresholds.

H.6.2 Deposition Analysis

The modeled deposition fluxes were processed as discussed in Section H.2.1 *Analysis Methods* to estimate the total annual nitrogen (N) and sulfur (S) values at each of the three assessment areas. **Table H-28** shows the spatial maximum and average across each assessment area for cumulative impacts. It also shows the maximum and average deposition fluxes for Atqasuk, Nuiqsut, and Utqiagvik. Note that the critical load range for nitrogen deposition shown in **Table H-28** is applicable only to the three federally managed areas (Arctic National Wildlife Refuge, Gates of the Arctic National Park and Preserve, and Noatak National Preserve). As shown in **Table H-28**, the nitrogen cumulative impacts are below or within the critical load range at all three assessment areas. Annual cumulative nitrogen deposition varies from 0.32 to 1.24 kg/ha-yr across these three assessment areas (conservation system units) when considering both the spatial maximum and the average of each area. Annual cumulative sulfur deposition varies from 0.30 to 1.58 kg/ha-yr across these three assessment areas when considering the spatial maximum, and varies from 0.30 to 0.61 kg/ha-yr when considering the average of each area. Among the three assessment areas, the Noatak assessment area is modeled to experience the highest nitrogen deposition and sulfur deposition due to cumulative impacts.

Table H-28
Alternative D Nitrogen and Sulfur Deposition Cumulative Impacts: Spatial Maximum and Average

Assessment Area	Nitrogen (kg N/ha-yr)			Sulfur (kg S/ha-yr)	
	Maximum	Average	Below/Within/Above Critical Load Range (1.0–3.0 kg/ha-yr)	Maximum	Average
Arctic National Wildlife Refuge	0.72	0.34	Below	0.71	0.31
Gates of the Arctic National Park and Preserve	0.59	0.38	Below	0.68	0.37
Noatak National Preserve	1.13	0.49	Within	1.58	0.61
Atqasuk	0.32	0.32	N/A	0.18	0.18
Nuiqsut	1.24	1.24	N/A	0.30	0.30
Utqiagvik	0.32	0.32	N/A	0.40	0.40

Note: N/A = Not Applicable

H.7 References

Alaska Department of Environmental Conservation (ADEC). 2011. Emissions, Meteorological Data, and Air Pollutant Monitoring for Alaska's North Slope. December 21, 2011. Prepared by MACTEC Engineering and Consulting. Internet website: http://dec.alaska.gov/air/ap/docs/North_Slope_Energy_Assessment_FINAL.pdf.

_____. 2013, NO2 – NOx In-stack Ratios per Source Tests Approved by the Alaska Department of Environmental Conservation, Last Update August 23, 2013. Internet website: https://dec.alaska.gov/air/air-permit/dispersion-modeling/

BLM (Bureau of Land Management). 2019. Willow Master Development Plan Draft Environmental Impact Statement. Anchorage, Alaska. August 2019.

BOEM (Bureau of Ocean Energy Management). 2017. Arctic Air Quality Modeling Study – Final Photochemical Modeling Report. BOEM 2016-076. Prepared by Ramboll Environ and Eastern Research Group, Inc. Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region, Anchorage, Alaska. July 7.

Brashers, B., J. Knapik, J. D. McAlpine, T. Sturtz, and R. Morris. 2016. Arctic Air Quality Modeling Study – Meteorological Model Performance Evaluation: 2009-2013 BOEM Arctic WRF Dataset. Prepared by Ramboll Environ U.S. Corporation for the U.S. Department of the Interior, Bureau of Ocean Energy Management. Alaska Outer Continental Shelf Region Study BOEM 2015-049.

Cimorelli, A. J., S. G. Perry, A. Venkatram, J. C. Weil, R. Paine, R. B. Wilson, R. F. Lee, et al. 2005. "AERMOD: A dispersion model for industrial source applications. Part I: General model formulation and boundary layer characterization." *J. Appl. Meteor.* 44: 682–693. Internet website: https://doi.org/10.1175/JAM2227.1.

Colorado State University. 2020. Internet website: views.cira.colostate.edu/fed.

Emery, C., Z. Liu, A.G. Russell, M.T. Odman, G. Yarwood, N. Kumar. 2017. Recommendations on statistics and benchmarks to assess photochemical model performance. J. Air Waste Manag. Assoc., 2017, DOI: 10.1080/10962247.2016.1265027.

EPA (Environmental Protection Agency). 2003. Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule; EPA-454/B-03-005; U.S. Environmental Protection Agency: Washington, DC, September 2003. Internet website: http://vista.cira.colostate.edu/Improve/wp-content/uploads/2016/04/RHRNaturalConditions.pdf.

_____. 2006. Air Toxics Risk Assessment Reference Library, Volume 3, Community-Scale Assessment, EPA-452/K-06-001C, April 2006.

_____. 2011, Memorandum: "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard", Tyler Fox, March 1, 2011.

_____. 2017a. Basic Information about Visibility. Internet website: https://www.epa.gov/visibility/basic-information-about-visibility.

_____. 2017b. What Is Acid Rain? Internet website: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

_____. 2018a, Table 2. Acute Dose-Response Values for Screening Risk Assessments, https://www.epa.gov/sites/production/files/2014-05/documents/table2.pdf, last updated June 18, 2018, Accessed July 2019.

_____. 2018b, Table 1. Prioritized Chronic Dose-Response Values, https://www.epa.gov/sites/production/files/2014-05/documents/table1.pdf, last updated June 18, 2018, Accessed July 2019.

_____. 2018c. Clean Air Status and Trends Network (CASTNET) Annual Total Deposition. Clean Air Markets Division. Internet website: www.epa.gov/castnet.

_____. 2019. AERMOD Model Formulation and Evaluation. EPA-454/R-19-014 . Internet website: https://www3.epa.gov/ttn/scram/models/aermod/aermod_mfed.pdf.

Fields Simms, P., R. Billings, M. Pring, R. Oommen, D. Wilson, and M. Wolf. 2014. Arctic Air Quality Modeling Study: Emissions Inventory – Final Task Report. Prepared by Eastern Research Group, Inc., for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region, Anchorage, Alaska. OCS Study BOEM 2014-1001.

Fields Simms, P., B. Do, B. Brashers, T. Stoeckenius, and R. Morris. 2018. Arctic Air Quality Impact Assessment Modeling Study: Final Project Report. Prepared by Eastern Research Group, Inc., Sacramento, California, for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, Alaska. OCS Study BOEM 2018-020.

FLAG (Federal Land Managers' Air Quality Related Values Work Group). 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG) – Phase I Report – Revised (2010). Natural Resource Report NPS/NRPC/NRR – 2012/232. Internet website: http://nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf.

Gibson, M. D., S. Kundu, and M. Satish. 2013. "Dispersion model evaluation of PM2.5, NOx and SO2 from point and major line sources in Nova Scotia, Canada using AERMOD Gaussian plume air dispersion model." *Atmospheric Pollution Research* 4(2): 157–167.

Hand, J. L. and W. C. Malm. 2006. Review of the IMPROVE Equation for Estimating Ambient Light Extinction Coefficients. National Park Service. May 2006. ISSN 0737-5352-71

NADP (National Atmospheric Deposition Program). 2014. Hybrid Approach to Mapping Total Deposition. Total Deposition Science Committee. Champaign, Illinois. Internet website: http://nadp.slh.wisc.edu/lib/brochures/tdepsheet.pdf.

_____. 2018. NADP Program Office, Wisconsin State Laboratory of Hygiene. Internet website: http://nadp.slh.wisc.edu/NADP/.

NPS (National Park Service). 2011. Air Quality Related Values. Natural Resource Stewardship and Science Inventory and Monitoring Division. Internet website: http://npshistory.com/publications/air-quality/aqrv-brief-2011.pdf.

_____. 2018. Alaska Ecoregions: Tundra and Taiga. Internet website: https://www.nature.nps.gov/air/studies/criticalLoads/Ecoregions/AK_Taiga_Tundra.cfm.

Perry, S. G., A. J. Cimorelli, R. J. Paine, R. W. Brode, J. C. Weil, A. Venkatram, R. B. Wilson, et al. 2005. "AERMOD: A dispersion model for industrial source applications. Part II: Model performance against 17 field study databases." *J. Appl. Meteor.* 44: 694–708. Internet website: https://doi.org/10.1175/JAM2228.1.

Ramboll. 2019. Willow Master Development Plan EIS Draft Air Quality Technical Support Document. Prepared for the Bureau of Land Management Alaska. Novato, California. May 2019.

Ruiz, L.H. and G. Yarwood, 2013. Interactions between organic aerosol and NOy: Influence on oxidant production. Prepared for the Texas AQRP (Project 12-012), by the University of Texas at Austin, and ENVIRON International Corporation, Novato, CA. (http://aqrp.ceer.utexas.edu/projectinfoFY12_13/12-012/12-012%20Final%20Report.pdf).

Seinfeld, J.H. and Pandis, S.N. (1998) Atmospheric Chemistry and Physics: From Air Pollution to Climate Change. Wiley, New York.

SLR (SLR Consulting). 2013a. Discoverer PM2.5 Speciated Monitoring Program at Deadhorse. Annual Data Summary January 1, 2012 – December 31, 2012. Prepared for Shell Offshore Inc. Prudhoe Bay, Alaska. February 2013.

_____. 2013b. Discoverer PM2.5 Speciated Monitoring Program at Wainwright. Annual Data Summary January 1, 2012 – December 31, 2012. Prepared for Shell Gulf of Mexico Inc. Prudhoe Bay, Alaska. February 2013.

_____. 2019. Volatile Organic Compounds (VOCs) Near the Village of Nuiqsut. Report prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. April 2019.

Smagorinsky, J., 1963. General circulation experiments with the primitive equations: 1. The basic experiment. Mon. Weather Rev., 91, 99-164.

Stoeckenius, T., J. Jung, B. Koo, T. Shah, and R. Morris, 2017. Arctic Air Quality Modeling Study – Final Photochemical Modeling Report. BOEM 2016-076. Prepared by Ramboll Environ, Novato, California, for the U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, Alaska. OCS Study BOEM 2016-076.

Sullivan, T. J. 2016. Air quality related values (AQRVs) for Arctic Network (ARCN) Parks: Effects from Ozone; Visibility Reducing Particles; and Atmospheric Deposition of Acids, Nutrients and Toxics. Natural Resource Report NPS/ARCN/NRR—2016/1155. National Park Service, Fort Collins, Colorado.

Wang, H. et al. 2015. Design and Demonstration of a Next-Generation Air Quality Attainment Assessment System for PM2.5 and O3. J Environ Sci (China). 2015 Mar 1;29:178-88. doi: 10.1016/j.jes.2014.08.023.

Zhang, L., S. Gong, J. Padro, L. Barrie, 2001. A size-segregated particle dry deposition scheme for an atmospheric aerosol module. Atmos. Environ., 35, 549-560.

Zhang, L., J. R. Brook, and R. Vet. 2003. A revised parameterization for gaseous dry deposition in airquality models. Atmos. Chem. Phys., 3, 2067–2082.

Appendix I

Spill Projections for the National Petroleum Reserve in Alaska Integrated Activity Plan Environmental Impact Statement

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska
U.S.	United States

Appendix I. Spill Projections for the National Petroleum Reserve in Alaska Integrated Activity Plan and Environmental Impact Statement

This appendix summarizes the spill or release estimates, behavior, and potential impacts that might result from oil and gas leasing and the potential exploration development and production. This analysis considers a variety of accidental spills, including crude and refined oil, produced water and seawater, and gas releases. These scenarios are conceptual views of the future and represent possible sets of potential accidents. The primary purpose of a scenario is to provide a common basis for analyzing potential environmental impacts, should future accidents occur.

The frequency of and impacts from oil spills on the Alaska North Slope have received extensive analysis and review in several recent environmental impact statements (EISs), environmental assessments, and other reports, listed below. Though the details differ among several of the documents, the basic data and conclusions are generally similar. The following documents are incorporated by reference, and the key points are summarized in this integrated activity plan (IAP)/EIS. Referenced documents are the following:

- Chukchi Sea Sale 193 Supplemental EIS (BOEM 2011)
- Northeast National Petroleum Reserve-Alaska Final Supplemental IAP/EIS (BLM 2008)
- Northeast National Petroleum Reserve-Alaska Final Amended IAP/EIS (BLM 2005)
- Northwest National Petroleum Reserve-Alaska Final IAP/EIS (BLM and MMS 2003)
- Northeast National Petroleum Reserve-Alaska Final IAP/EIS (BLM and MMS 1998)
- Alpine Satellite Development Plan EIS (BLM 2004)
- National Petroleum Reserve-Alaska Final IAP/EIS (BLM 2012)
- Alaska North Slope Spills Analysis (Nuka Research and Planning 2010)
- Oil Spill Occurrence Rates for Alaska North Slope Crude & Refined Oil Spills (Nuka Research and Planning 2013)

In the National Planning Reserve in Alaska (NPR-A) planning area, spills could occur from pipelines, storage tanks, production and exploration facilities and infrastructure, drilling rigs (well-control incidents), airstrips, roads, vessels, and bridges. Spills that leave the pads and roadbeds or that enter water sources directly could reach one or more of several habitat types; examples are wet and dry tundra, tundra ponds, lakes, flowing creeks and rivers, and potentially the adjacent nearshore Beaufort or Chukchi seas. Spills could occur any time during the year. Hydrocarbon spills include both crude oil and refined hydrocarbons such as fuel, motor oil, and hydraulic fluid.

The State of Alaska Department of Environmental Conservation (ADEC) requires reporting of oil and other hazardous substances, and maintains a database of spills in the state. Oil spills include categories for crude oil and refined petroleum products such as motor oil, fuel, and hydraulic fluid. Process water is a category that includes both seawater and produced water. Process water spills can be quite large and could affect extensive areas. Process water spills in freshwater can have significant impacts on water quality and biological resources. Other types of spills that are reported and tracked are those of hazardous and extremely hazardous materials. This includes materials such as propylene glycol, methyl alcohol, and drilling mud. This analysis focuses on the chance of occurrence over the lifetime of the oil and gas development in the NPR-A and the potential impacts of hydrocarbon spills, hazardous material spills, gas leaks, and produced water or seawater spills.

I.1 SPILL HISTORY

The North Slope oil industry history shows that most of the oil, produced water, seawater, and other material spills that have occurred have been less than 10 gallons (about a quarter-barrel), and few have been greater than 100,000 gallons (2,380 barrels [one barrel is equal to 42 gallons]; BLM 2012).

The National Research Council (2003) reported that many small terrestrial spills have occurred in the oil fields, but they have not been frequent or large enough for their impacts to have accumulated. The primary impacts have been on gravel, which is difficult to clean and has made the gravel unavailable for rehabilitation due to contamination. Appendices F and G of the same National Research Council report provide a detailed analysis of size, frequency, distribution, type, and general impacts of Alaska North Slope oil spills. These analyses are the basis for the above-quoted conclusion.

In 2006, a large crude oil spill occurred from a 34-inch-diameter transit pipeline, known as the Gathering Center 2 spill. It was estimated at 212,252 gallons, or 5,054 barrels, and is the largest recorded North Slope industry crude oil spill to date (ADEC 2020). The spill volume was large because it was a small leak from a low-pressure line that went undetected for some time. The same conditions that allowed it to continue undetected (snow cover and low temperatures) limited the spread of oil and environmental impact to approximately 2 acres. The estimated large crude oil spill sizes computed in this report for large spills take the Gathering Center 2 spill into account and increase the estimated large spill size notably from similar analyses written before 2006.

Most Alaskan North Slope industry spills have been contained on gravel pads and roadbeds (National Research Council 2003), and most of those that have reached the tundra have covered fewer than 5 acres (Nuka Research and Planning 2010). Also, as noted below, snow cover and low temperatures through much of the year also reduce the ability of leaked oil to spread. When detected, spills have been promptly contained and cleaned up, as required by State, federal, and North Slope Borough regulations (National Research Council 2003).

When a large spill occurs, significant analysis takes place on the contributing factors. Lessons learned from the Gathering Center 2 spill have contributed to the Pipeline Inspection, Protection, Enforcement and Safety Act of 2006, signed by President George W. Bush on December 29, 2006. The act extends the oversight jurisdiction of the United States (U.S.) Department of Transportation to oil and gas pipelines operating at low pressure, like the Gathering Center 2 transit pipeline.

I.2 NPR-A SPILL ANALYSIS

Estimating a substance spill is an exercise in probability, based on Alaska North Slope oil spill data. There is uncertainty in the location, number, and size of any spills; the physical and chemical properties of spilled oil; and the environmental conditions at the time of a spill. This analysis assumes that the rate and volume of spills would stay consistent with recent history; however, the spill rate could decrease in the future due to technological advances and prevention preparedness, or it could increase due to climate change complications.

This analysis considers the history of development in the planning area and across the Alaska North Slope. Much of the information in this section is based on the analysis in the following documents:

- 1998 Northeast IAP/EIS (BLM and MMS 1998)
- Northwest National Petroleum Reserve-Alaska Final IAP/EIS (BLM and MMS 2003)
- Northeast National Petroleum Reserve-Alaska Final Amended IAP/EIS (BLM 2005)
- Northeast National Petroleum Reserve-Alaska Final Supplemental IAP/EIS (BLM 2008)
- National Petroleum Reserve-Alaska Final IAP/EIS (BLM 2012)
- Nanushuk EIS (USACE 2019)

Recent Alaska North Slope oil spill history has been incorporated into this updated analysis (ADEC 2020). Based on recent spills information, data accuracy concerns from older data, and comparisons to spills projections in older documents, the projections contained in this document were made using spills data from 2000 through 2018, the most recent year for which finalized data were available. Spill records were reviewed and records not related to oil and gas exploration and development were removed; these included spills from military facilities, schools, and telecommunications equipment. For ease of projection, spills of materials measured in pounds (a small number of records) were removed in order to only use volume measurement records.

The oil spill analyses in this IAP/EIS are based on spill-size categories that are consistent with U.S. Environmental Protection Agency regulations at 40 Code of Federal Regulations 112. Small spills are less than 50 barrels (2,100 gallons); medium spills are greater than 50 and less than 858 barrels (36,036 gallons); large spills are greater than 858 barrels. Over the lifetime of exploration and development of the NPR-A area, the chance of small spills occurring is high, and they are expected to occur. As spill sizes become larger, the probability of occurrence reduces. One or more large spills may occur over the life of the production in the NPR-A. **Table I-1** and **Table I-2** provide spill rates and size, and average spill sizes, respectively.

Table I-1
North Slope Spill Rates by Substance and Size per Billion Barrels of Oil Produced (2000-2018)

Substance	Spill Size			
	Small (0 to 2,100 gallons)	Medium (2,101 to 36,036 gallons)	Large (>36,036 gallons)	Total
Crude oil	129.53	2.63	0.20	**132.36**
Refined oil	563.37	1.41	0.00	**564.79**
Seawater and produced water	94.57	8.08	1.41	**104.07**
Other hazardous materials	386.16	3.23	0.20	**389.59**
Total	1,173.62	15.36	1.82	1,190.80

Source: ADEC 2020
Note: Totals do not match due to rounding.

Table I-2
Average North Slope Spill Size in Gallons (2000-2018)

Substance	Small	Medium	Large
Crude oil	60	9,893	212,252
Refined oil	24	3,269	0
Seawater and produced water	207	6,854	88,981
Other hazardous materials	63	5,341	42,000

Source: ADEC 2020; 42 gallons = 1 barrel

The responses to a spill and amount of oil recovered are variable and depend on such factors as the weather conditions, such as seasonal variation; time of year, including the amount of daylight; location; and the size of the spill. The amount of oil recovered can range from none to effectively all of the oil. By assuming no cleanup in this oil spill analysis, the estimated impacts on the resources are overestimated or are greater than what would actually occur.

Although this section does not consider prevention measures in place to prevent spills into the environment, the Bureau of Land Management may require a contingency plan under 43 Code of Federal Regulations 3162.5 that describes procedures to be implemented to protect life, property, and the environment. Additionally, Alaska Statute 46.04.030, the ADEC 18 Alaska Administrative Code (AAC) 75, the U.S. Environmental Protection Agency 40 Code of Federal Regulations 112, and the U.S. Department of Transportation 49 Code of Federal Regulations 194, as mandated by the Oil Pollution Act of 1990, state a pipeline or production facility must operate in compliance with an approved oil discharge prevention and contingency plan.

I.2.1 Small Crude and Refined Oil Spills

Onshore or offshore refined oil spills can occur during any phase of exploration, development, production, or transportation; along ice roads, gravel roads, pads, tundra, and pipeline corridors; and from all sources of equipment. Historically, most small spills have occurred on gravel pads or roads (BLM 2012). Typical refined products spilled on the Alaska North Slope are aviation fuel, diesel fuel, gasoline, engine lubricant, grease, fuel oil, hydraulic oil, transformer oil, and transmission oil. On the Alaska North Slope, diesel spills represent 52 percent of refined oil spills by frequency and 74 percent by volume; engine lubricant spills are 11 percent by frequency and 5 percent by volume; hydraulic oil spills are 32 percent by frequency and 13 percent by volume; and aviation fuel is 0.3 percent by frequency and 2 percent by volume. All other categories of refined spills are less than 1 percent by frequency and volume (BLM 2012).

The estimated small crude oil spill rate for the Alaska North Slope is 129.53 spills per billion barrels of oil produced. Mean historical small crude oil spill size is 60 gallons or 1.4 barrels (ADEC 2020).

The estimated refined oil product small spill rate for the Alaska North Slope is 563.37 spills per billion barrels of oil produced. Mean historical spill size for small refined oil spills is 24 gallons or 0.57 barrels.

Based on the total oil production projected in Appendix B of the NPR-A Final IAP/EIS and historical North Slope crude and refined oil spill rates, **Section I.2.5** shows the estimated number of small crude oil/refined oil spills for Alternatives A, B, C, D, and E, and the estimated volume in barrels over the exploration, development, and production life. The high case production estimates are used for each alternative in order to avoid underestimating potential impacts.

I.2.2 Medium and Large Crude Oil Spills

This section summarizes the key variables used for the medium and large oil spill analysis.

Information on crude oil spills is based on historical Alaska North Slope crude oil spill data obtained by the ADEC, Division of Spill Prevention and Response, Statewide Oil and Hazardous Substance Spill Database (ADEC 2020). This introduction summarizes the assumptions used to analyze medium and large oil spills, which are a mixture of project-specific information, modeling results, statistical analysis, and professional judgment. Medium and large spills are most likely to occur from pipelines, processing facilities, storage tanks, and well blowouts. In the rare event that well pressure control systems fail, well blowouts have the possibility of spreading wind-blown oil, natural gas, and drilling muds in a plume downwind of the drilling rig. Plan-level environmental impact statements would analyze the possibility of and response to a blowout, including models for season; see the Alpine Oil Discharge Prevention and Contingency Plan (ConocoPhillips 2018) for an example of what would be included in this type of plan.

Mean medium and large crude spill numbers are estimated by assuming the high case resource estimates provided in Appendix B of the NPR-A Final IAP/EIS and are produced using the Alaska North Slope large crude spill rates. The high case production estimates are used for each alternative in order to avoid underestimating potential impacts. Estimates are shown below in **Section I.2.5**.

Historical spill rates for large crude oil spills are 0.20 total spills per billion barrels of oil produced. The only large crude oil spill that occurred during the reporting period was 212,252 gallons (5,054 barrels). Historical spill rates for medium spills was 2.63 spills per billion barrels of oil produced. The mean medium crude oil spill size was 9,893 gallons (236 barrels). Estimates by alternative are shown below.

A large spill from a facility or pipeline in the NPR-A area could happen at any time during the year. A medium or large crude oil spill could occur in or reach any of the following environments:

- Gravel pad and then the tundra, snow, or ice
- Open water (lagoon, lake, or river)
- Broken ice (lagoon, lake, or river)
- On top of or under solid ice (lagoon, lake, or river)
- Shoreline (lagoon, lake, or river)Tundra or snow and ice

Based on oil weathering modeling after 30 days in open water or broken ice, 29 to 40 percent of the oil evaporates, 3 to 48 percent disperses, and 13 to 56 percent remains. After 30 days under ice in a lagoon or lake, nearly 100 percent of the oil remains in place and unweathered.

The estimated refined oil product medium spill rate for the Alaska North Slope is 1.41 spills per billion barrels of oil produced. Mean historical spill size for medium refined oil spills is 3,269 gallons or 77.8 barrels.

I.2.3 Seawater and Produced Water Spills

Of concern to stakeholders are the potential effects of large seawater or produced or process water spills on tundra or freshwater habitat. This section summarizes the key variables used for the large seawater and process or produced water spill analysis. Information is based on Alaska North Slope spill data in Appendix D of the 2010 North Slope Spills Analysis (Nuka Research and Planning 2010) and on the ADEC spills database (ADEC 2020). To be classified as produced water, water must contain less than 1 percent crude oil, less than 1 percent sodium, less than 500 parts per million dissolved hydrogen sulfide, and greater than 99 percent water.

It is projected that approximately 94.57 small, 8.08 medium, and 1.41 large produced water or seawater spills may occur per billion barrels of oil produced (**Table I-1**). Mean historical produced water and seawater spill sizes were 207 gallons (4.93 barrels) for small spills, 6,854 gallons (163.19 barrels) for medium spills, and 88,981 gallons (2,118.60 barrels) for large spills.

Seawater and Produced Water Spill Fate

Spills of seawater and produced water are soluble and mobile in soils that are not frozen. Flushing soils with water can return surface soil salinity to near-normal conditions within 30 days in wet tundra, but salt may persist longer at moist or dry sites (Simmons et al. 1983). Simmons et al. (1983) conducting experimental seawater spills found few effects in wet tundra sites, but live plant cover was reduced by 61 to 87 percent 1 year later in dry and moist tundra sites. Unlike a crude oil spill, remediation typically does not involve removing the tundra. Treatment usually entails vacuum recovery and snow removal in the winter, and removal of any affected standing water combined with flushing in the summer. Additional flushing to dilute salinity, and burning to remove oil spilled with produced water, may be used as additional short-term treatment methods. Long-term treatments include soil amendments to counteract salinity, fertilization to promote vegetative growth, and natural recolonization (Behr-Andres et al. 2001).

I.2.4 Hazardous and Extremely Hazardous Substance Spills

Spills containing hazardous and extremely hazardous substances occur during all phases of oilfield activities. Although spills of hazardous and extremely hazardous substances do not occur in the amount or volume when compared with crude oil spills, they still do occur; they can cause significant harm to a receiving environment or humans if not prevented or captured in secondary containments. According to the ADEC's Statewide Oil and Hazardous Substance Spill Database (ADEC 2020), the most commonly spilled hazardous substances are glycol (both propylene and ethylene glycol), corrosion inhibitor, and emulsion breaker. For the projections shown in tables within this document, hazardous substances and extremely hazardous substances were combined into one category.

The Bureau of Land Management estimates that approximately 386.16 small, 3.23 medium, and 0.20 large produced water or seawater spills may occur per billion barrels of oil produced (**Table I-1**). Mean historical process water spill sizes were 63 gallons (1.5 barrels) for small spills, 5,341 gallons (127.17 barrels) for medium spills, and 42,000 gallons (1,000 barrels) for large spills.

I.2.5 Projections by Alternative

Based on the frequency of spills per billion barrels produced (shown in **Table I-1**, above) and the lifetime oil production data (based on a 70-year production lifetime) by alternative from Appendix B of the NPR-A Final IAP/EIS, the following projections of spills by alternative were developed (**Table I-3** though **Table I-7**). Only high case production scenarios were analyzed to provide maximum impact for the purposes of analysis. Due to the fact that the start dates of production are hard to predict, the total production during the assumed 70-year lifetime of development within the NPR-A was used. Lifetime production under Alternative A was assumed to be 1.35 billion barrels of oil. Lifetime production under Alternative B was assumed to be 1.48 billion barrels of oil. Lifetime production under Alternative C was assumed to be 1.98 billion barrels of oil. Lifetime production under Alternative D was assumed to be 2.64 billion barrels of oil. Lifetime production under Alternative E was assumed to be 2.64 billion barrels of oil.

Table I-3
Alternative A Projected Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude oil	174.86	3.55	0.27	178.68
Refined oil	760.55	1.91	0	762.46
Seawater and produced water	127.66	10.91	1.91	140.49
Other hazardous materials	521.31	4.36	0.27	525.95

Table I-4
Alternative B Projected Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude oil	191.70	3.89	0.30	195.89
Refined oil	833.79	2.09	0.00	835.88
Seawater and produced water	139.96	11.96	2.09	154.02
Other hazardous materials	571.51	4.79	0.30	576.60

Table I-5
Alternative C Projected Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude oil	256.46	5.20	0.40	262.07
Refined oil	1,115.48	2.80	0.00	1,118.28
Seawater and produced water	187.25	16.00	2.80	206.05
Other hazardous materials	764.59	6.40	0.40	771.39

Table I-6
Alternative D Projected Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude oil	341.95	6.94	0.53	349.42
Refined oil	1,487.30	3.73	0.00	1,491.04
Seawater and produced water	249.66	21.34	3.73	274.73
Other hazardous materials	1,019.45	8.54	0.53	1,028.52

Table I-7
Alternative E Projected Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude oil	341.95	6.94	0.53	349.42
Refined oil	1,487.30	3.73	0.00	1,491.04
Seawater and produced water	249.66	21.34	3.73	274.73
Other hazardous materials	1,019.45	8.54	0.53	1,028.52

I.3 FATE AND BEHAVIOR OF SPILLED OIL

This section describes the properties and behavior of spilled oil that must be considered when evaluating the potential effects of an oil spill in the various environments of the NPR-A.

Spreading, evaporation, dispersion, dissolution, and emulsification are the primary processes that affect the fate of spilled oil (Boehm 1987; Payne et al. 1991; Lehr 2001). These processes, collectively called weathering, dominate during the first few days to week of a spill, and, with the exception of dissolution, they can dramatically change the nature of the oil. A number of longer-term processes also occur, including photo- and biodegradation, auto-oxidation, and sedimentation; however, these longer-term processes are more important in the later stages of weathering and usually determine the ultimate fate of the spilled oil.

The chemical and physical composition of oil changes with weathering. Some oils weather rapidly and undergo extensive changes in physical and chemical composition, whereas others remain relatively unchanged over long periods. As a result of evaporation, the effects of weathering are generally rapid, occurring in 1 to 2 days, for hydrocarbons with lower molecular weights. Degradation of the higher weight fractions is slower and occurs primarily through microbial degradation and chemical oxidation.

Oil spreading on water reduces the bulk quantity of oil in the vicinity of the spill, but increases the area over which effects may occur; thus, oil in flowing systems (as opposed to contained systems) would be less concentrated in any given location and may cause impacts over a much larger area.

Evaporation is the primary mechanism for loss of low molecular weight constituents and light oil products. As lighter components evaporate, the remaining petroleum product becomes denser and more viscous. Hydrocarbons that evaporate into the atmosphere are broken down by sunlight into smaller compounds. This process, referred to as photodegradation, occurs rapidly in air, and the rate of photodegradation increases as the molecular weight increases.

The dispersion of oil into water may increase the surface area of oil susceptible to dissolution and degradation and thereby limit the potential for physical impacts.

Dissolution of oil in water is not a major process controlling the oil’s fate in the environment; however, it is one of the primary processes affecting the toxic effects of a spill, especially in confined waterbodies.

Emulsification, the incorporation of water into oil, is the opposite of dispersion. During emulsification, external energy from wave action causes small drops of water to become surrounded by oil. The emulsified oil may remain in a slick, which can contain as much as 70 percent water by weight and can have a viscosity a hundred to a thousand times greater than the original oil.

Photodegradation can be an important factor in causing the disappearance of a slick, especially one composed of lighter products and constituents; however, it is less important during cloudy days and can be nonexistent during winter on the North Slope.

In the immediate aftermath of a spill, natural biodegradation of oil is not typically an important process controlling the fate of oil in waterbodies previously unexposed to oil.

Overall, because the environmental fate of released oil is controlled by many factors, its persistence is difficult to predict with great accuracy. Besides the primary processes discussed in the preceding paragraphs, major factors affecting environmental fate are the type of product, spill volume, spill rate, oil temperature, terrain, receiving environment, time of year, and weather.

The time of year in which a spill occurs also has a major effect on the fate of crude oil, as it is linked to climatic factors such as air temperature, water, or soil; depth of snow cover; whether there is ice or open water; and the depth of the active layer. During winter, the air temperature can be so cold that it modifies the viscosity of the oil, limiting its spread and sometimes even causing it to gel. The lower the ambient temperature, the less crude oil evaporates, as demonstrated by both Prudhoe Bay and Endicott crude samples (Fingas 1996). Frozen ground limits the depth of penetration of some spill, and ice acts as a barrier to penetration until it melts.

Efforts are made to recover as much oil or other spilled substances as possible using a variety of techniques. Information on different types of booms, skimmers, tactics, efficiencies, and state and federal recovery rates are given by the state and federal agencies. This type of information evolves, has a rigorous process for usage, and is explained in much further detail within a contingency plan. See the ADEC's 18 AAC 75.425 for more information. The 18 AAC 75.425 also describes the actions to be taken to contain and control the spilled oil, including, as applicable, boom deployment strategies, construction of temporary berms, and other methods. Section vii of 18 AAC 75.425 describes the actions to be taken to recover the contained or controlled oil using mechanical response options, including procedures and provisions for skimming, absorbing, or otherwise recovering the contained or controlled product from water or land. Section viii of 18 AAC 75.425 describes procedures for lightering, transfer, and storage of oil from damaged tanks or from undamaged tanks that might be at risk of discharging additional oil. Section ix of 18 AAC 75.425 describes procedures for transfer and storage of recovered oil and oily water, including methods for estimating the amount of recovered oil.

Table A2 in 18 AAC 75 also describes specific chemical soil cleanup-level criteria for each individual chemical.

I.3.1 Spills on Tundra

Oil movement over the ground surface follows the topography of the land. In general, oil flows until it reaches a surface waterbody or a depression or until absorption prevents further movement. Oil flowing over land can infiltrate vegetation, soil, and snow. If released onto tundra, oil can penetrate the soil as a result of gravity and capillary action, with the rate of penetration depending on the season, the nature of the soil, and the type of petroleum product.

In summer, spills can penetrate the active layer (the layer of soil and rock that thaws each summer and freezes each winter, which overlies the layer of permanently frozen soil and rock) and then spread laterally on the frozen subsurface, accumulating in local topographic depressions. From there, the oil can penetrate the permafrost (Collins et al. 1993).

In winter, when the ground and water surfaces are frozen, spreading is controlled by the snow cover or frozen soil. Snow cover can act as an absorbent, slowing the spread of oil or preventing the spill from reaching the tundra surface. Oil tends to spread on the surface of the frozen soil, and its penetration of the soil is limited; however, any soil pore space that is not filled with ice may allow spilled oil to move into the frozen soil (Yershov et al. 1997; Chuvilin et al. 2001).

Topography and vegetation on much of the North Slope limit the spread of spills. During summer, flat coastal tundra develops a dead-storage capacity, averaging a depth of 0.5 to 2.3 inches (Miller et al. 1980); it would retain 300 to 1,500 barrels (12,600 to 63,000 gallons) of oil per acre. Even at high water levels, the tundra vegetation tends to limit the spread of oil, with vegetation and peat functioning as sorbents that allow water to filter through. It traps the more viscous oil (Barsdate et al. 1980) but makes oil recovery more difficult.

On the other hand, even small spills can be spread over large areas if the oil is pressurized and discharges into the air. With the high-velocity, bi-directional winds on the North Slope, oil can be misted miles downwind of a leak. For example, in December 1993, an ARCO drill site line failed, and 1 to 4 barrels (42 to 168 gallons) of crude oil misted over an estimated 100 to 145 acres (Ott 1997). Additionally, in late May or early June, the ice in the northern Alaska rivers breaks up, causing a rapid flood that, combined with ice and snow damming, can inundate large areas of tundra in a matter of days. A spill during ice breakup could be spread over a significantly larger area by the flooding water.

Spills on the tundra would be treated following the ADEC tundra treatment guidelines (ADEC 2010).

I.3.2 Spills into Water

Oil spreading on the water surface, but not necessarily being transported by moving water, would be restricted in most planning area waters. Because of the increased viscosity (a property that reduces spreading) of oil in cold water, oil spills in planning area waterbodies would generally spread less than those in temperate fresh or marine waters.

With knowledge of the time of year and the expected ice conditions, one can predict the likely configuration of oil spilled under, in, on, or among ice with a fair degree of confidence. This information can be used to plan appropriate strategies for monitoring and responding to spills (Dickins et al. 2000).

Weathering processes generally would be similar in freshwater ponds and streams, and coastal marine saltwater regimes, with seasonal ice cover capable of greatly slowing weathering in both regimes. During winter, oil weathering depends primarily on whether the oil is exposed to the atmosphere.

Evaporation of oil generally correlates to temperature, with lower temperatures linked to slower evaporation rates of crude oil (Fingas 1996). Oil between or on ice is subject to normal evaporation; oil that is frozen into the underside of ice, however, is unlikely to undergo any evaporation until spring. This is when the deterioration of multiyear ice causes the encapsulated oil to rise to the surface through brine channels in the ice. For oil spilled during freeze-up, with the likely absence of wave action, evaporation is the only major weathering process (Dickins et al. 2000). Oil spills disperse in water by wind, waves, currents, or ice.

In most cases, the weathering processes acting on oil in and along streams or rivers are similar to those described above for freshwater or marine spills. The dynamics of a river or stream environment, however, have additional effects on the fate and behavior of spilled oil. Oil entering rivers and streams begins to spread as in freshwater or marine spills, but the spreading is rapidly overcome by the surface current, at which point an elongated slick forms. The oil flows downstream at the speed of the current in the absence of wind.

In general, oil tends to accumulate in areas of quiet water or eddies at the inside of river bends on a meandering river or stream, or in other pools where velocities are slower. Water near the center of a stream channel flows faster than water near the banks or bottom of the channel, where the retarding forces of friction with the channel are greater. This difference in current speed and the resulting shearing forces between water layers is typically the major mixing mechanism that causes a slick to spread out as it moves downstream.

The Bureau of Ocean Energy Management has completed a study of marine spill rates (ABS Consulting Inc. 2016). An Alaska-specific marine spill study is in progress but is not yet available.

I.3.3 Spills on Gravel

Most frequently, spills into a receiving environment occur on gravel pads and roads. The ultimate fate of oil and other spills on gravel pads and roads depends on a variety of factors, including snow cover, the thickness and continuity of freeze zones within the gravel, the locations of any buried infrastructure, utility lines and piping, and the temperature and amount of the spilled substance. Initial spills may be largely contained by secondary containment or recovered by absorbent pads and other spill recovery methods. Hydrocarbon contaminated gravel can be removed and treated or disposed of off-site to remove the contaminants (Orr 2019). Spills of hazardous waste and extremely hazardous waste must be removed and sent to a permitted hazardous waste disposal facility.

As discussed above, spills in the winter are often easier to contain as spreading is controlled by the snow cover or frozen gravel. Snow cover can act as an absorbent, increasing the viscosity and slowing the spread or preventing the spill from penetrating into the surface (Chuvilin 2001). In non-winter conditions, spilled materials are often able to penetrate into the gravel surface. Below the surface, many gravel pads and roads may stay partially frozen year-round. Spilled substances often follow thaw lenses, thawed areas around infrastructure, and utility lines and pipes; they may spread along the subsurface saturated water level within the gravel. Spills spreading in this manner may travel across the pad or road in unpredictable directions, and spread onto the surrounding tundra.

I.3.4 The National Petroleum Reserve-Alaska Oil-Spill Experiment

In July 1970, 5 barrels (210 gallons) of Prudhoe Bay crude were experimentally spilled in a 0.07-acre tundra pond in the NPR-A near Utqiagvik (Miller et al. 1978; Barsdate et al. 1980; Hobbie 1982). The general behavior of this experimental spill is instructive about what could be expected from a small spill in the planning area during summer or from a winter spill that melts during the thaw.

In this experimental spill, the oil spread over the water surface within a few hours to a 0.06-inch thickness. Within 24 hours, the slick thickened as lighter hydrocarbons evaporated and shrank into a 10- to 16-foot band on the downwind side of the pond. For about a month, the oil moved back and forth across the pond, shifting sides with changes in wind direction. Gradually, the oil worked partway into the pond’s vegetated margins. By the end of summer, all the oil was trapped along the pond margins, either on the water’s surface or on the bottom. No oil left the pond during the next spring runoff, despite substantial water throughflow. Half of the oil was estimated to have evaporated or degraded within a year, but the rest of it remained, with little change for at least 5 years.

I.4 GAS RELEASES

The gas produced in the NPR-A is expected to be dry gas, with no water or condensates. This analysis identifies three general types of potential gas releases: from loss of well control at production areas, from ruptured gas pipelines, and from gas processing facilities. This section summarizes the key variables used for the gas release analysis.

Loss of well control is estimated at a rate of 3.6×10^{-4} gas blowouts per exploration well and 7.0×10^{-4} gas blowouts per development well drilled, according to the International Association of Oil and Gas Producers (OGP 2010). The production well-control incident rate for production of gas is 5.7×10^{-5} blowouts per well year (OGP 2010). While gas blowouts occur at a low frequency, for purposes of analysis, a well-control incident was assumed to occur; the impacts of a gas release from a well were analyzed.

A release from a well is estimated to last 1 day and to release 10 million cubic feet of natural gas. A release from a ruptured transmission pipeline or gas processing facility is estimated to be 20 million cubic feet over a few hours. These releases would be in the area next to the release site. Thermal effects are estimated to be within about 1,640 feet (500 meters) of the ignition source. Small-scale gas leaks may go undiscovered for long periods of time and may go unreported or underreported due to the fact that no easily identifiable evidence of the leak is left behind. Reliable records of gas releases on the North Slope are not available; thus, no attempt to model future gas releases could be made.

I.4.1 Gas Release Fate

Natural gas is primarily made of up methane and ethane, which make up 85 to 90 percent of its volume. Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic in the atmosphere but is classified as a simple asphyxiate, posing an inhalation hazard. Being lighter than ambient air, it has the tendency to rise and dissipate into the atmosphere. Onshore, from an elevated pipeline, the gas would disperse into the atmosphere; underground, from a buried pipeline release, it would bubble to the surface and continue into the atmosphere, where it would dissipate.

Natural gas releases pose a primarily acute hazard. Hazards associated with natural gas are predominantly due to its flammability. If an ignition source exists, a gas release can result in an immediate fire or explosion near the point of the release. This hazard is reduced over a relatively short period after the release ends and as the gas disperses. If the vapors accumulate in a processing facility or compressor station, then the hazard may remain longer.

I.5 CUMULATIVE IMPACTS

A cumulative impact is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can include additive and synergistic interactions. Spills of crude oil, petroleum products, hazardous materials, and seawater and produced water occur across the entire North Slope and state of Alaska as part of oil and gas exploration, development, and transportation activities conducted on federal, state, tribal, and private lands. Spills can also occur due to a variety of activities that take place within the planning area, including non-oil and gas related transportation, military operations and facilities, native villages and subsistence activities, and scientific research. The alternative chosen in the NPR-A IAP Record of Decision is unlikely to significantly affect spills related to these activities. Taken together, these spills can add up to greater impacts than are acknowledged in any one document or analysis. Impacts of spills can vary drastically based on the type of spill, location, time of year, time to discovery, and spill size.

I.6 References

ABS Consulting Inc. 2016. 2016 Update of Occurrence Rates for Offshore Oil Spills. Arlington, Virginia. Prepared for U.S. Department of the Interior, Bureau of Ocean Energy Management / Bureau of Safety and. Environmental Enforcement. Internet website: https://www.bsee.gov/sites/bsee.gov/files/osrr-oil-spill-response-research/1086aa.pdf.

ADEC (Alaska Department of Environmental Conservation). 2010. Tundra Treatment Guidelines: A Manual for Treating Oil and Hazardous Substance Spills to Tundra, third edition. Timothy C. Cater. ABR, Inc. Environmental Research & Services, Fairbanks, Alaska.

_____. 2020. ADEC Spill Database. State of Alaska Department of Environmental Conservation. Internet website: https://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch.

Barsdate, R. J., M. C. Miller, V. Alexander, J. R. Vestal, and J. E. Hobbie. 1980. "Oil spill effects." *In: Limnology of Tundra Ponds*. Dowden, Hutchinson and Ross, Inc., Stroudberg, Pennsylvania.

Behr-Andres, C. B., J. K. Wiegers, S. D. Forester, and J. S. Conn. 2001. Tundra Spill Cleanup and Remediation Tactics: A Study of Historic Spills and Literature. Alaska Department of Environmental Conservation. Internet website: https://www.arlis.org/docs/vol1/N/1030898004.pdf.

BLM (U.S. Department of the Interior, Bureau of Land Management). 2004. Alpine Satellite Development Plan Final Environmental Impact. Vols. 1 and 2. U.S. Department of the Interior, Bureau of Land Management, Anchorage, Alaska.

_____. 2005. Amendment to the Northeast National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement. Anchorage, Alaska. January 2005.

_____. 2008. Northeast National Petroleum Reserve-Alaska Final Supplemental IAP/EIS. Anchorage, Alaska. May 2008.

_____. 2012. National Petroleum Reserve-Alaska (NPR-A) Final Integrated Activity Plan/Environmental Impact Statement. In cooperation with the North Slope Borough, U.S. Bureau of Ocean Energy Management, and U.S. Fish and Wildlife Service, Anchorage, Alaska. Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=14702.

BLM and MMS (U.S. Department of the Interior, Bureau of Land Management and Minerals Management Service). 1998. Northeast National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement. Anchorage, Alaska.

_____. 2003. National Petroleum Reserve in Alaska Northwest National Petroleum Reserve-Alaska Final IAP/EIS. Internet website: https://books.google.com/books?id=yh0xAQAAMAAJ&lpg=SA4-PA58&ots=gl3XTG-7ux&dq=2003.%20National%20Petroleum%20Reserve%20in%20Alaska%20Northwest%20National%20Petroleum%20Reserve%E2%80%94Alaska%20Final%20IAP%2FEIS&pg=PP1#v=onepage&q=2003.%20National%20Petroleum%20Reserve%20in%20Alaska%20Northwest%20National%20Petroleum%20Reserve%E2%80%94Alaska%20Final%20IAP/EIS&f=false.

Boehm, P. D. 1987. Transport and Transformation Processes Regarding Hydrocarbon and Metal Pollutants in Offshore Sedimentary Environments. Pp. 233–286. In: *Long-Term Environmental Effects of Offshore Oil and Gas Development* (D. F. Boesch and N. N. Rabalais, editors). Elsevier Applied Science, London.

BOEM (Bureau of Ocean Energy Management). 2011. Chukchi Sea, Lease Sale 193, Final Second Supplemental Environmental Impact Statement. Alaska OCS Region, Anchorage, Alaska.

Chuvilin, E. M., N. S. Naletova, E. C. Miklyaeva, E. V. Kozlova, and A. Instanes. 2001. "Factors affecting spreadability and transportation of oil in regions of frozen ground." *Polar Records* 37: 229–338.

Collins, C. M., C. H. Racine, and M. E. Walsh. 1993. Fate and Effects of Crude Oil Spilled on Subarctic Permafrost Terrain in Interior Alaska: Fifteen Years Later. CRREL Report 93-13. U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

ConocoPhillips. 2018. Alpine Oil Discharge Prevention and Contingency Plan Alpine Field and Satellites and Alpine Pipeline System. February 2018. Appendix P, Final Supplemental Environmental Impact Statement Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/65817/155659/190439/Appendix_P__Alpine_Oil_Discharge_Prevention_and_Contingency_Plan.pdf.

Dickins, D. F., K. Vaudry, and S. Potter. 2000. "Oil spills in ice discussion paper." Prepared by D. F. Dickins Associates Ltd., Vaudry & Associates Inc., SL Ross Environmental Research Limited for Alaska Clean Seas, Prudhoe Bay, Alaska.

Fingas, M. F. 1996. "The evaporation of oil spills: Variation with temperature and correlation with distillation data." Pp. 29–72. In: *Proceedings of the Nineteenth Arctic and Marine Oilspill Program (AMOP) Technical Seminar, June 12-14, 1996, Calgary, Alberta*. Volume I. Environment Canada, Ottawa, Ontario.

Hobbie, J. E. 1982. Effects of Oil on Tundra Ponds and Streams. Final Report for Period October 1, 1978 to September 30, 1980. DOE/EV/02989-2. U.S. Department of Energy, Energy Research and Development Administration, Washington, DC.

Lehr, W. J. 2001. "Review of modeling procedures for oil spill weathering." Pp. 51–90. In: *Oil Spill Modeling and Processes* (C. A. Brebbia, editor). WIT Press, Boston, Massachusetts.

Miller, M. C., R. T. Prentki, and R. J. Barsdate. 1980. "Physics of the ponds." In: *Limnology of Tundra Ponds, Barrow, Alaska* (J. E. Hobbie, editor). U.S./IBP Synthesis Series 13. Dowden, Hutchinson, and Ross, Stroudsburg, Pennsylvania.

Miller, M. C., V. Alexander, and R. J. Barsdate. 1978. "The Effects of oil spills on phytoplankton in an Arctic lake and ponds." *Arctic* 31(3): 192–218.

National Research Council. 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Board of Environmental Studies and Toxicology, Polar Research Board, Division of Earth and Life Studies. Internet website: http://www.nap.edu/openbook/0309087376/html/1.html.

Nuka Research and Planning. 2010. North Slope Spills Analysis. Report to the Alaska Department of Environmental Conservation. November 2010. Internet website: https://dec.alaska.gov/media/7570/nssa-final-report.pdf.

_____. 2013. Oil Spill Occurrence Rates for Alaska North Slope Crude & Refined Oil Spills. Report to the Bureau of Ocean and Energy Management, OCS Study BOEM 2013-205. October 2013. Internet website: https://www.boem.gov/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/131104_BOEMOilSpillOccurrenceFinalReport.pdf.

OGP (International Association of Oil & Gas Producers). 2010. OGP Risk Assessment Data Dictionary, Blowout Frequencies. Report No. 434-2. United Kingdom, OGP. Internet website: http://www.ogp.org.uk/pubs/434-02.pdf.

Orr, V. 2019. "Cooking Dirt: Reclamation facilities turn contaminated soil into clean material." *Alaska Business Journal*. July 15, 2019. Internet website: https://www.akbizmag.com/industry/environmental/cooking-dirt/.

Ott, A. G. 1997. Letter dated August 20, 1997, to Johanna Munson, State NPR-A Representative, from A. G. Ott, Regional Supervisor, Alaska Department of Fish and Game, Habitat and Restoration Division.

Payne, J. R, G. D. McNabb, and J. R. Clayton. 1991. "Oil weathering behavior in Arctic environments." In: Proceedings from the Pro Mare Symposium on Polar Marine Ecology, May 12–16, 1990, Trondheim, Norway. *Polar Research* 10: 631–662.

Simmons, C. L., K. R. Everett, D. A. Walker, A. E. Linkins, and P. J. Webber. 1983. Sensitivity of Plant Communities and Soil Flora to Seawater Spills, Prudhoe Bay, Alaska. Cold Regions Research and Engineering Laboratory Report 83.-24. Hanover, New Hampshire.

USACE (U.S. Army Corps of Engineers). 2019. Nanushuk Final Environmental Impact Statement. Alaska District. Fairbanks. November 2018.

Yershov, R. D., E. M. Chuvilin, O. G. Smirnova, and N. S. Naletova. 1997. "Interaction of oil with frozen soils." Pp. 381–384. In: *Ground Freezing 97: Frost Action in Soils* (S. Knutsson, editor). A. A. Balkema, Rotterdam, Amsterdam.

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Appendix J
Water Resources

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Chapter Page

TABLES

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
cfs	cubic feet per second
cfsm	cubic feet per second per square mile
cm	centimeters
°C	Celsius
ha	hectare
IPF	instantaneous peak flow
km^2	square kilometer
m	meter
mi	mile
mg/L	milligrams per liter
mm	millimeters
µg/L	microgram per liter
µmhos/cm	micromhos per centimeter

Appendix J. Water Resources

Note: **Tables J-1** through **J-17** relate to *Affected Environment*; **Tables J-18** through **J-26** relate to *Environmental Consequences*.

Table J-1
Average Monthly Air Temperature Data

Inigok Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	3.28	-6.09	-13.36	-20.64
1999	-29.84	-28.79	-28.37	-19.8	-4.87	5.2	10.52	8.86	1.32	-9.97	-21.05	-30.97
2000	-25.8	-26.82	-27.01	-18.77	-8.38	7.26	8.85	5.81	0.69	-9.66	-19.33	-22.56
2001	-25.35	-19.9	-28.46	-17.87	-	-	-	5.3	1.46	-13.45	-20.33	-25.17
2002	-29.7	-29.4	-19.97	-15.83	-1.79	5.34	9.78	6.26	3.29	-6.04	-14.29	-21.47
2003	-24.86	-28.05	-25.68	-13.16	-4.8	5.29	-	-	0.09	-4.56	-17.5	-24.55
2004	-27.16	-34.79	-28.45	-18.48	-3.78	8.22	11.58	9.58	0.4	-7.47	-18.58	-24.73
2005	-24.25	-27.15	-23.53	-17.14	-4.7	4.2	7.24	8.6	1.4	-8.08	-24.43	-22.84
2006	-27.75	-22.52	-29.98	-20.72	-4.05	8.13	9.84	5.17	4.16	-4.26	-18.63	-19.89
2007	-27.9	-26.63	-29.34	-14.52	-8.01	6.67	11	9.11	3.09	-8.5	-13.97	-22.37
2008	-30.68	-29.13	-30.23	-13.05	-3.31	8.98	10.94	4.89	0.45	-8.31	-17.77	-19.24
2009	-28.2	-27.15	-31.33	-15.45	-1.95	6.34	11.51	7.06	1.28	-5.68	-21.39	-21.35
2010	-28.81	-25.87	-26.12	-12.16	-6.01	5.02	10.66	9.18	4.14	-7.34	-11.27	-27.02
2011	-25.1	-21.15	-21.79	-20.45	-4.9	5.08	10.47	7.84	2.58	-6.18	-22.49	-26.8
2012	-33.15	-25.52	-33	-16.25	-5.49	7.17	12.91	10.36	2.46	-3.52	-18.2	-26.93
2013	-27.61	-32.4	-24.42	-19.51	-5.46	8.74	11.93	7.56	-	-5.52	-16.29	-21.23
2014	-23.31	-24.53	-	-14.32	-1.33	4.93	8.9	6.11	1.22	-5.87	-	-
2015	-	-	-	-	0.29	10.23	9.06	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Fish Creek Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	2.9	-5.65	-12.35	-20.57
1999	-30.29	-28.57	-28.02	-19.54	-5.3	2.63	-	-	1.29	-9.05	-20.7	-30.02
2000	-25.6	-27.37	-25.89	-18.91	-9.16	5.61	7.13	5.08	0.41	-9.35	-19.02	-21.78
2001	-25.05	-20.51	-28.75	-17.67	-	3.86	7.57	4.39	1.09	-12.87	-19.08	-24.41
2002	-29.31	-29.73	-20.77	-16.44	-2.52	3.67	7.71	5.74	3.1	-5.99	-14.22	-19.75
2003	-24.34	-27.52	-25.41	-13.69	-5.26	2.71	8.77	3.75	0.03	-4.27	-18.18	-23.13
2004	-26.03	-34.43	-28.82	-18.09	-4.8	6.09	9.29	8.59	0.44	-7.43	-18.32	-24.42
2005	-24.55	-27.22	-23.59	-17.26	-5.04	2.29	5.32	6.97	0.95	-7.35	-23.71	-21.45
2006	-27.47	-22.79	-29.12	-20.39	-4.08	6.94	8.21	-	4.35	-	-18.24	-19.95
2007	-27.58	-25.89	-29.33	-13.9	-6.65	7.7	8.73	8.26	3.3	-6.48	-12.08	-21.3
2008	-30.07	-28.54	-29.47	-13.13	-2.85	8.69	11.52	6.41	1.56	-7.84	-17.08	-19.42
2009	-28.12	-27.49	-30	-15.61	-2.85	4.62	9.44	6.74	1.25	-4.53	-20.07	-20.9
2010	-28.85	-24.97	-25.14	-12.3	-5.75	4.69	10.86	8.01	3.51	-5.42	-11.13	-26.68
2011	-25.32	-22.28	-23.18	-20.13	-5.76	2.93	8.8	6.84	2.35	-5.44	-21.12	-26.59
2012	-32.71	-25.71	-32.95	-15.7	-5.84	-	10.93	9.54	2.62	-3.45	-17.09	-26.89
2013	-26.83	-31.55	-24.07	-19.75	-	-	10.18	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Tunalik Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	2.93	-4.63	-12.52	-21.21
1999	-30.29	-27.89	-28.33	-19.44	-4.49	5.11	9.41	8.14	1.27	-9.19	-20.77	-31.19
2000	-26.86	-26.08	-26.33	-17.81	-8.28	5.48	6.54	5.69	0.47	-8.98	-19.32	-22.14
2001	-24.5	-17.78	-27.19	-17.27	-10.4	4.97	7.41	4.54	1.57	-13.15	-18.14	-24.91
2002	-29.35	-28.41	-17.63	-15.31	-1.96	4.24	7.59	5.09	3.07	-	-	-
2003	-	-	-	-	-	-	-	-	-	-	-	-23.72
2004	-25.16	-	-	-	-	-	-	-	0.6	-5.79	-16.06	-24.01
2005	-23.78	-26.6	-23.1	-16.74	-4.64	4.42	8.51	8.52	2	-7.21	-20.66	-22.09
2006	-26.02	-22.88	-28.77	-20.74	-3.96	5.07	7.01	4.91	3.47	-3.75	-14.59	-20.27
2007	-27.72	-24.74	-27.11	-14.04	-7.48	7.22	12.53	10.43	3.72	-7.5	-12.78	-19.89
2008	-28.91	-28.4	-29.12	-13.07	-3.9	5.06	8.43	4.33	0.04	-7.44	-16.23	-17.84
2009	-26.82	-27.19	-29.56	-14.78	-1.01	6.58	11.74	6.61	1.19	-4.93	-20.34	-19.85
2010	-28.15	-25.26	-25.58	-13.28	-5.7	6.33	8.54	8.96	4.07	-7.39	-10.35	-22.89
2011	-22	-19.75	-19.23	-19.57	-3.97	5.44	9.9	7.86	2.6	-5.96	-20.91	-25.36
2012	-31.87	-24.77	-32.43	-16.52	-4.92	6.93	10.08	8.5	1.27	-2.81	-16.26	-25.18
2013	-25.83	-31.06	-22.85	-18.14	-4.72	8.22	11.33	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Umiat Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	3.91	-6.81	-15.57	-20.44
1999	-28.79	-28.08	-27.14	-17.33	-4.11	7.76	10.99	9.28	1.38	-13.1	-21.57	-31.49
2000	-24.7	-23.57	-27.25	-17.56	-7.99	8.83	9.77	6.17	0.21	-10.35	-19.06	-22.98
2001	-25.2	-18.47	-27.89	-16.24	-10.79	7.52	9.64	5.84	1.58	-14.63	-18.88	-25.19
2002	-27.11	-26.49	-17.33	-14.56	-0.9	6.7	10.54	6.55	3.74	-6.48	-14.48	-21.24
2003	-23.18	-26.49	-23.76	-11.04	-3.97	7.79	10.09	5.61	-0.68	-5.18	-16.62	-23.87
2004	-26.48	-33.88	-27.43	-16.45	-2.35	10.55	13.07	10.54	-0.72	-7.82	-18.69	-25.64
2005	-22.04	-26.41	-22.62	-15.8	-4.31	5.92	7.8	9.22	1.92	-9.4	-24.84	-23.59
2006	-27.82	-18.96	-27.27	-20.4	-2.92	-	-	-	4.81	-4.46	-17.41	-20.64
2007	-27.01	-23.98	-28.77	-13.84	-7.81	9.57	12.51	10.36	3.31	-10.81	-14.16	-20.4
2008	-27.45	-26.31	-28.33	-11.27	-2.98	10.7	11.83	4.63	-0.74	-9.97	-18.91	-17.51
2009	-25.42	-24.39	-29.1	-13.09	-0.6	8.21	12.51	7.02	0.76	-6.98	-22.77	-19.04
2010	-	-	-	-	-5.52	7.46	11.4	-	4.55	-9.77	-11.7	-25.55
2011	-22.45	-19	-17.59	-19.63	-3.16	6.88	11.23	8.12	1.88	-7.01	-22.98	-25.54
2012	-31.56	-23.46	-33.12	-15.8	-4.67	9.07	13.39	10.44	2.22	-4.29	-19.38	-26.57
2013	-28.02	-32.26	-24.14	-18.87	-4.92	11.04	12.2	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Koluktak Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1999	-	-	-	-	-	-	-	-	1.45	-10.35	-21.48	-31.86
2000	-25.81	-26.14	-28.48	-18.97	-8.06	-	-	-	0.83	-9.83	-20.1	-22.54
2001	-25.56	-19.32	-28.44	-17.9	-	-	-	-	-	-	-	-
2002	-	-	-	-	-	-	-	-	3.34	-6.24	-13.92	-22.6
2003	-25.41	-28.75	-26.28	-12.6	-4.41	6.96	10.15	-	-	-	-	-
2004	-	-	-	-	-2.55	9.9	12.79	10.23	0.23	-7.74	-19.15	-26.14
2005	-24.28	-27.72	-24.18	-17.07	-4.42	5.52	8.48	9.44	1.88	-8.08	-24.57	-23.84
2006	-28.06	-22.33	-30.13	-20.82	-3.45	8.6	10.6	5.8	4.29	-3.99	-18.44	-20.37
2007	-28.51	-26.83	-29.9	-14.31	-7.63	8.74	12.77	10.28	3.39	-9.63	-14.96	-23.27
2008	-30.68	-29.78	-31.14	-12.95	-2.67	9.96	11.73	5.04	0.15	-8.52	-18.54	-19.22
2009	-28.22	-27.15	-31.68	-15.18	-0.92	7.85	12.82	7.28	1.23	-6.11	-22.6	-22.11
2010	-29.58	-26.96	-27.56	-12.53	-	-	-	-	4.52	-8.36	-11.35	-26.35
2011	-24.48	-20.23	-21.38	-20.52	-4.04	6.57	11.23	8.26	2.74	-6.39	-23.52	-26.47
2012	-33.36	-25.51	-35.22	-17.13	-5.13	8.46	13.46	10.22	2.24	-3.52	-18.87	-27.52
2013	-28.16	-33.31	-24.78	-19.96	-5.01	10.46	12.8	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Lake 145 Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2007	-	-	-	-	-	-	-	-	2.39	-5.57	-10.32	-19.7
2008	-29.07	-28.02	-29.29	-13.24	-4.77	3.6	6.42	4.06	0.8	-	-	-
2009	-	-	-	-	-	-	-	-	0.98	-3.81	-	-
2010	-	-	-	-	-6.47	1.58	6.67	6.5	2.62	-4.47	-10.64	-25.21
2011	-24.51	-21.96	-22.68	-19.61	-5.53	1.52	6.85	5.58	2.56	-4.8	-19.6	-25.67
2012	-31.9	-25.28	-33.64	-15.74	-5.81	3.39	9.37	8.99	2.52	-2.84	-15.75	-25.78
2013	-26.4	-30.91	-23.66	-19.67	-5.79	3.17	7.82	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Piksiksak Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2004	-	-	-	-	-	-	-	-	0.36	-6.69	-17.65	-25.04
2005	-24.04	-27.52	-23.74	-16.83	-4.6	5.07	8.16	9.06	1.46	-7.68	-22.59	-23.13
2006	-27.05	-22.33	-29.94	-20.81	-3.65	7.23	9.18	5.25	4.11	-4.3	-16.76	-20.63
2007	-28.28	-25.75	-28.39	-14.19	-7.58	7.88	12.43	10.05	3.51	-8.23	-14.04	-21.54
2008	-30.4	-29.03	-29.91	-12.77	-3.61	8.71	10.48	4.37	0.05	-7.84	-17.47	-18.02
2009	-27.6	-26.89	-31.24	-14.82	-1.28	6.96	12.36	6.79	0.86	-5.3	-21.4	-21.6
2010	-28.76	-26.04	-26.37	-12.26	-5.93	6	10.18	8.99	4.09	-7.04	-11.59	-25.02
2011	-23.4	-19.65	-20	-20.49	-4.26	5.62	10.21	7.6	2.44	-6.12	-22.83	-26.32
2012	-32.72	-25.38	-33.39	-16.93	-5.05	8.04	12.32	9.37	1.65	-2.81	-17.76	-26.41
2013	-27.34	-32.43	-24.13	-19.38	-2.84	10.3	12.11	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

South Meade Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	0.17	-4.65	-17.86	-24.86
2004	-26.35	-34.93	-28.58	-18.18	-4.01	7.1	9.81	8.89	0.71	-6.21	-17.26	-24.88
2005	-24.15	-26.71	-23.6	-17.13	-5.12	2.83	6.68	8.11	1.05	-6.75	-22.03	-22.02
2006	-26.26	-23.59	-29.97	-20.99	-4.01	5.81	7.94	4.43	3.44	-3.99	-16.35	-21.41
2007	-28.79	-26.42	-28.33	-14.08	-7.72	5.39	10.72	9.14	3.46	-6.1	-12.53	-21.34
2008	-30.5	-28.98	-29.61	-13.64	-4.33	6.54	8.69	4.23	0.75	-7.65	-17.41	-18.64
2009	-28.08	-28.11	-30	-15.87	-2.29	4.84	10.55	6.38	1.1	-4.59	-19.76	-21.3
2010	-29.23	-25.23	-25.51	-12.95	-6.36	3.5	8.74	8.2	3.51	-5.93	-12.08	-25.87
2011	-24.91	-21.5	-22.01	-20.28	-5.11	-	-	-	2.45	-5.7	-21.45	-26.13
2012	-33.06	-26.14	-33.49	-16.04	-5.44	6.09	10.82	-	1.51	-3.6	-16.74	-26.18
2013	-26.53	-31.41	-23.7	-19.13	-4.98	7.41	10.91	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Awuna 1 Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	1.88	-6.26	-16.7	-21.38
1999	-28.64	-26.59	-28.58	-17.86	-3.29	8.67	11.46	8.36	0.94	-13.41	-21.52	-32.26
2000	-25.39	-22.78	-26.74	-17.73	-7.62	8.68	8.56	8.32	-0.75	-10.18	-20.05	-22.09
2001	-23.9	-18.1	-27.74	-	-	-	-	-	-	-	-	-
2002	-	-	-	-	-	-	-	-	2.49	-6.71	-14.9	-21.1
2003	-22.89	-26.54	-23.39	-11.01	-4.84	8.59	8.72	5.38	-1.43	-5.11	-15.83	-23.41
2004	-26.42	-33.68	-26.62	-15.48	-	-	-	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Awuna 2 Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	-1.39	-5.27	-16.27	-24.02
2004	-27.89	-34.57	-27.17	-15.53	-0.83	11.7	13.15	10.71	-1.65	-8.32	-17.7	-26.44
2005	-22.49	-27.09	-22.83	-16.9	-3.94	-	-	-	1.78	-9.75	-25.25	-24.17
2006	-28.86	-19.84	-27.34	-21.47	-3.5	7.15	9.83	5.06	4.19	-5.57	-16.53	-22.44
2007	-27.85	-27.14	-30.59	-13.09	-6.06	10.61	14.13	10.73	3.25	-11.32	-	-22.32
2008	-29.31	-27.61	-29.52	-12.02	-3.39	8.69	-	-	-1.13	-9.78	-19.52	-18.1
2009	-27.1	-25.96	-28.78	-14.21	-0.46	8.2	12.42	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	3.87	-9.7	-12.84	-24.73
2011	-21.76	-	-	-	-	-	-	-	1.01	-8.21	-22.92	-25.78
2012	-31.69	-23.03	-32.7	-14.98	-5.11	9.81	12.07	8.66	0.32	-4.72	-20.17	-26.86
2013	-27.07	-33.11	-22.11	-18.91	-5.25	10.98	11.88	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

Drew Point Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	3.05	-4.52	-11.33	-20.75
1999	-30.4	-27.43	-28.07	-20.03	-5.49	0.87	5.31	5.49	0.37	-8.52	-20.26	-28.97
2000	-25.47	-27.71	-24.99	-18.62	-9.27	3.53	4.68	4.46	0.41	-7.88	-18.5	-21.45
2001	-24.46	-19.75	-28.22	-17.83	-11.16	2	5.2	4.73	-	-	-	-
2002	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	0.16	-3.37	-18.57	-22.84
2004	-24.47	-33.08	-28.37	-17.6	-4.86	3.84	6.41	7.32	0.9	-6.05	-16.91	-24.44
2005	-23.79	-26.37	-23.39	-17.39	-5.35	0.8	3.25	5.61	0.49	-6.03	-21.21	-20.56
2006	-25.82	-22.8	-28.77	-20.47	-3.45	4.05	5.23	2.35	2.39	-3.39	-16.05	-20.54
2007	-27.5	-25.4	-28.6	-13.5	-8.24	2	5.46	6.31	2.53	-5.28	-10.42	-
2008	-29.09	-27.63	-28.58	-	-4.95	3.49	5.36	3.84	0.96	-6.18	-16.54	-18.55
2009	-27.4	-27.85	-28.04	-15.98	-4.09	1.75	6.8	5.92	0.99	-3.87	-18.69	-
2010	-	-	-24.4	-12.83	-6.74	1.22	6.07	6.16	2.52	-4.6	-11.14	-24.65
2011	-24.5	-22.11	-22.43	-19.41	-5.55	1.58	5.88	5.31	2.48	-4.63	-19.61	-25.32
2012	-31.6	-25.46	-32.32	-15.61	-5.96	3.42	8.55	8.49	2.2	-2.35	-15.39	-25.29
2013	-25.45	-30.55	-23.39	-19.09	-5.77	4.12	7.56	4.36	-0.54	-3.98	-14.48	-
2014	-17.02	-17.48	-16.89	-15.92	-2.76	1.47	4.47	3.64	1.09	-5.47	-12.59	-22.61
2015	-24.71	-22.17	-24.57	-	-1.22	5.99	4.5	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-1 (continued)
Average Monthly Air Temperature Data

East Teshekpuk Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2004	-	-	-	-	-	-	-	-	3.17	-5.25	-17.01	-23.61
2005	-23.24	-26.27	-23.23	-17.09	-4.99	1.41	4.51	7.91	2.45	-6.28	-22.16	-20.77
2006	-26.2	-22.56	-28.5	-20.07	-4.15	4.76	7.1	3.67	3.31	-3.11	-16.96	-19.65
2007	-26.95	-25.4	-28.32	-13.61	-7.82	2.63	7.24	7.09	2.72	-6.05	-10.77	-20
2008	-28.62	-27.51	-28.85	-13.06	-4.28	4.68	-	4.61	1.15	-7.03	-16.22	-18.54
2009	-27.4	-27.4	-29.02	-15.72	-3.55	2.51	7.55	6.57	1.34	-4.06	-18.68	-20.17
2010	-27.98	-24.22	-24.33	-12.57	-6.33	2.06	7.12	7.38	3.35	-4.68	-10.96	-25.27
2011	-24.45	-21.97	-22.69	-19.58	-5.54	1.82	7.5	6.28	2.74	-5.21	-20.02	-25.35
2012	-31.77	-25.2	-32.8	-15.74	-5.85	4.01	10.53	9.59	2.64	-2.71	-16	-25.61
2013	-25.67	-30.53	-23.47	-19.48	-5.81	4.18	8.97	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Ikpikpuk Station: Average Monthly Air Temperatures (degrees Celsius)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2005	-	-	-	-	-	-	-	-	1.09	-6.85	-23.15	-21.77
2006	-26.87	-22.97	-29.44	-20.77	-4.09	6.34	8.18	4.43	3.64	-3.54	-17.48	-20.02
2007	-27.83	-26.69	-28.99	-13.85	-7.86	4.12	9.01	8.39	3.1	-6.8	-12.14	-21.38
2008	-30.13	-28.83	-29.92	-13.19	-3.82	6.8	-	4.59	0.88	-7.57	-16.91	-18.6
2009	-28.35	-27.57	-30.54	-15.72	-2.76	4.19	9.59	6.72	1.38	-4.58	-20.14	-20.87
2010	-28.5	-24.88	-25.36	-12.85	-6.29	2.91	8.97	8.37	3.7	-5.26	-11.27	-26.1
2011	-24.86	-21.4	-22.26	-20.17	-5.11	2.95	8.51	7.05	2.71	-5.62	-21.28	-25.93
2012	-33.03	-25.69	-32.81	-16.06	-5.66	5.7	11.67	9.82	2.22	-3.1	-17	-26.38
2013	-26.55	-31.35	-24.13	-20.07	-5.36	7.07	10.47	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-2
Average Seasonal Air Temperature Data

Inigok Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	-5.4	-
1999	-26.34	-17.66	8.23	-9.9	-12.22
2000	-27.89	-18.04	7.31	-9.44	-11.27
2001	-22.69	-19.64	-	-10.8	-
2002	-28.05	-12.5	7.14	-5.68	-9.37
2003	-24.69	-14.56	-	-7.29	-
2004	-28.7	-16.89	9.81	-8.54	-11.06
2005	-25.32	-15.1	6.69	-10.35	-10.82
2006	-24.44	-18.22	7.71	-6.22	-9.98
2007	-24.74	-17.32	8.95	-6.49	-10.04
2008	-27.35	-15.6	8.26	-8.54	-10.5
2009	-24.78	-16.25	8.33	-8.57	-10.42
2010	-25.32	-14.79	8.32	-4.85	-9.58
2011	-24.53	-15.66	7.83	-8.67	-10.17
2012	-28.56	-18.27	10.18	-6.39	-10.74
2013	-28.87	-16.43	9.42	-	-10.5
2014	-22.97	-	6.67	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

Fish Creek Station: Mean Seasonal Air Temperatures (Degrees Celsius)					
Year	WINTER	SPRING	SUMMER	AUTUMN	ANNUAL
1998	-	-	-	-5.04	-
1999	-26.41	-17.6	-	-9.48	-
2000	-27.67	-17.98	5.95	-9.32	-11.52
2001	-22.51	-	5.29	-10.32	-11.87
2002	-27.75	-13.21	5.73	-5.71	-9.76
2003	-23.75	-14.8	4.86	-7.44	-10.11
2004	-27.72	-17.23	8.01	-8.43	-11.41
2005	-25.34	-15.28	4.89	-10.01	-11.11
2006	-23.94	-17.84	6.35	-5.87	-10.26
2007	-24.43	-16.66	8.24	-5.1	-9.54
2008	-26.59	-15.17	8.88	-7.79	-9.97
2009	-24.93	-16.16	6.96	-7.75	-10.52
2010	-24.9	-14.42	7.89	-4.36	-9.36
2011	-24.84	-16.31	6.23	-8.04	-10.67
2012	-28.39	-18.19	8.41	-5.94	-11.21
2013	-28.32	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

Tunalik Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	-4.74	-
1999	-26.41	-17.4	7.58	-9.56	-12.22
2000	-28.09	-17.47	5.91	-9.27	-11.43
2001	-21.6	-18.3	5.65	-9.94	-11.23
2002	-27.53	-11.6	5.66	-	-
2003	-	-	-	-	-
2004	-	-	-	-7.07	-
2005	-24.73	-14.8	7.18	-8.61	-10
2006	-23.69	-17.79	5.67	-4.94	-9.97
2007	-24.23	-16.23	10.09	-5.54	-8.87
2008	-25.68	-15.39	5.94	-7.87	-10.55
2009	-23.84	-15.12	8.33	-7.99	-9.75
2010	-24.4	-14.87	7.96	-4.59	-9.16
2011	-21.61	-14.2	7.76	-8.07	-9.17
2012	-27.39	-17.97	8.52	-5.9	-10.65
2013	-27.23	-15.21	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

Umiat Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	-6.16	-
1999	-25.69	-16.18	9.36	-11.12	-11.77
2000	-26.65	-17.6	8.25	-9.74	-10.68
2001	-22.34	-18.33	7.67	-10.69	-11.05
2002	-26.26	-10.89	7.95	-5.75	-8.34
2003	-23.54	-12.95	7.38	-7.47	-9.1
2004	-27.95	-15.4	11.4	-9.07	-10.37
2005	-24.64	-14.23	7.66	-10.72	-10.23
2006	-23.6	-16.83	-	-5.67	-
2007	-23.87	-16.84	10.83	-7.27	-9.2
2008	-24.68	-14.24	9.04	-9.88	-9.65
2009	-22.38	-14.28	9.26	-9.66	-9.32
2010	-	-	9.52	-5.68	-
2011	-22.45	-13.39	8.76	-9.34	-9.03
2012	-26.93	-17.89	10.99	-7.12	-10.29
2013	-28.84	-16	-	-	-

Source: Urban 2017
"-" = Data unavailable

Koluktak Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1999	-	-	-	-10.13	-
2000	-27.98	-18.5	-	-9.7	-
2001	-22.57	-	-	-	-
2002	-	-	-	-5.61	-
2003	-25.48	-14.45	-	-	-
2004	-	-	10.99	-8.88	-
2005	-25.99	-15.2	7.84	-10.23	-10.62
2006	-24.82	-18.11	8.33	-6.02	-9.79
2007	-25.18	-17.31	10.61	-7.09	-9.91
2008	-27.87	-15.61	8.9	-8.97	-10.5
2009	-24.78	-15.94	9.33	-9.13	-10.3
2010	-26.19	-15.61	-	-5.1	-
2011	-23.8	-15.25	8.71	-9.03	-9.78
2012	-28.51	-19.18	10.74	-6.68	-10.97
2013	-29.54	-16.69	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

Lake 145 Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2007	-	-	-	-4.51	-
2008	-25.54	-15.79	4.71	-	-
2009	-	-	-	-	-
2010	-	-	4.95	-4.17	-
2011	-23.96	-15.9	4.68	-7.25	-10.58
2012	-27.67	-18.43	7.28	-5.33	-11.05
2013	-27.59	-16.34	-	-	-

Source: Urban 2017
"-" = Data unavailable

Piksiksak Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	-7.98	-
2005	-25.47	-15.04	7.46	-9.58	-10.42
2006	-24.23	-18.11	7.22	-5.64	-9.91
2007	-24.85	-16.75	10.15	-6.28	-9.44
2008	-26.94	-15.46	7.84	-8.41	-10.41
2009	-24.08	-15.79	8.72	-8.58	-10.16
2010	-25.45	-14.88	8.42	-4.87	-9.41
2011	-22.79	-14.86	7.84	-8.81	-9.69
2012	-28.2	-18.47	9.93	-6.27	-10.75
2013	-28.61	-15.41	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

South Meade Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	-7.42	-
2004	-28.58	-16.91	8.62	-7.57	-11.07
2005	-25.2	-15.26	5.91	-9.22	-10.63
2006	-23.97	-18.29	6.06	-5.61	-10.34
2007	-25.51	-16.74	8.45	-5.07	-9.64
2008	-26.9	-15.88	6.49	-8.1	-10.83
2009	-24.84	-16.05	7.28	-7.72	-10.48
2010	-25.25	-14.96	6.85	-4.84	-9.87
2011	-24.18	-15.84	-	-8.2	-
2012	-28.49	-18.35	8.61	-6.25	-11.26
2013	-27.93	-15.9	-	-	-

Source: Urban 2017
"-" = Data unavailable

Awuna 1 Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	-7.02	-
1999	-25.5	-16.56	9.5	-11.35	-11.82
2000	-26.9	-17.36	8.52	-10.32	-10.62
2001	-21.47	-	-	-	-
2002	-	-	-	-6.38	-
2003	-23.41	-13.1	7.35	-7.43	-9.51
2004	-27.71	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

Awuna 2 Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	-7.62	-
2004	-28.7	-14.5	11.86	-9.21	-10.31
2005	-25.28	-14.53	-	-11.06	-
2006	-24.44	-17.39	7.35	-5.96	-9.9
2007	-25.76	-16.62	11.85	-7.25	-9.41
2008	-26.44	-15.01	-	-10.14	-11.05
2009	-23.65	-14.49	9.07	-	-
2010	-	-	-	-6.26	-
2011	-	-	-	-10.02	-
2012	-26.92	-17.63	10.18	-8.15	-10.69
2013	-28.88	-15.38	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Drew Point Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	-4.27	-
1999	-26.15	-17.84	3.92	-9.46	-13.01
2000	-27.38	-17.62	4.23	-8.65	-11.68
2001	-21.96	-19.09	4	-	-
2002	-	-	-	-	-
2003	-	-	-	-7.22	-
2004	-26.66	-16.93	5.88	-7.34	-11.37
2005	-24.82	-15.36	3.24	-8.88	-11.07
2006	-23.07	-17.53	3.88	-5.66	-10.54
2007	-24.45	-16.81	4.61	-4.4	-10.07
2008	-25.45	-15.7	4.24	-7.24	-10.87
2009	-24.49	-16.04	4.86	-7.15	-
2010	-	-14.68	4.52	-4.41	-
2011	-23.81	-15.75	4.28	-7.23	-10.62
2012	-27.51	-17.95	6.86	-5.15	-10.91
2013	-26.98	-16.05	5.36	-6.31	-10.04
2014	-16.67	-11.81	3.21	-5.65	-8.28
2015	-23.2	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-2 (continued)
Average Seasonal Air Temperature Data

East Teshekpuk Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	-6.35	-
2005	-24.31	-15.08	4.64	-8.64	-10.55
2006	-23.2	-17.55	5.18	-5.56	-10.14
2007	-23.95	-16.62	5.68	-4.71	-9.87
2008	-25.33	-15.42	5.61	-7.36	-10.6
2009	-24.35	-16.1	5.57	-7.1	-10.57
2010	-24.12	-14.43	5.56	-4.1	-9.64
2011	-23.96	-15.9	5.24	-7.47	-10.46
2012	-27.49	-18.16	8.06	-5.33	-10.79
2013	-27.16	-16.22	-	-	-

Source: Urban 2017
"-" = Data unavailable

Ikpikpuk Station: Mean Seasonal Air Temperatures (degrees Celsius)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2005	-	-	-	-9.61	-
2006	-23.9	-18.07	6.32	-5.77	-10.15
2007	-24.78	-16.93	7.21	-5.29	-10
2008	-26.73	-15.67	6.82	-7.87	-10.78
2009	-24.75	-16.35	6.86	-7.75	-10.62
2010	-24.74	-14.85	6.79	-4.29	-9.65
2011	-24.21	-15.8	6.2	-8.04	-10.38
2012	-28.27	-18.2	9.1	-5.93	-10.84
2013	-27.99	-16.48	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-3
Average Monthly Wind Speed Data

Inigok Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2004	-	-	-	-	-	-	-	-	3.77	4.36	4.63	-
2005	4.71	-	4.4	3.49	4.54	4.52	4.17	3.08	-	-	-	-
2006	-	-	-	-	-	-	-	-	2.88	3.85	-	-
2007	3.36	3.4	3.68	3.58	3.79	4.39	3.76	3.14	3.71	-	-	-
2008	3.8	3.14	-	3.66	5.17	3.41	3.88	3.16	2.97	3.81	-	3.16
2009	3.56	3.88	-	3.36	3.86	4.5	4.1	3.47	3.84	-	-	-
2010	3.41	4.79	3.44	3.4	5.16	4.73	3.58	3.72	3.42	-	-	-
2011	-	5.64	-	3.92	2.95	4.82	3.47	3.5	4.15	4.03	3.27	-
2012	3.3	-	-	3.51	3.86	3.94	3.11	3.76	3.44	3.99	-	2.75
2013	4.94	-	-	3.9	3.81	3.55	4.02	3.04	-	-	-	-
2014	5.16	-	-	3	4.16	3.55	3.73	4.25	4.24	-	-	-
2015	-	-	-	-	3.58	3.41	3.69	-	-		-	-

Source: Urban 2017
"-" = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Fish Creek Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	3.71	3.89	3.89	4.76
2004	4.47	3.61	-	3.53	-	3.4	-	3.45	3.68	4.87	-	-
2005	4.55	4.49	5.05	3.83	4.62	4.9	4.47	3.31	5.59	3.84	-	-
2006	-	-	-	-	3.64	3.79	4.08	-	3.15	4.69	-	3.49
2007	-	3.28	3.72	4.31	3.83	4.93	4.09	3.43	4.46	-	-	-
2008	3.67	2.97	2.81	4.18	5.12	3.77	3.92	3.21	3.25	3.99	-	-
2009	-	4.14	-	3.8	4.12	5.16	4.55	3.62	3.94	4.06	3.57	-
2010	2.42	-	3.18	3.88	5.28	5.34	3.95	4.04	3.57	-	-	-
2011	-	-	-	4.07	3.33	5.36	4.01	3.84	4.37	4.52	-	-
2012	-	-	2.59	3.79	4.11	4.56	3.51	3.93	3.76	3.99	3.39	-
2013	-	4.14	5.22	4.02	3.78	3.75	4.38	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Tunalik Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	3.84	4.02	4.32	5.59
2004	3.92	-	5.65	5.27	5.97	4.71	3.64	3.38	3.98	6.04	6.38	-
2005	4.04	-	5.62	4.29	6.23	5.12	4.77	3.49	5.09	4.05	2.83	3.54
2006	-	-	-	-	4.72	4.04	3.96	3.44	3.29	4.39	4.56	-
2007	-	4.01	4.18	5.1	4.37	4.55	3.88	3.33	3.92	4.73	-	4.2
2008	-	3.29	4.07	3.82	5.97	2.99	2.99	3.71	3.39	3.55	-	-
2009	-	5.59	-	4.46	4	4.82	4.25	3.62	3.79	4.17	3.35	-
2010	1.75	6.31	-	4.55	5.9	5.2	4.19	4.38	3.21	6.22	5.03	3.93
2011	2.9	6.09	3.53	4.61	3.88	5.39	3.92	3.59	4.38	4.22	-	-
2012	3.81	-	3.4	4.71	4.14	4.88	3.35	3.96	3.48	4.01	3.85	3.68
2013	-	4.57	4.82	4.41	4.81	4.34	4.12	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Umiat Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2005	-	-	-	-	3.58	3.93	3.52	2.62	-	-	-	-
2006	-	-	1.24	1.8	1.4	-	-	-	2.21	2.49	-	-
2007	-	-	-	3.12	3.42	3.59	3.15	2.64	2.44	-	-	-
2008	3.12	-	-	3.02	4.02	3.25	3.21	2.82	2.54	2.92	-	-
2009	3.13	-	-	2.48	3.59	3.48	3.15	3.01	3.14	-	-	-
2010	-	-	-	-	3.99	3.76	3.14	-	2.82	-	-	-
2011	-	5.01	-	3.45	2.57	4.11	2.86	2.98	3.37	-	2.93	2.56
2012	2.6	-	2.29	2.56	3.32	3.35	2.73	2.99	2.84	3.49	-	-
2013	-	-	2.99	3.81	3.25	3.24	3.24	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Koluktak Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2004	-	-	-	-	-	-	-	-	3.49	4.19	3.97	-
2005	4.01	3.71	3.24	2.96	4.34	4.09	3.88	2.94	4.06	3.02	-	-
2006	-	-	-	3.24	3.11	3.71	3.45	2.93	2.45	3.16	-	-
2007	-	-	2.98	3.25	3.6	3.66	3.31	2.81	2.91	-	-	-
2008	3.37	-	-	3.32	4.94	3.07	3.5	2.97	2.51	3.41	-	-
2009	-	3.62	-	2.9	3.53	3.82	3.43	3.2	3.31	-	-	-
2010	3.16	4.25	-	2.79	-	-	-	-	2.87	-	-	-
2011	-	-	-	3.34	2.58	4.28	3.03	3.05	3.69	-	3.02	3.55
2012	3.5	-	2.26	3	3.41	3.48	2.71	3.33	3.09	3.63	2.65	2.38
2013	4.41	-	-	3.47	3.74	3.41	3.6	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Koluktak Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2007	-	-	-	-	-	-	-	-	5.43	-	6.01	4.21
2008	4.12	3.06	3.43	4.34	4.92	4.04	4.71	3.61	3.83	4.43	4.73	-
2009	3.81	4.63	4.29	3.89	4.02	5.72	5.1	4.46	4.34	-	-	-
2010	-	-	-	-	5.09	5.67	4.29	4.69	4.29	6.4	5.01	3.32
2011	-	4.98	-	4.13	3.49	5.87	4.7	4.47	4.7	5.49	-	-
2012	4.13	-	3	3.91	4.07	4.75	4.24	4.94	4.51	4.45	3.53	3.51
2013	5.62	-	5.54	3.87	3.89	3.94	4.92	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Piksiksak Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2005	-	-	-	-	-	-	-	-	4.65	3.7	-	-
2006	-	-	-	3.67	4.05	3.79	3.75	3.08	2.81	4.11	-	-
2007	-	-	-	4.07	4.14	4.33	3.61	3.06	3.48	-	-	-
2008	3.51	2.96	-	3.61	5.15	3.17	3.47	3.21	2.91	3.51	-	3.9
2009	3.88	4.89	-	3.85	3.85	4.55	3.88	3.65	3.44	3.64	-	-
2010	3.04	5.28	-	3.67	5.17	4.92	3.51	3.74	3.22	-	-	3.36
2011	-	6.23	2.94	4.12	3.41	4.9	3.49	3.35	3.95	4.11	2.86	3.52
2012	-	-	-	4.02	3.81	4.15	3.19	3.93	3.11	3.57	2.97	-

Source: Urban 2017
"-" = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

South Meade Station: Mean Monthly Wind Speed (meters per second)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2003	-	-	-	-	-	-	-	-	3.94	4.3	3.66	-
2004	-	-	4.54	4.13	5.63	4.53	4.08	3.52	3.65	5.35	5.68	-
2005	4.24	-	5.16	4.18	5.19	5.02	4.56	3.54	5.43	3.72	2.66	2.83
2006	-	-	-	-	-	-	-	-	3.11	4.94	3.45	3.45
2007	-	-	3.52	4.33	3.78	4.79	4.05	3.35	4.42	4.68	-	3.64
2008	-	3.3	-	4.14	5.03	3.59	4.04	3.21	3.23	-	4.43	3.59
2009	3.34	4.72	-	4.07	3.82	4.93	4.28	3.91	3.51	3.66	3.29	-
2010	2.51	5.52	3.65	4.13	5.31	5.27	3.95	4.07	3.43	5.76	-	-
2011	-	5.59	-	3.93	3.53	-	-	-	3.93	4.6	2.91	3.83
2012	3.65	3.43	-	4.05	3.92	4.58	3.43	-	3.4	3.61	2.89	2.85
2013	5.3	-	5.1	3.91	4.47	3.93	4.07	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Awuna 2 Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	3.47	-	4.21	-
2004	2.71	-	3.63	2.95	3.88	3.34	2.83	2.67	4.12	5	3.54	-
2005	-	3.14	3.28	3.51	4.12	-	-	-	3.59	3.17	-	-
2006	-	-	2.94	2.93	3.14	3.85	3.42	2.82	-	-	-	-
2007	-	-	-	-	-	-	-	2.57	2.74	-	-	2.91
2008	-	2.37	2.81	3.59	4.15	2.62	-	-	2.36	3.95	-	4.1
2009	2.75	4.38	3.14	3.45	3.73	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	2.63	4.13	3.75	3.56
2011	-	-	-	-	-	-	-	-	3.66	3.45	2.53	3.07
2012	2.71	-	1.71	2.64	3.2	3.15	2.73	3.48	2.82	3.77	2.33	2.3
2013	3.22	3.13	2.99	3.35	4.07	3.14	3.12	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

Drew Point Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2004	-	-	-	-	-	-	-	-	3.76	5.35	6.07	-
2005	4.43	4.96	5.51	4.23	4.86	4.85	4.33	3.75	6.34	4.26	3.07	3.97
2006	-	-	-	-	4.13	3.62	4.19	3.48	3.65	5.95	4.27	3.86
2007	3.38	4.04	3.63	4.78	3.74	5.31	4.46	3.45	5.23	5.39	6.14	4.28
2008	4.31	2.87	3.66	-	4.73	3.69	4.25	3.37	3.53	4.87	5.06	-
2009	-	4.86	-	4.1	3.95	5.44	4.26	3.96	4.04	4.35	3.71	-
2010	-	-	3.98	4.42	5.17	5.56	3.92	4.36	4.04	6.76	-	-
2011	-	-	3.1	4.17	3.62	5.68	4.37	4.34	4.59	5.66	-	-
2012	-	-	-	4.06	4.15	4.61	3.74	4.26	4.22	4.63	3.54	-
2013	-	-	5.77	-	4.23	3.67	-	3.44	4.46	-	5.31	-
2014	-	-	3.15	3.39	4.73	-	-	4.59	5.22	6.03	4.38	3.79
2015	-	5.03	4.56	4.47	4.27	3.78	4.03	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-3 (continued)
Average Monthly Wind Speed Data

East Teshekpuk Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2005	-	-	-	-	-	-	-	-	6.33	4.16	2.94	-
2006	-	-	-	-	3.74	3.29	4.33	3.67	3.61	5.52	-	3.71
2007	3.93	4.19	3.85	4.56	3.89	5.2	4.49	3.83	4.99	-	5.84	4.16
2008	-	3.21	-	4.34	4.95	3.7	-	-	-	4.28	4.49	-
2009	-	4.15	-	-	4.02	5.47	4.75	4.1	4.14	-	3.89	-
2010	3.71	5.47	3.77	4.17	5.07	5.35	3.52	4.33	4.03	5.83	-	-
2011	-	5.07	-	4.1	3.39	5.49	4.25	4.21	4.6	4.92	-	3.93
2012	4.13	-	-	3.94	4.04	4.3	3.8	4.5	4.27	4.24	3.48	3.41
2013	5.27	4.83	5.36	3.96	3.8	3.53	4.52	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Ikpikpuk Station: Mean Monthly Wind Speed (meters per second)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2006	-	-	-	3.6	3.8	3.9	4.17	3.19	3.17	4.77	2.95	3.58
2007	3.56	3.32	3.49	4.18	3.8	5.09	4.27	3.33	4.46	-	-	3.36
2008	4	2.96	-	3.87	5.12	3.81	-	3.11	3.09	3.75	4.4	-
2009	-	4.31	-	3.64	3.89	5.15	4.45	3.61	3.63	-	3.14	-
2010	-	5.41	3.49	3.83	5.03	5.37	3.94	3.89	3.28	4.96	-	-
2011	-	-	-	-	-	-	-	3.67	4.13	4.47	-	3.86
2012	3.69	3.18	2.54	3.66	3.94	4.61	3.43	3.97	3.56	3.79	3.11	2.92
2013	5.23	-	5.17	3.57	4.02	3.82	4.18	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-4
Average Seasonal Wind Speed Data

Inigok Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	4.25	-
2005	-	4.15	3.93	-	-
2006	-	-	-	-	-
2007	3.34	3.68	3.76	-	3.73
2008	3.33	-	3.48	-	-
2009	3.52	-	4.02	-	-
2010	-	4.01	4	-	-
2011	-	-	3.92	3.81	-
2012	-	-	3.6	3.56	-
2013	3.91	4.21	3.54	-	-
2014	-	-	3.85	-	-

Source: Urban 2017
"-" = Data unavailable

Fish Creek Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	3.83	-
2004	4.3	-	3.33	4.83	4.16
2005	-	4.51	4.22	-	4.31
2006	-	-	3.74	-	-
2007	-	3.95	4.14	-	-
2008	-	4.04	3.63	-	-
2009	-	4.02	4.43	3.86	4.11
2010	-	4.12	4.43	-	-
2011	-	-	4.39	-	-
2012	-	3.49	3.99	3.72	3.47
2013	4	4.34	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-4 (continued)
Average Seasonal Wind Speed Data

Tunalik Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	4.06	-
2004	-	5.63	3.9	5.47	-
2005	-	5.39	4.45	4	4.57
2006	-	-	3.81	4.08	-
2007	-	4.55	3.91	4.35	4.29
2008	-	4.63	3.23	-	3.87
2009	-	-	4.22	3.77	-
2010	-	5.03	4.58	4.83	4.6
2011	4.25	4	4.29	-	4.23
2012	-	4.07	4.06	3.78	3.99
2013	-	4.68	-	-	-

Source: Urban 2017
"-" = Data unavailable

Umiat Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2005	-	-	3.35	-	-
2006	-	1.48	-	-	-
2007	-	3.13	3.12	-	-
2008	-	3.31	3.09	-	-
2009	-	3.16	3.21	-	-
2010	-	-	3.42	-	-
2011	-	-	3.31	3.22	-
2012	-	2.73	3.02	-	-
2013	-	3.35	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-4 (continued)
Average Seasonal Wind Speed Data

Koluktak Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	3.88	-
2005	-	3.52	3.64	-	-
2006	-	-	3.36	-	-
2007	-	3.28	3.26	-	-
2008	-	-	3.18	3.01	-
2009	-	-	3.48	-	-
2010	-	-	-	-	-
2011	-	-	3.44	3.52	-
2012	3.21	2.89	3.17	3.13	3
2013	3.44	3.66	-	-	-

Source: Urban 2017
"-" = Data unavailable

Lake 145 Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2007	-	-	-	5.77	-
2008	3.81	4.23	4.12	4.33	4.1
2009	4.1	4.07	5.09	-	-
2010	-	-	4.88	5.25	-
2011	-	3.53	5.01	-	4.41
2012	-	3.66	4.64	4.17	4.06
2013	4.78	4.44	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-4 (continued)
Average Seasonal Wind Speed Data

Piksiksak Station: Mean Seasonal Wind Speed (meters per second)					
Year	WINTER	SPRING	SUMMER	AUTUMN	ANNUAL
2004	-	-	-	-	-
2005	-	-	-	3.45	-
2006	-	-	3.54	3.3	-
2007	-	-	3.66	-	-
2008	-	-	3.29	3.48	-
2009	4.2	-	4.02	-	-
2010	-	-	4.05	-	-
2011	-	3.48	3.9	3.65	3.8
2012	-	3.54	3.75	3.22	-
2013	-	4.43	-	-	-

Source: Urban 2017
"-" = Data unavailable

South Meade Station: Mean Seasonal Wind Speed (meters per second)					
Year	WINTER	SPRING	SUMMER	AUTUMN	ANNUAL
2003	-	-	-	3.97	-
2004	-	4.78	4.04	4.9	-
2005	-	4.85	4.37	3.93	4.26
2006	-	-	-	3.85	-
2007	-	3.87	4.05	-	-
2008	3.79	-	3.62	3.75	3.86
2009	3.86	-	4.37	3.49	-
2010	-	4.36	4.42	-	-
2011	-	-	-	3.83	-
2012	3.64	-	4.03	3.3	3.56
2013	4.15	4.5	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-4 (continued)
Average Seasonal Wind Speed Data

Awuna 2 Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	3.66	-
2004	-	3.49	2.94	4.23	-
2005	-	3.64	-	-	-
2006	-	3	3.36	-	-
2007	-	-	-	-	-
2008	3.02	3.52	-	2.82	3.13
2009	3.72	3.44	-	-	-
2010	-	-	-	3.51	-
2011	-	-	-	3.21	-
2012	-	2.52	3.12	2.99	2.76
2013	2.88	3.47			

Source: Urban 2017
"-" = Data unavailable

Drew Point Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	5.06	-
2005	-	4.87	4.31	4.55	4.54
2006	-	-	3.77	4.64	-
2007	3.75	4.04	4.41	5.58	4.48
2008	3.84	4.24	3.77	4.49	4.07
2009	-	4.25	4.54	4.04	-
2010	-	4.53	4.6	5.43	-
2011	-	3.62	4.79	-	-
2012	-	-	4.2	4.14	-
2013	-	4.75	-	4.6	-
2014	-	3.77	-	5.22	-
2015	4.35	4.43	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-4 (continued)
Average Seasonal Wind Speed Data

East Teshekpuk Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2005	-	-	-	4.47	-
2006	-	-	3.77	4.36	-
2007	3.93	4.1	4.5	5.5	4.54
2008	-	-	-	-	-
2009	-	-	4.76	4.14	-
2010	-	4.34	4.39	-	4.46
2011	-	-	4.64	4.44	-
2012	-	-	4.2	4	3.9
2013	4.49	4.38	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Ikpikpuk Station: Mean Seasonal Wind Speed (meters per second)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2006	-	-	3.75	3.65	-
2007	3.49	3.82	4.22	-	4.07
2008	3.45	-	3.56	3.75	-
2009	-	-	4.39	3.54	-
2010	-	4.12	4.39	-	-
2011	-	-	-	3.93	-
2012	3.59	3.38	4	3.49	3.54
2013	4.32	4.26	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-5
Average Monthly Precipitation

Inigok Station: Mean Monthly Precipitation (mm)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2005	-	-	-	-	-	-	-	-	2.4	0	0	0
2006	0	0	0	0	0	0	0	4	2.7	2.8	0	0
2007	0	0	0	0	0	2.7	0.5	6.8	2.2	0.1	0	0
2008	0	0	0	0	-	6.3	16.7	6	3.3	0.1	0	0
2009	0	0	0	0	1.1	3.8	4.1	21.4	2.5	5.2	0	0
2010	0	0	0	0	0	1.8	46.7	20.5	1.4	1	0	0
2011	0	0	0	0	0	1.5	22.4	19.1	32.3	0.3	0	0
2012	0	0	0	0	0	0	36.1	35.6	31	1.5	0	0
2013	0	0	0	0	0	1.8	2.8	3.3	-	0	0	0
2014	0	0	-	0	-	-	1.8	2.5	2	0.8	-	-
2015	-	-	-	-	-	-	1.5	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Fish Creek Station: Mean Monthly Precipitation (mm)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2006	-	-	-	-	-	-	-	-	2.3	1.8	0	0
2007	0	0	0	0	0	3.8	0.1	3.3	1.9	0.3	0	0
2008	0	0	0	0	0	5.4	14.2	6.6	4.3	0.1	0	0
2009	0	0	0	0	0	5.2	4	24.3	2.4	1.9	0	0
2010	0	0	0	0	0	0	45.7	16.8	6.3	0.3	0	0
2011	0	0	0	0	0	0.5	15.7	12.7	35.8	0.3	0	0
2012	0	0	0	0	0	1.5	14.7	42.2	25.9	3	0	0
2013	0	0	0	0	0	0.5	0	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Tunalik Station: Mean Monthly Precipitation (mm)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2009	-	-	-	-	-	-	-	-	23.6	4.1	-	-
2010	-	-	-	-	-	-	-	-	1.5	0	0	0
2011	0	0	0	0	0	14.7	35.3	31.2	17	0.5	0	0
2012	0	0	0	0	0	1.5	29	60.7	29.5	2.8	0	0
2013	0	0	0	0	0	27.4	56.1	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-5 (continued)
Average Monthly Precipitation

Koluktak Station: Mean Monthly Precipitation (mm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2012	-	-	-	-	-	-	-	-	39.9	1.3	0	0
2013	0	0	0	0	-	35.3	53.1	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Lake 145 Shore Station: Mean Monthly Precipitation (mm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2007	-	-	-	-	-	-	-	-	4.7	0.5	0	0
2008	0	0	0	0	0	2.5	34.8	11.7	9.7	1.2	0	0
2009	0	0	0	0	0	0.1	7.2	52.8	3.9	3.8	-	-
2010	-	-	-	-	0	0.3	46	3	6.3	0.1	0	0
2011	0	0	0	0	0	1.6	24.1	12.8	24.3	5	0	0
2012	-	-	-	-	-	-	10.3	27.3	26.3	3.5	0	0
2013	0	0	0	0	0	2.2	38.2	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

South Meade River Station: Mean Monthly Precipitation (mm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2007	-	-	-	-	-	-	-	-	15.2	0.3	0	0
2008	0	0	0	0	0	6.3	38.1	11.9	7.1	1.5	0	0
2009	0	0	0	0	0	0	0	68.1	6.9	0.8	0	0
2010	0	0	0	0	0	0.5	0	20.3	6.6	0.3	0	0
2011	0	0	0	0	0	-	-	-	20.8	3.8	0	0
2012	0	0	0	0	0	0.5	1.3	-	38.6	2.8	0	0
2013	0	0	0	0	0	29.5	48.3	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-5 (continued)
Average Monthly Precipitation

Drew Point Station: Mean Monthly Precipitation (mm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2009	-	-	-	-	-	-	-	-	4.8	0.8	0	-
2010	-	-	0	0	0	0	35.8	8.1	4.3	0	0	0
2011	0	0	0	0	0.3	4.1	34.8	19.1	23.4	0	0	0
2012	0	0	0	0	0	0.8	25.1	25.9	29.2	3.3	0	0
2013	0	0	0	0	0	18	43.2	17.8	12.7	0	0	0
2014	0	0	0	0	-	-	21.1	16.8	18.8	2.5	0	0
2015	0	0	0	0	-	-	3.8	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Ikpikpuk River Station: Mean Monthly Precipitation (mm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2005	-	-	-	-	-	-	-	-	0	0	0	0
2006	0	0	0	0	-	6.6	25.4	26.9	4.8	8.1	0	0
2007	0	0	0	0	0	1	1.8	10.4	14.5	0.8	0	0
2008	0	0	0	0	0	9.4	-	18.8	6.9	0.3	0	0
2009	0	0	0	0	0	9.4	12.4	65.8	8.4	1.5	0	0
2010	0	0	0	0	-	0.5	46.5	11.2	3.6	0.3	0	0
2011	0	0	0	0	0	1.5	18.3	16.8	32.5	6.9	0	0
2012	0	0	0	0	0	0.5	13.5	28.4	23.9	2.5	0	0
2013	0	0	0	0	0	9.1	49	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-6
Average Seasonal Precipitation

Inigok Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2005	-	-	-	2.4	-
2006	0	0	4	5.5	9.5
2007	0	0	10	2.3	12.3
2008	0	0.1	29	3.4	32.5
2009	0	1.1	29.3	7.7	38.1
2010	0	0	69	2.4	71.4
2011	0	0	42.9	32.5	75.4
2012	0	0	71.6	32.5	104.1
2013	0	0	-	-	-

Source: Urban 2017
"-" = Data unavailable

Fish Creek Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2006	-	-	-	4.1	-
2007	0	0	7.2	2.2	9.4
2008	0	0	26.2	4.4	30.6
2009	0	0	33.5	4.3	37.8
2010	0	0	62.5	6.6	69.1
2011	0	0	29	36.1	65
2012	0	0	58.4	29	87.4
2013	0	0	-	-	-

Source: Urban 2017
"-" = Data unavailable

Tunalik Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2010	-	-	-	1.5	-
2011	0	0	81.3	17.5	98.8
2012	0	0	91.2	32.3	123.4
2013	0	0	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-6 (continued)
Average Seasonal Precipitation

Koluktak Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2012	-	-	-	41.1	-
2013	0	0	-	-	-

Source: Urban 2017
"-" = Data unavailable

Lake 145 Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2007	-	-	-	5.2	-
2008	0	0	49	10.9	59.9
2009	0	0	60.1	-	-
2010	-	-	49.3	6.4	-
2011	0	0	38.5	29.3	67.8
2012	-	-	-	29.8	-
2013	0	0	-	-	-

Source: Urban 2017
"-" = Data unavailable

South Meade Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2007	-	-	-	15.5	-
2008	0	0	56.4	8.6	65
2009	0	0	68.1	7.6	75.7
2010	0	0	20.8	6.9	27.7
2011	0	0	-	24.6	-
2012	0	0	7.1	41.4	48.5
2013	0	0	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-6 (continued)
Average Seasonal Precipitation

Drew Point Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2010	-	0	43.9	4.3	-
2011	0	0.3	57.9	23.4	81.5
2012	0	0	51.8	32.5	84.3
2013	0	0	79	12.7	91.7
2014	0	-	76.2	21.3	97.5
2015	0	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Ikpikpuk Station: Mean Seasonal Precipitation (mm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2005	-	-	-	0	-
2006	0	0	58.9	13	71.9
2007	0	0	13.2	15.2	28.4
2008	0	0	62.2	7.1	69.3
2009	0	0	87.6	9.9	97.5
2010	0	0	58.2	3.8	62
2011	0	0	36.6	39.4	75.9
2012	0	0	42.4	26.4	68.8
2013	0	0	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-7
Average Monthly Snowfall

Inigok Station: Mean monthly snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	1.5	3.1	12.9	21.5
1999	23.2	23.7	25.9	30.4	30.3	4.1	0.6	2.5	5.2	13.2	17.8	19
2000	28.1	37.7	37.2	40.6	44.9	12.4	0.5	2.3	0.4	7.1	11.4	10.8
2001	20.2	23.3	24.6	26.4	29	-	-	1.3	1.1	12.9	18.9	24.3
2002	25.2	23.4	28.3	29.4	14.2	2.5	2.3	2.6	2.5	3.9	4.1	9.3
2003	8.5	9.1	11.2	18.6	26.9	2.9	2	0.2	-0.1	16	26.5	27.4
2004	30.4	50.6	42.4	54.7	47.6	4.1	7.9	7.2	6.6	10.6	17.5	17.7
2005	16.9	16.8	18.3	23.2	27.6	5.8	2.2	3.2	0.9	7.4	17.3	28.8
2006	30.5	31.5	35.2	38.7	36.2	4.1	1.9	4.5	7.5	5.4	8.9	13.9
2007	21.5	22.1	20.7	22.2	25.1	7.1	4.9	3.8	2.1	4.6	13.4	17.8
2008	24.4	22.7	30.8	32.9	28.4	1.2	5.1	4.1	3.2	15.2	28.9	25.3
2009	22.6	26.8	26	34.4	16.4	2.2	3	6.5	7.7	8.9	13.8	22.9
2010	23.3	25.2	27.6	29	33.8	6.8	3.3	5.1	2.6	8.6	27.9	36
2011	36.6	36.8	36.6	37.6	32.5	2.1	1.2	1.6	1.1	9.4	22.5	26.1
2012	27.9	32.4	35.7	42.1	38	3.4	1.3	2.9	6.2	13.3	26.3	30
2013	29.9	28.9	-	34.8	29.2	5.3	5.1	4	-	16.1	24.1	33
2014	31.3	33.7	32.3	35	15.7	4.1	4.3	4	4.5	15.7	-	-
2015	-	-	-	-	24	4.6	4.4	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Fish Creek Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1998	-	-	-	-	-	-	-	-	4.1	4.6	9.2	11.2
1999	16.2	12	-	17.5	21	4.1	1.6	3.7	3.6	7.3	9.7	-
2000	6	14.3	15.4	20.8	29.2	7.1	3.6	3.7	3.6	8.9	10.6	14.3
2001	15.3	16.4	16.4	-	-	-	-	8.5	6.7	12.5	15.1	16.2
2002	18.8	18.7	25	26.9	19.4	4	4.3	4.3	5.1	7.9	9.6	15.9
2003	13.6	13.1	13.6	17.9	22.2	4.9	3.8	5.4	5.6	7.5	15.3	17.9
2004	22.4	24.8	22.7	27.5	24.9	4.3	5.1	7.5	6.5	10.8	12.7	11.5
2005	14.7	17.1	17.7	18.9	21.6	5.1	4.5	5.2	4.4	6.4	17.1	18.6
2006	17.6	22.9	24.9	30	27.7	6	7.4	10.6	8.5	6.2	13.6	17.5
2007	17.2	18.6	22.9	28.4	30.1	-	-	5.3	4.8	3.3	9.2	13.8
2008	14	26.2	28	38.8	35.1	5.5	4.9	5.6	5	17.3	31.9	28.3
2009	28.4	35.7	39.2	38.8	26.8	4.4	5.6	8.4	8.7	9.1	14.8	22.1
2010	22.4	23.2	24.6	27.2	30.8	8.3	7.2	8.5	9.6	9.7	17.8	25.6
2011	-	-	-	-	-	-	-	6.1	5.7	7.2	15	20.4
2012	27.2	35.9	41.4	35.5	34.8	7.1	5.4	8.2	7.2	9.1	27.2	28.1
2013	25.8	25.2	27.4	39.2	39.4	6.7	9.2	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Tunalik Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1999	-	-	-	-	-	-	-	1.7	1.5	4.6	6.4	3.8
2000	16	43.1	35.9	43.8	44.9	7.2	1.3	2.6	2.4	10.9	17.7	17.9
2001	17.6	17.8	17.8	17.8	21.5	1.9	2.5	2	2.4	8.1	16	17.6
2002	20.9	20.6	18.2	18.2	15.4	5.3	5.5	1.1	2.3	3.3	-	-
2003	-	-	-	-	-	-	-	-	1.4	7.6	9.9	11.2
2004	7.7	6.8	7.1	14.9	5.8	0.4	2.2	1.4	3.2	9.7	12.5	10.9
2005	17.6	18.8	19.6	21.9	21.5	1.1	-0.1	0.7	1.4	2.6	8.5	12.6
2006	17.3	24.2	28.1	29.8	24.4	0.4	0	2.2	-	3.6	8.1	20.6
2007	13.5	6.4	7.8	12.1	15.8	-	1.9	2.3	1.9	3.7	8.6	11.2
2008	13.5	19.9	17.9	24.3	17.3	2.6	2	6.5	3.9	16.9	18.7	20.7
2009	25.4	43.3	47.1	46.6	26.2	5.3	5.9	5.3	4.3	7.8	11.3	20.5
2010	22	27.9	30.5	33.7	32.9	4.6	2.7	7.1	7.4	14	23	30.3
2011	30	38	55.5	57.6	46.5	4.6	10.4	10.5	5.2	1.4	7.8	27.2
2012	31.6	31.7	31.3	42.6	37.5	1.6	9.2	6.5	2.1	3.5	5	4.7
2013	5.1	5.3	5.2	5.5	7.5	3.4	3.1	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Umiat Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2000	-	-	-	-	-	-	-	3.5	2.4	11.9	19.8	24.9
2001	25.3	26	28	43.2	41.9	5.6	5.7	6.3	5	27	-	-
2002	47.6	46.8	52.1	54.4	30.3	3.7	6.5	4.4	4.1	6.9	13.2	17.4
2003	22.5	35	41.3	42.1	35.1	1.9	4.7	8.5	2.2	17	34.2	38.5
2004	50.4	53.2	53.7	59.6	43.2	3.5	9.3	3.7	3.7	6.9	20.3	19.1
2005	24.3	33.8	36.7	41.8	49.5	8.4	4.8	4.9	4.8	7.5	19.1	34.8
2006	23.6	40.1	40.7	43.2	35.3	4.7	5.2	6	5.8	5	14	19.9
2007	26.1	24.7	26.4	29.7	30.5	6.7	6.3	5.4	4.6	5.9	18.2	20.2
2008	22.6	26.9	36.3	41.9	40.6	5.2	6.5	6.9	4.8	22.5	34.1	34.4
2009	36	38.8	43.6	49.6	22.4	5.6	7.2	7.3	9.6	18.2	32.8	39.3
2010	39.1	-	-	51.6	52.2	9.6	8.6	7.5	5.2	10.4	30	43.5
2011	44.6	49.1	46.7	46.3	39.9	5.7	6.5	7.2	3.5	10.6	27.1	40.8
2012	44.3	46.7	53	55.8	46.9	8.9	8.6	4	3.4	13.1	32	35.5
2013	39.1	38.1	39.6	53	55.7	4.1	6.3	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Koluktak Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1999	-	-	-	-	-	-	-	-	13	7.2	10.8	9.6
2000	11	17	17.8	25	28.6	-	-	1.4	1	7.6	9.1	8
2001	7.6	9.8	10	18	16.7	-	-	1.5	1.9	-	-	-
2002	-	-	-	-	-	-	-	4.3	1.9	3.9	6	11.6
2003	20.3	20.5	20.3	27.2	27.2	2.1	2.6	-	-	-	-	-
2004	-	-	-	31.2	17	1.1	0.6	1.1	5.6	18.3	26.3	25.4
2005	24.7	32.1	34.8	36.4	35.7	3.6	2.9	3.1	2.6	3.1	11.2	17.9
2006	18.9	20.8	23.4	23.9	18.8	1.4	1.6	2.1	1.5	1.9	4.6	6.6
2007	8.3	8.5	4.4	13.4	14.7	1.3	1.8	1.3	1.4	4.3	8.3	10.8
2008	14.8	19.5	26.9	29.8	20.5	1.8	3	2.8	2	15.9	32.7	33.8
2009	30.9	32.7	30.8	34.5	13.2	3.6	3.8	4.4	2.2	3.4	3.8	-
2010	27.6	29.2	33.2	33	34.5	-	-	5.3	3.1	9.2	19.5	27.6
2011	27.6	27.6	29.6	28.3	21.3	2.6	5.8	5.6	2.9	10.3	22.2	33.1
2012	40	40.7	48.3	49.8	40	4.7	7.1	4.4	2.5	5.7	11.9	20
2013	25.6	27.9	29.2	38.4	37.9	3.6	7.5	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Lake 145 Station: Mean Monthly Snow depth (cm)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2007	-	-	-	-	-	-	-	-	3.9	5.4	8.6	7.8
2008	9.7	12.6	14.5	15.5	16.2	1.4	2.8	4.7	3.4	9.3	26	27.2
2009	29.7	37.9	-	-	-	-	-	1.3	2.3	4.7	8.4	-
2010	-	-	-	-	46.7	13.6	5.2	3.8	1.2	11.3	23.1	28.9
2011	29.1	29.6	35.2	36.3	38.1	14	-	2.2	2.7	22.5	22.8	43.3
2012	46.3	52	56.4	59.5	63.3	26.9	-	3.8	2.6	11.5	18.3	23.5
2013	31.7	34.3	34.1	38.2	37.4	8.6	4.2	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Piksiksak Station: Mean Monthly Snow depth (cm)												
Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2004	-	-	-	-	-	-	-	-	6.3	7.6	8.9	7
2005	6.9	6.6	6.9	11.3	14.5	2	3.8	4.6	5.2	3.9	5	3
2006	3.5	11.1	11.8	15.4	14.7	4	4.5	5	5.8	4.3	3.9	5.3
2007	6.7	5.5	5.2	6.9	7.7	2.9	4	5.8	8.5	3.5	3.7	7.6
2008	9.1	10.3	12.7	17.2	11	3.6	6.1	10.7	11.2	4.5	8.3	7.7
2009	7.6	7.7	13.3	22.4	10	10.1	10.9	15.6	15.6	11.1	4.4	8.8
2010	11.1	16.7	19.4	20.8	20.7	13.4	10.4	11.6	14.1	8.6	14.7	13.9
2011	24.5	24.3	25.2	23.8	19.1	12.2	7.6	13.7	11.2	8.3	14.7	18.6
2012	18.9	23.7	27.5	28.8	22.6	13.2	16.2	22	17.6	-	-	-
2013	-	25.5	25.9	-	-	16.6	19.8	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

South Meade Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	1.2	6.9	14.8	23.8
2004	29.2	29.8	38.6	40.8	33.1	4.8	3.2	2.1	3.3	9.8	11.1	9.6
2005	11.7	14.9	16.4	21.1	24	7	1.2	10.7	10.1	10.6	14.4	17.8
2006	25	25.3	26.3	33.1	27.4	-	1.1	4.3	5.7	3.9	4.1	7
2007	16.7	19.9	19.9	21.8	25.1	6.2	-	2.7	2.9	3.3	10.6	19.9
2008	19.8	23	22.6	26.5	27.4	-	-	-	2.3	6.5	16.9	13.8
2009	18.7	24.2	20.7	20.3	10	0.5	4	5.2	5.9	6.1	6.4	22.3
2010	22	22.2	32.3	43.9	43.3	13.7	7	5.5	5.3	6.6	13.2	21.8
2011	27.3	27.4	27.1	31.8	25.9	-	-	5.4	6.2	13.3	13	-
2012	-	31.7	-	38.4	43.8	4.4	4.5	7.7	6.2	7.9	10	13.6
2013	23.7	23.6	32.7	34.1	31.4	1.9	6.5	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Awuna 1 Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2000	-	-	-	-	-	-	-	17.1	15.1	12.3	21.7	32.8
2001	39.8	44	46.8	-	-	-	-	2.6	-	-	-	-
2002	-	-	-	-	-	-	-	15.5	6.5	6.9	11.2	24.2
2003	33.6	50.8	61.5	59	57.7	17.5	12.6	11.6	3	11	31.5	41.8
2004	40.9	43.1	47.9	50	-	-	-	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Awuna 2 Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2003	-	-	-	-	-	-	-	-	5	13	23.6	25
2004	27.6	30	36.3	46.2	31.4	1.5	-	1.5	10.4	44.3	56.6	57.7
2005	58.7	63.1	66.5	72.5	76.2	49.8	-	1.4	1.9	10.3	32.6	53.5
2006	53.8	44.3	53.6	60.1	53.7	2.8	4.4	5.1	4.5	-	-	-
2007	-	-	-	-	-	-	1.9	1.2	2.5	16.7	53.5	61.6
2008	69.6	71.3	75.8	82.5	82.7	15.5	4	4.6	2.8	12.8	19	25.2
2009	32.2	45	44	51.1	32.9	9	9.7	7.5	-	-	-	-
2010	-	-	-	-	-	-	-	5.8	2.7	11.1	27.9	34.1
2011	37.2	45	-	-	-	-	-	14.9	14.6	13.2	10.3	16.8
2012	24.5	40.8	39.8	39.8	28.6	4.1	7	20.5	22.5	16.6	14.8	14.4
2013	21.1	24.4	26.9	36	35.4	9.7	15.9	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

Drew Point Station: Mean Monthly Snow depth (cm)												
Year	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
2000	-	-	-	-	-	-	-	5.4	5.8	9.8	20.2	38.1
2001	41.8	41.8	42	41.2	41.6	11.5	1.8	-0.9	-	-	-	-
2002	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	1	0.9	4.5	14.9	19.2
2004	23.1	39.2	46.7	45.7	42.3	9.9	3.8	7	3.7	3.4	5.5	10.5
2005	20.5	23.2	23.1	24.8	24.4	7.8	1.3	9.4	8.4	5.5	9.3	13.1
2006	14.1	19.5	20.3	26.4	28.4	5.9	5	6.3	3.7	2.4	8	10.3
2007	10.3	10	13.8	16.6	18.9	3.3	3.6	4.6	4	4	12.5	14.1
2008	12.6	16.5	17.2	19	35.2	9.3	7	5.9	4.4	13.5	20	18.9
2009	18.3	21.7	18.7	24.4	16	3.1	2.8	2.8	1.7	2.4	7.9	-
2010	-	27.1	36.5	45.4	47.9	-	-	3.6	2.5	14.7	22.1	21.1
2011	34.7	35.6	-	-	-	-	-	6	3.4	15.7	18.9	22.9
2012	25.2	46.8	50.4	54.6	50.1	10	0.8	2.9	3.2	5.8	17.2	17.6
2013	19.6	21.8	21.9	28.6	26.2	2.2	2	3.7	5.2	14.2	17.4	22.5
2014	32.4	28.6	29.8	32.7	18.1	2.7	2.3	3.3	2.9	9.1	11.9	-
2015	-	-	-	-	20.5	2.6	5.3	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-7 (continued)
Average Monthly Snowfall

East Teshekpuk Lake Station: Mean Monthly Snow depth (cm)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2004	-	-	-	-	-	-	-	-	2.7	7.7	10.8	9.5
2005	9.9	12.4	13.2	23.5	28.7	6.2	3.4	7.6	6.6	10.3	15	19.8
2006	24.6	28.4	29.2	33.4	33.8	6.3	3.3	9.4	9	8.9	14	17.1
2007	15.6	17.9	18.3	25.3	28.6	10.3	6.9	3.1	2.2	3.7	11.3	16
2008	14.8	18.5	20.1	21.9	19.8	14.8	11.4	8.6	8.4	23	37.9	37.5
2009	40.9	48.8	47	51.7	40.2	6.3	3.4	3.5	4.6	6.8	8.8	17.3
2010	20.1	19.5	25.3	34.4	35.9	8.9	4.3	11.2	11.4	14.2	25.8	29.4
2011	31.5	34.2	37.2	45	48.1	14.5	-	9.3	8.4	20.7	30	31.1
2012	39	41.6	46.2	44.9	46.3	12.9	10.2	8.4	7.3	13.3	30.1	30.2
2013	29.9	30.2	30.6	36.9	37.3	7	4	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Ikpikpuk Station: Mean Monthly Snow depth (cm)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2005	-	-	-	-	-	-	-	-	2.6	5.2	9.4	18.8
2006	21.4	25.3	39.1	42.8	39.3	9.1	6.8	6.6	6.1	4.9	6.7	12.9
2007	11.6	15.7	16.5	22.5	31.7	12.2	-	4.6	-	6.3	22.7	23.3
2008	26.3	27.1	-	29.8	22.9	3.5	5.9	8.9	8.4	19.7	34.5	29.8
2009	28.4	41.4	56.1	57	41.7	6	6.2	8.4	11.2	-	-	-
2010	-	-	-	-	-	-	-	3.2	2.5	6.8	18	23.2
2011	23.8	26.8	-	50.3	45.1	5.2	3.5	4.5	5.8	13.9	16.8	18
2012	27.1	40.6	40	40.7	43.3	8.4	4.6	5.2	5.2	10.2	18.8	21.8
2013	19.8	20.8	23	35.8	30.3	6.5	3.6	-	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-8
Average Seasonal Snowfall

Inigok Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	5.3	-
1999	22.8	28.8	2.4	12.5	17.4
2000	29.7	40.9	6.5	6.3	20.7
2001	17.8	26.6	1.3	11	18.1
2002	24.3	23.9	2.5	3.5	12.2
2003	8.9	18.8	2.3	18	15.1
2004	35.5	48.2	6.4	11.6	24.8
2005	17.1	23	3.3	8.7	12.8
2006	30.2	36.7	3.5	7.3	18.3
2007	19	22.7	5.3	6.6	14.3
2008	21.6	30.8	3.5	15.8	18.4
2009	24.8	25.8	3.9	10.1	15.9
2010	23.8	30.2	5	13	19.3
2011	36.5	35.5	1.6	11.1	20.2
2012	28.8	38.6	2.5	15.6	21.6
2013	29.3	30.4	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-8 (continued)
Average Seasonal Snowfall

Fish Creek Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1998	-	-	-	6	-
1999	13.2	19.5	3	6.4	9.7
2000	11.5	21.9	4.7	7.6	11.7
2001	15.3	16.4	8.5	11.4	13.3
2002	17.9	23.7	4.2	7.5	13.3
2003	14.3	17.8	4.6	9.5	11.8
2004	21.7	25	5.6	10	15
2005	14.3	19.4	5.1	9.4	11
2006	19.6	27.6	8	9.1	16.2
2007	17.8	25.9	5.4	5.7	13.6
2008	17.6	34.2	5.3	18	20.1
2009	30.6	34.9	6.2	10.8	20.1
2010	22.6	27.6	8	11.7	17.5
2011	-	-	6.1	9.3	11.6
2012	27.7	37.3	6.9	14.5	22.4
2013	26.4	34.9	-	-	-

Source: Urban 2017
"-" = Data unavailable

Tunalik Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1999	-	-	-	4.1	4
2000	20.6	41.7	3.7	10.2	20.3
2001	17.8	19.1	2.1	8.7	11.8
2002	19.6	17.3	4	2.5	11.4
2003	-	-	-	7.4	8.3
2004	8.6	9.2	1.3	9.2	7
2005	15.7	20.9	0.6	5.3	8.9
2006	17.9	27.5	0.7	5.9	16.3
2007	13.8	11.6	2.1	4.7	7.8
2008	14.7	19.7	3.6	15.1	14.1
2009	29.1	39.7	5.5	7.6	20.6
2010	23.3	32.3	4.8	14.8	19.6
2011	32.6	53	8.1	6	28.3
2012	30.1	37.1	6.7	3.6	19.6
2013	5	5.9	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-8 (continued)
Average Seasonal Snowfall

Umiat Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2000	-	-	3.5	11.3	13.2
2001	25.4	37.7	5.8	14.7	21.6
2002	47	45.4	4.9	8.2	23.7
2003	24.9	39.4	4.7	17.8	24.2
2004	47.1	52.1	5.5	10.4	27.3
2005	25.6	42.2	5.4	10.4	16.4
2006	35.9	39.7	5.3	8.2	21.7
2007	23.5	28.9	6.1	9.5	17
2008	23.1	39.5	6.2	20.4	23.4
2009	36.3	38.6	6.7	20.1	25.6
2010	39.2	52.1	8.6	10.3	23.3
2011	45.5	44.3	6.4	15.9	29.1
2012	43.9	52.1	6.9	16	28.8
2013	37.5	48.9	-	-	-

Source: Urban 2017
"-" = Data unavailable

Koluktak Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
1999	-	-	-	10.2	-
2000	12.6	21.9	3.7	5.9	11.8
2001	8.5	14.4	1.5	1.9	9.3
2002	-	-	4.3	4	5.6
2003	17.2	24.8	2.4	-	16.8
2004	-	22.1	0.9	17.3	13.9
2005	27.3	35.6	3.1	6	10
2006	19.2	22	1.7	2.7	10.4
2007	7.8	10.8	1.5	4.6	6.5
2008	14.9	25.7	2.5	16.8	16.9
2009	32.5	25.9	3.9	2.7	17.3
2010	28.5	33.3	5.3	10.6	20.6
2011	27.6	26.4	4.7	11.8	17.8
2012	37.9	46	5.4	6.7	22.4
2013	24.3	35.1	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-8 (continued)
Average Seasonal Snowfall

Lake 145 Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2007	-	-	-	5.9	-
2008	10	15.4	3	12.5	11.9
2009	30.7	-	1.3	3.9	13.7
2010	-	46.2	7.1	12.7	17.5
2011	29.2	36.4	5.2	16.6	26.5
2012	46.9	60.2	9.7	11.8	32.9
2013	29.8	36.5	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Piksiksak Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	7.6	-
2005	6.8	10.9	4.3	4.7	4.6
2006	5.6	14	4.5	4.7	7.4
2007	5.8	6.6	4.3	5.2	5.7
2008	9	13.6	6.8	8	9.4
2009	7.7	15.1	12.5	10	11.5
2010	12.2	20.3	11.7	12.4	14.6
2011	20.8	22.8	10.9	11.5	17.6
2012	20.2	27	17.5	-	21.7
2013	25.4	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-8 (continued)
Average Seasonal Snowfall

South Meade Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	8.9	-
2004	27.7	37.4	3.4	8.2	18.4
2005	11.9	20.4	9.6	11.7	12.8
2006	22.6	28.9	3.3	4.4	17
2007	14.7	22.3	3.6	5.6	14.2
2008	20.9	25.5	-	10.7	18.9
2009	18.7	17.4	3.6	6.1	12.2
2010	22.2	39.9	8.7	8.4	19.7
2011	25.5	28.3	5.4	10.5	21.1
2012	-	-	5.9	8.1	12.2
2013	20.1	32.7	-	-	-

Source: Urban 2017
"-" = Data unavailable

Awuna 1 Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2000	-	-	17.1	16.3	20.2
2001	38.7	46.6	2.6	-	34.3
2002	-	-	15.5	8.2	12.7
2003	35.4	59.4	13.9	15	32.7
2004	41.9	-	-	-	-

Source: Urban 2017
"-" = Data unavailable

Awuna 2 Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2003	-	-	-	13.9	-
2004	27.5	38	1.5	37.4	35.6
2005	59.7	71.7	3.8	15.1	25.8
2006	50.8	55.8	4.1	4.5	35.2
2007	-	-	1.3	24.5	27.9
2008	67.4	80.4	8.4	11.6	39.7
2009	33.3	42.5	8.7	-	28.4
2010	-	-	5.8	13.8	16.6
2011	38.1	-	14.9	12.8	21
2012	27.3	35.8	10.5	17.9	22.5
2013	19.7	32.8	-	-	-

Source: Urban 2017
"-" = Data unavailable

Table J-8 (continued)
Average Seasonal Snowfall

Drew Point Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2000	-	-	5.4	11.6	17
2001	40.5	41.6	6	-	31.7
2002	-	-	-	-	-
2003	-	-	1	6.7	8.5
2004	26.5	44.9	6.9	4.3	21.5
2005	18.2	24.1	8.7	7.7	10.1
2006	15.4	25	5.7	4.6	12.4
2007	10.2	16.4	3.9	6.8	9.6
2008	14.4	23.7	7.3	12.7	15
2009	19.5	19.6	2.9	4	10.8
2010	-	43.1	5	13	25
2011	30.3	-	6	12.7	19.4
2012	31.5	51.7	4.8	8.8	24.3
2013	19.6	25.5	2.7	12.3	15.4
2014	27.9	26.8	2.8	7.9	15.9
2015	-	-	-	-	-

Source: Urban 2017
“-“ = Data unavailable

East Teshekpuk Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2004	-	-	-	7.1	-
2005	10.5	21.9	7.1	10.6	12.2
2006	24.1	32.1	6.3	10.6	18.7
2007	16.8	23.4	6.5	5.7	12.7
2008	16.4	20.6	11.5	23.2	19.8
2009	42	46.6	4.5	6.7	24.1
2010	18.9	31.8	8.1	17.2	20
2011	31.6	43.1	10.8	19.7	28.5
2012	36.7	45.8	10.4	16.7	27.2
2013	30.1	34.9	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-8 (continued)
Average Seasonal Snowfall

Ikpikpuk Station: Mean Seasonal Snow depth (cm)					
Year	**WINTER**	**SPRING**	**SUMMER**	**AUTUMN**	**ANNUAL**
2005	-	-	-	5.8	-
2006	21.7	40.4	7.7	5.9	19
2007	13.4	23.5	7.1	15.1	17.6
2008	24.9	26.4	5.9	21	19.6
2009	33	53.3	7	-	35.4
2010	-	-	3.2	9.1	10.9
2011	24.6	46.6	4.4	12.2	18.3
2012	28.2	41.4	6.1	11.4	22.2
2013	20.8	29.7	-	-	-

Source: Urban 2017
“-“ = Data unavailable

Table J-9
Summary of Drainage Basins and Streams of the Planning Area

Stream Location	Headwaters	Receiving Waters	Drainage Area at Gage (mi^2)	Peak Flow (cfs[1])	Period of Record
Colville River (near Nuisqut)	Brooks Range, Foothills	Harrison Bay	8,070	200,000	1977
Colville River (at Umiat)	Brooks Range, Foothills	Harrison Bay	13,860	268,000	2002–18
Otuk Creek (at Ivotuk)	Brooks Range	Upper Colville, Harrison Bay	56	1,740	2000, 2003–07
Ikpikpuk River below Fry Creek	Foothills	Smith Bay	1,697	28,800	2005–09
Prince Creek (near Umiat)	Foothills	Upper Colville, Harrison Bay	222	6,629	2009
Seabee Creek (at Umiat)	Foothills	Upper Colville, Harrison Bay	23	550	2007
Meade River (near Atqasuk)	Foothills, Coastal Plain	Admiralty Bay	1,790	55,400	1977, 2005–18
Nunavak Creek (at Utqiagvik)	Coastal Plain	Chukchi Sea	2.9	131	1971–2004
Miguakikak River	Teshekpuk Lake, Coastal Plain	Smith Bay	1460	1600	1977
Fish Creek (mile 32)	Coastal Plain	Harrison Bay	791	3240	2004–09
Awuna River (1)	Foothills	Upper Colville, Harrison Bay	907	28,000	2001
Awuna River (2)	Foothills	Harrison Bay	1,515	33,500	2001
Upper Fish Creek	Coastal Plain	Harrison Bay	806	5333	2001–17
Judy Creek	Foothills, Coastal Plain	Harrison Bay	620	8687	2001–17
Ublutuoch River	Coastal Plain	Harrison Bay	128	3108	2001–17
Ikpikpuk River	Foothills, Coastal Plain	Smith Bay	1695	38634	2001–17

Sources: USGS 2019; Hinzman 2007; and Childers et al. 1979
[1]Cubic feet per second
[2]square miles; Peak flow due to snowmelt, hurricanes, ice jams, or debris

Table J-9 (continued)
Summary of Drainage Basins and Streams of the Planning Area

Stream Location	Headwaters	Receiving Waters	Drainage Area at Gage (mi^2)	Peak Flow (cfs[1])	Period of Record
Hannahbear Creek (near Ingiok)	Coastal Plain	South Fork Fish Creek, Harrison Bay	9	212	2012–16
Redworm Creek	Coastal Plain	Harrison Bay	25	210	2012–15
Bill's Creek (near Nuiqsut)	Coastal Plain	Harrison Bay	9	88	2009–14
Oil Creek	Coastal Plain	Ublutuoch River, Harrison Bay	9	102	2009–10, 2012–17
Crea Creek	Coastal Plain	Harrison Bay	11	141	2009–17
Blackfish Creek	Coastal Plain	Harrison Bay	9	210	2009–17
Utukok River	Mountains	Kasegaluk Lagoon	2,765	62,000	
Etivluk River	Mountains	Colville River, Harrison Bay	2,264	45,100	1976–1977
Ublutuoch River (Mile 13.7)	Coastal Plain	Harrison Bay	186	1,600	2004–09

Sources: USGS 2019; Hinzman 2007; and Childers et al. 1979
[1]Cubic feet per second
[2]square miles; Peak flow due to snowmelt, hurricanes, ice jams, or debris

Table J-10
Surface Water Discharge Summary Data

Ikpikpuk River (below Fry Creek, near Alaktak) Annual Discharge Summary in Cubic Feet per Second							
Year	**Mean**	**Seven-Day Low Flow**	**Instantaneous Peak Flow (IPF)**	**IPF Date**	**Total Runoff (Acre-Feet)**	**Average Runoff (CFSM)[4]**	**Total Runoff (Inches)**
2004–05	811	0.0	23,000[1,2,3]	6/7/2005	587,100	0.48	6.49
2005–06	664	0.0	22,000[3]	5/30/2006	481,000	0.392	5.32
2006–07	406	0.0	28,800[3]	6/5/2007	294,000	0.239	3.25
2007–08	616	0.0	21,500[3]	5/29/2008	225,327	0.363	4.94
2008–09	997	0.0	25,600[3]	5/24/2009	722,065	0.588	7.98

Source: USGS 2019
[1]Discharge is a maximum daily average
[2]Discharge is an estimate
[3]Discharge is due to snowmelt, ice jams, or debris jams
[4]Cubic feet per second per square mile

Table J-10 (continued)
Surface Water Discharge Summary Data

Colville River (at Umiat) Annual Discharge Summary in Cubic Feet per Second							
Year	**Mean**	**Seven-Day Low Flow**	**Instantaneous Peak Flow (IPF)**	**IPF Date**	**Total Runoff (Acre-Feet)**	**Average Runoff (CFSM)[1]**	**Total Runoff (Inches)**
2002	-	-	212,000	5/26/2002	-	-	-
2002–03	-	-	213,000	6/10/2003	-	-	-
2003–04	-	-	222,000	5/24/2004	-	-	-
2004–05	-	-	161,000	6/8/2005	-	-	-
2005–06	10,270	0.0	159,000	5/30/2006	7,437,000	0.743	10.09
2006–07	7,933	0.0	180,000	6/5/2007	5,743,000	0.574	7.79
2007–08	7,530	0.0	98,000	5/28/2008	5,467,000	0.544	7.41
2008–09	10,360	0.0	135,000	6/7/2009	7,503,000	0.749	10.17
2009–10	8,400	0.5	186,000	6/1/2010	6,081,000	0.607	8.25
2010–11	9,144	0.3	230,000	5/29/2011	6,620,000	0.661	8.98
2011–12	10,000	0.5	164,000	6/2/2012	7,261,000	0.723	9.85
2012–13	10,510	1.0	239,000	6/4/2013	7,611,000	0.76	10.32
2013–14	13,660	6.0	195,000	6/4/2014	9,891,180	0.986	13.4
2014–15	10,370	12.0	268,000	5/21/2015	7,509,268	0.749	10.2
2015–16	11,650	2.5	193,000	5/25/2016	8,459,795	0.841	11.4
2016–17	9,965	1.0	82,000	8/19/2017	7,213,660	0.719	9.76
2017–18	12,320	6.0	108,000	6/1/2018	8,921,158	0.889	12.1

Source: USGS 2019
[1]Cubic feet per second per square mile
“-“ = Data unavailable

Table J-10 (continued)
Surface Water Discharge Summary Data

Meade River (at Atkasuk) Annual Discharge Summary in Cubic Feet per Second							
Year	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff (Acre-Feet)	Average Runoff (CFSM)[4]	Total Runoff (Inches)
2005–06	1,045	0.0	28,000	8/2/2006	756,500	0.586	7.96
2006–07	580	0.0	43,200	6/6/2007	419,700	0.325	4.42
2007–08	643	0.0	19,000[1,2,3]	5/30/2008	46,650	0.36	4.91
2008–09	753	0.0	19,000[1,2,3]	5/26/2009	545,200	0.422	5.73
2009–10	344	0.0	20,000[1,2,3]	6/9/2010	248,900	0.193	2.62
2010–11	627	0.0	34,400[3]	5/30/2011	453,800	0.352	4.77
2011–12	660	0.0	22,300[3]	6/2/2012	479,400	0.37	5.04
2012–13	948	0.0	29,500[3]	6/4/2013	686,000	0.531	7.22
2013–14	790	0.0	25,700[3]	6/6/2014	571,602	0.441	5.99
2014–15	855	0.0	55,400[3]	5/22/2015	618,737	0.477	6.48
2015–16	496	0.0	13,000	5/24/2016	359,874	0.277	3.77
2016–17	524	0.0	10,300[3]	6/5/2017	379,448	0.293	3.98
2017–18	802	0.0	9,680	6/8/2018	580,310	0.448	6.08

Source: USGS 2019
[1]Discharge is a maximum daily average
[2]Discharge is an estimate
[3]Discharge is due to snowmelt, ice jams, or debris jams
[4]Cubic feet per second per square mile

Table J-10 (continued)
Surface Water Discharge Summary Data

Nunavak Creek (near Utqiagvik) Annual Discharge Summary in Cubic Feet per Second							
Year	**Mean**	**Seven-Day Low Flow**	**Instantaneous Peak Flow (IPF)**	**IPF Date**	**Total Runoff (Acre-Feet)**	**Average Runoff (CFSM)[3]**	**Total Runoff (Inches)**
1984–85	1.00	0.0	22	6/4/1985	-	-	-
1984–86	1.48	0.0	31	6/22/1986	-	-	-
1984–87	1.12	0.0	117	6/20/1987	-	-	-
1984–88	1.79	0.0	79	6/20/1988	-	-	-
1984–89	2.26	0.0	96	6/6/1989	-	-	-
1984–90	0.74	0.0	28	5/27/1990	-	-	-
1984–91	0.73	0.0	25	6/17/1991	-	-	-
1984–92	0.26	0.0	16	6/10/1992	-	-	-
1984–93	1.09	0.0	93	9/19/1993	-	-	-
1984–94	2.17	0.0	115	6/14/1994	-	-	-
1984–95	1.29	0.0	98	6/11/1995	-	-	-
1984–96	0.519	0.0	32	5/31/1996	-	-	-
1984–97	1.03	0.0	24	6/15/1997	-	-	-
1984–98	0.867	0.0	25[1]	6/2/1998	-	-	-
1984–99	1.86	0.0	98	6/13/1999	-	-	-
1984–00	1.38	0.0	68	6/15/2000	-	-	-
1984–01	1.12	0.0	84	6/14/2001	-	-	-
1984–02	0.762	0.0	19	5/25/2002	-	-	-
1984–03	0.692	0.0	25[1,2]	6/9/2003	-	-	-
1984–04	2.46	0	55	6/9/2004	-	-	-

Source: USGS 2019
[1]Discharge is a maximum daily average
[2]Discharge is an estimate
[3]Cubic feet per second per square mile
"-" = Data unavailable

Table J-10 (continued)
Surface Water Discharge Summary Data

Esatkuat Creek (near Utqiagvik) Annual Discharge Summary in Cubic Feet per Second

Year	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff (Acre-Feet)	Average Runoff (CFSM)[3]	Total Runoff (Inches)
1971–72	-	-	67	6/13/1972	-	-	-
1972–73	0.85	-	49[2]	6/11/1973	-	-	-

Source: USGS 2019
[2]Discharge is an estimate
[3]Cubic feet per second per square mile
"-" = Data unavailable

Esatkuat Creek (outlet near Utqiagvik) Annual Discharge Summary in Cubic Feet per Second

Year	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff (Acre-Feet)	Average Runoff (CFSM)[1]	Total Runoff (Inches)
1971–72	-	-	86	6/15/1972	-	-	-
1972–73	1.57	-	101	6/12/1973	-	-	-

Source: USGS 2019
[1]Cubic feet per second per square mile
"-" = Data unavailable

Fish Creek (near Nuiqsut) Annual Discharge Summary in Cubic Feet Per Second

Year	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff (Acre-Feet)	Average Runoff (CFSM)[2]	Total Runoff (Inches)
2004–05	228	-	2,830[1]	6/18/2005	-	-	-
2005–06	235	0.0	3,150[1]	6/12/2006	170,500	0.299	4.06
2006–07	122	0.0	2,180[1]	6/9/2007	88,220	0.155	2.1
2007–08	114	0.0	2,110[1]	6/6/2008	82,728	0.145	1.97
2008–09	244	0.0	3,240[1]	6/3/2009	176,500	0.31	4.2

Source: USGS 2019
[1]Discharge is due to snowmelt, ice jams, or debris jams
[2]Cubic feet per second per square mile
"-" = Data unavailable

Table J-10 (continued)
Surface Water Discharge Summary Data

Judy Creek (near Nuiqsut) Annual Discharge Summary in Cubic Feet per Second							
Year	**Mean**	**Seven-Day Low Flow**	**Instantaneous Peak Flow (IPF)**	**IPF Date**	**Total Runoff (Acre-Feet)**	**Average Runoff (CFSM)[4]**	**Total Runoff (Inches)**
2004–05	174	0.0	5,390[1,2]	6/9/2005	-	-	-
2005–06	161	0.0	3,950	6/7/2006	116,500	0.252	3.42
2006–07	85	0.0	5,180	6/5/2007	61,740	0.133	1.81
2007–08	110	0.0	3,880[3]	5/29/2008	80,050	0.173	2.35
2008–09	141	0.0	2,600[1,2,3]	6/2/2009	102,400	0.221	3.01

Source: USGS 2019
[1]Discharge is a maximum daily average
[2]Discharge is an estimate
[3]Discharge is due to snowmelt, ice jams, or debris jams
[4]Cubic feet per second per square mile
"-" = Data unavailable

Ublutuoch River (near Nuiqsut) Annual Discharge Summary in Cubic Feet per Second							
Year	**Mean**	**Seven-Day Low Flow**	**Instantaneous Peak Flow (IPF)**	**IPF Date**	**Total Runoff (Acre-Feet)**	**Average Runoff (CFSM)[4]**	**Total Runoff (Inches)**
2006–07	26	0.0	1,500[1,2,3]	6/5/2007	18,760	-	-
2007–08	30	0.0	950[1,2,3]	5/29/2008	21,830	-	-
2008–09	66	0.0	1,600[1,2,3]	6/2/2009	47,760	-	-

Source: USGS 2019
[1]Discharge is a maximum daily average
[2]Discharge is an estimate
[3]Discharge is due to snowmelt, ice jams, or debris jams
[4]Cubic feet per second per square mile
"-" = Data unavailable

Table J-11
Surface Water Discharge Monthly Data

Upper Fish Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2000–01	-	-	-	-	-	-	0	0	0	42	99	0	20	36	12	12	13	10	3	12	0
2001–02	0	0	0	0	0	0	23	101	0	32	58	20	15	22	8	7	8	6	2	8	0
2002–03	0	0	0	0	0	0	0	0	0	46	96	0	18	24	13	11	13	10	10	11	8
2003–04	5	9	2	1	2	0	0	0	0	65	123	0	21	36	12	9	12	8	8	10	4
2004–05	6	8	3	1	3	0	0	0	0	42	76	0	21	34	12	8	11	6	5	6	4
2005–06	1	3	0	0	0	0	1	15	0	47	89	12	16	25	11	8	10	7	6	7	5
2006–07	4	5	2	1	2	0	0	1	0	28	60	2	7	14	3	2	3	1	1	1	1
2007–08	0	1	0	0	0	0	3	20	0	26	62	12	6	11	4	3	4	2	2	3	1
2008–09	0	1	0	0	0	0	12	64	0	48	90	20	11	19	6	5	6	5	6	7	3
2009–10	2	4	1	0	0	0	0	0	0	49	102	0	15	25	12	9	13	7	5	7	4
2010–11	2	4	1	0	0	0	1	27	0	45	72	22	12	21	8	6	8	4	5	8	4
2011–12	3	6	2	1	2	0	0	3	0	50	98	3	13	23	8	7	8	6	7	9	6

Table J-11 (continued)
Surface Water Discharge Monthly Data

Upper Fish Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2012–13	5	9	2	1	2	0	0	1	0	74	151	2	23	42	14	12	14	11	11	14	8
2013–14	8	12	3	1	3	0	21	63	0	57	93	35	25	43	15	10	14	7	8	13	6
2014–15	5	13	2	1	2	0	40	128	0	46	89	22	11	21	6	6	6	5	5	6	3
2015–16	2	3	1	1	1	0	9	57	0	31	55	19	11	18	5	7	16	3	15	22	12
2016–17	10	20	3	1	3	0	3	33	0	44	77	23	14	21	10	18	24	10	24	28	19
2017–18	23	29	15	7	16	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Kemnitz 2018
"-" = Data unavailable

Table J-11 (continued)
Surface Water Discharge Monthly Data

Judy Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2000–01	-	-	-	-	-	-	0	0	0	41	125	0	5	9	3	5	15	2	1	6	0
2001–02	0	0	0	0	0	0	36	202	0	14	25	10	8	17	4	5	8	3	1	5	0
2002–03	0	0	0	0	0	0	0	1	0	37	127	8	9	20	5	5	5	4	6	10	3
2003–04	2	3	0	0	0	0	14	91	0	51	126	13	7	12	4	4	8	4	6	13	3
2004–05	1	2	0	0	0	0	0	0	0	49	124	0	8	14	2	2	3	2	2	2	1
2005–06	0	1	0	0	0	0	3	57	0	44	107	9	5	8	3	4	8	2	2	4	2
2006–07	1	2	1	0	0	0	0	1	0	25	119	1	2	5	1	1	1	0	0	0	0
2007–08	0	0	0	0	0	0	9	97	0	22	56	6	3	6	2	2	2	1	1	1	1
2008–09	0	1	0	0	0	0	14	61	0	26	61	6	3	5	2	3	5	2	5	9	2
2009–10	1	2	0	0	0	0	0	0	0	49	246	0	4	7	3	6	15	3	3	4	2
2010–11	1	2	0	0	0	0	7	153	0	42	144	9	5	8	3	2	3	2	4	10	2
2011–12	2	4	0	0	0	0	2	22	0	51	179	8	4	8	2	2	3	2	5	10	2
2012–13	2	6	1	0	0	0	0	4	0	72	174	15	7	14	5	5	7	4	5	6	4
2013–14	3	4	1	0	1	0	30	96	0	42	106	20	9	20	6	4	5	3	5	9	3
2014–15	2	4	1	0	1	0	36	167	0	18	42	7	4	6	2	3	3	2	3	6	1
2015–16	0	1	0	0	0	0	28	97	0	16	32	9	3	8	1	4	16	1	10	21	7
2016–17	9	19	3	1	3	0	5	67	0	44	113	11	4	10	2	14	31	2	21	29	16
2017–18	17	40	6	2	6	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Kemnitz 2018
“-“ = Data unavailable

Table J-11 (continued)
Surface Water Discharge Monthly Data

Ublutuoch Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2000–01	-	-	-	-	-	-	0	0	0	12	53	0	1	3	1	1	2	1	0	1	0
2001–02	0	0	0	0	0	0	11	52	0	4	12	2	2	6	1	1	1	0	0	1	0
2002–03	0	0	0	0	0	0	0	0	0	11	44	0	3	6	2	2	3	1	1	2	1
2003–04	0	1	0	0	0	0	0	0	0	23	66	1	2	4	1	1	1	0	1	1	0
2004–05	0	0	0	0	0	0	0	0	0	13	43	0	2	4	1	0	1	0	0	0	0
2005–06	0	0	0	0	0	0	0	0	0	12	35	0	1	2	1	1	1	0	0	1	0
2006–07	0	0	0	0	0	0	0	0	0	8	39	0	1	2	0	0	0	0	0	0	0
2007–08	0	0	0	0	0	0	3	26	0	6	20	1	0	1	0	0	0	0	0	0	0
2008–09	0	0	0	0	0	0	7	47	0	13	45	2	1	2	0	0	1	0	1	1	1
2009–10	0	1	0	0	0	0	0	0	0	17	89	0	2	3	1	2	2	1	1	1	0
2010–11	0	0	0	0	0	0	0	9	0	18	54	2	1	2	0	0	0	0	0	1	0
2011–12	0	0	0	0	0	0	0	0	0	15	60	1	1	3	0	0	0	0	0	1	0
2012–13	0	1	0	0	0	0	0	0	0	24	68	0	2	4	1	1	1	0	1	1	1
2013–14	0	1	0	0	0	0	10	34	0	12	30	5	2	5	1	1	1	0	1	1	1
2014–15	1	2	0	0	0	0	12	63	0	6	15	1	1	1	0	0	1	0	0	1	0
2015–16	0	0	0	0	0	0	5	25	0	5	9	2	1	2	0	1	2	0	3	7	1
2016–17	2	5	1	0	1	0	3	38	0	10	37	1	1	1	0	2	5	0	6	8	4
2017–18	4	5	2	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Kemnitz 2018
"-" = Data unavailable

Table J-11 (continued)
Surface Water Discharge Monthly Data

Ikpikpuk Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2001–02	-	-	-	-	-	-	-	-	-	61	171	26	35	235	3	13	53	2	32	49	17
2002–03	13	32	1	0	1	0	5	61	0	161	714	6	41	275	7	25	59	8	38	106	7
2003–04	2	5	0	0	0	0	160	751	0	71	364	14	12	27	5	49	248	6	53	280	7
2004–05	4	6	1	0	1	0	1	14	0	254	653	13	16	113	1	1	1	0	1	1	0
2005–06	0	0	0	0	0	0	44	655	0	92	279	7	18	49	5	66	181	16	11	19	7
2006–07	4	11	0	0	0	0	0	3	0	130	750	7	4	34	0	0	0	0	0	0	0
2007–08	0	0	0	0	0	0	70	588	0	105	301	18	18	51	4	16	52	5	3	5	1
2008–09	1	1	0	0	0	0	151	712	0	111	451	5	6	24	1	27	106	1	44	167	9
2009–10	2	7	0	0	0	0	5	135	0	183	713	6	6	25	1	20	122	2	3	4	2
2010–11	0	2	0	0	0	0	103	917	0	111	640	19	11	30	4	5	16	2	33	113	2
2011–12	5	18	1	0	1	0	48	266	0	121	675	5	7	27	3	23	46	5	86	367	19
2012–13	12	28	2	1	2	0	38	496	0	252	989	25	27	88	4	35	74	20	34	76	9
2013–14	3	8	1	0	1	0	124	485	0	181	567	45	27	70	8	6	17	3	26	82	6
2014–15	28	85	5	1	4	0	207	1,094	0	27	161	4	2	3	1	9	72	1	14	60	3
2015–16	1	3	0	0	0	0	166	696	0	42	154	13	4	25	1	52	306	0	29	75	12
2016–17	23	94	3	1	2	0	46	465	0	60	269	6	13	105	2	93	371	6	54	99	26
2017–18	16	35	2	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Kemnitz 2018
"-" = Data unavailable

Table J-11 (continued)
Surface Water Discharge Monthly Data

Oil Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2008–09	0.0	2.9	0	0.0	2.9	0	0.0	0.2	0	0.3	0.9	0	0.0	0.1	0	0.0	0.0	0	0.0	0.0	0
2009–10	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	-	-	-	-	-	-	-	-	-
2010–11	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0
2011–12	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.3	0.8	0	0.1	0.2	0	0.0	0.1	0	0.0	0.1	0
2012–13	0.0	0.1	0	0.0	0.0	0	0.0	0.0	0	0.6	2.9	0	0.2	0.3	0	0.1	0.1	0	0.0	0.1	0
2013–14	0.0	0.0	0	0.0	0.0	0	0.0	0.1	0	0.3	0.5	0	0.1	0.2	0	0.1	0.1	0	0.1	0.1	0
2014–15	0.0	0.0	0	0.0	0.0	0	0.3	2.0	0	0.3	0.5	0	0.1	0.1	0	0.0	0.1	0	0.0	0.1	0
2015–16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2016–17	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0
2017–18	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-

Source: Adapted from Whitman and Arp 2018
"-" = Data unavailable

Table J-11 (continued)
Surface Water Discharge Monthly Data

Bills Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2008–09	-	-	-	-	-	-	0.0	0.0	0.0	0.5	1.6	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009–10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.8	0.0	0.2	0.3	0.1	0.1	0.3	0.0	0.0	0.0	0.0
2010–11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.9	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011–12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.1	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012–13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.5	0.0	0.2	0.4	0.1	0.1	0.1	0.0	0.0	0.1	0.0
2013–14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.2	0.0	0.2	0.4	0.1	0.1	0.1	0.0	0.1	0.1	0.1
2014–15	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Adapted from Whitman and Arp 2018
“-“ = Data unavailable

Table J-11 (continued)
Surface Water Discharge Summary Data

Redworm Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2011–12	-	-	-	-	-	-	0.0	0.0	0.0	1.3	3.7	0.0	0.2	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.0
2012–13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	5.9	0.0	0.4	0.8	0.2	0.1	0.2	0.1	0.1	0.1	0.0
2013–14	0.0	0.0	0.0	0.0	0.0	0.0	-	-													
2014–15	-	-	-	-	-	-	0.7	3.8	0.0	0.9	2.2	0.3	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.0
2015–16	0.0	0.0	0.0	0.0	0.0	0.0	0.7	4.1	0.0	0.7	1.0	0.3	0.1	0.3	0.1	0.1	0.1	0.1	0.3	0.8	0.1
2016–17	0.1	0.3	0.0	0.0	0.0	0.0	0.3	4.2	0.0	1.1	3.5	0.3	0.1	0.2	0.1	0.2	0.3	0.1	0.4	0.6	0.3
2017–18	0.3	0.5	0.1	0.0	0.1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Adapted from Whitman and Arp 2018
"-" = Data unavailable

Table J-11 (continued)
Surface Water Discharge Summary Data

Crea Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2008–09	-	-	-	-	-	-	0.0	0.0	0.0	0.6	1.7	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009–10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.5	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010–11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011–12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.5	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012–13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	3.7	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013–14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	1.2	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014–15	0.0	0.0	0.0	0.0	0.0	0.0	0.5	4.0	0.0	0.3	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015–16	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.8	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.4	0.0
2016–17	0.2	0.5	0.0	0.0	0.0	0.0	0.1	0.7	0.0	0.3	1.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.3	0.1
2017–18	0.1	0.2	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Adapted from Whitman and Arp 2018
“-“ = Data unavailable

Table J-11 (continued)
Surface Water Discharge Summary Data

Hannahbear Creek Monthly Discharge in Cubic Feet per Second																					
Year	Oct			Nov			May			June			Jul			Aug			Sep		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min
2011–12										0.2	0.4	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
2012–13	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	6.0	0.0	0.2	0.3	0.1	0.1	0.1	0.0	0.1	0.1	0.0
2013–14	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.0	0.5	1.4	0.3	0.2	0.5	0.1	0.0	0.1	0.0	0.1	0.1	0.0
2014–15	0.0	0.1	0.0	0.0	0.0	0.0	0.2	1.6	0.0	0.2	0.4	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015–16	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.0	0.3	0.5	0.1	0.1	0.2	0.0	0.0	0.2	0.0	0.1	0.3	0.1
2016–17	0.1	0.2	0.0	0.0	0.0	0.0				-	-	-	-	-	-	-	-	-	-	-	-

Source: Adapted from Whitman and Arp 2018
"-" = Data unavailable

Table J-12
Length of Rivers in the Planning Area

River	Length (Miles)	Total Length (Miles)
Perennial Rivers and Streams	Total Length	55,540
Adrigigon Creek	8.8	
Adventure Creek	19.6	
Agutiroak Creek	13.9	
Alatakrok River	5.6	
Alice Creek	19.1	
Amo Creek	27.3	
Anak Creek	14.1	
Anuk Creek	27.8	
Apikuguruak Creek	13.6	
Avak River	34.4	
Avalik River	39.3	
Avalitkok Creek	34.2	
Avgumun Creek	6.5	
Avingak Creek	28.5	
Awuna River	43.3	
Baby Creek	9.6	
Banshee Creek	6.4	
Bearpaw Creek	3.9	
Birthday Creek	13.4	
Blankenship Creek	15.1	
Boat Creek	6.5	
Bogie Creek	11.4	
Branch of Kogosukruk River	25.6	
Bronx Creek	56.9	
Bupto Creek	20.0	
Bushy Creek	18.6	
Carbon Creek	25.2	
Chertchip Creek	7.5	
Colville River	0.0	
Crassico Creek	10.1	
Cula Creek	28.6	
Cutaway Creek	37.0	
Disappointment Creek	19.8	
Discovery Creek	29.6	
Drenchwater Creek	6.4	
Driftwood Creek	14.2	
Ekakevik Creek	6.2	
Elbow Creek	14.6	

Table J-12 (continued)
Length of Rivers in the Planning Area

River	Length (Miles)	Total Length (Miles)
Elusive Creek	30.5	
Etivluk River	32.5	
Fay Creek	10.5	
Fish Creek	40.4	
Friendly Creek	5.2	
Fry Creek	49.2	
Garry Creek	4.5	
Grayling Creek	40.7	
Hardway Creek	18.9	
Henry Creek	26.9	
Igklo River	1.1	
Ikpitcheak Creek	8.2	
Iligluruk Creek	5.3	
Inaru River	50.2	
Ingaluat Creek	4.2	
Inicok Creek	4.3	
Ipnavik River	12.9	
Irak Creek	12.2	
Ishuktak Creek	47.9	
Ivisaruk River	64.0	
Jubilee Creek	8.7	
Judy Creek	28.2	
Kaksu River	26.1	
Kalikpik River	16.7	
Kamiktungitak Creek	7.5	
Kantangnak Creek	9.2	
Kaolak River	47.9	
Katrikiorak Creek	9.3	
Kay Creek	8.4	
Kealok Creek	27.2	
Ketik River	28.6	
Key Creek	40.7	
Kidney Creek	8.3	
Kigalik River	45.9	
Kikak Creek	4.6	
Kikiakrorak River	41.5	
Kikoligarak Creek	3.9	
Kikolik Creek	5.1	
Kiligwa River	10.6	

Table J-12 (continued)
Length of Rivers in the Planning Area

River	Length (Miles)	Total Length (Miles)
Killi Creek	2.2	
Kogosukruk River	44.0	
Kogru River	1.8	
Kogruk Creek	12.0	
Kolipsun Creek	21.4	
Kowlak Creek	23.2	
Kucheak Creek	47.6	
Kugrua River	33.7	
Kukak Creek	30.7	
Kuna River	31.5	
Kunarak Creek	5.0	
Kungok River	19.9	
Kutchaurak Creek	37.4	
Liberator Creek	14.2	
Lili Creek	24.0	
Lookout River	40.6	
Lost Temper Creek	22.6	
Maguriak Creek	13.2	
Maybe Creek	16.0	
Mayoriak River	3.3	
Meade River	17.5	
Mechanic Creek	5.5	
Medial Creek	9.9	
Memorial Creek	14.4	
Meridian Creek	17.2	
Mikigealiak River	21.6	
Mitten Creek	8.0	
Napanik Creek	7.5	
Nigisaktuvik River	47.5	
Niklavik Creek	23.2	
Nimwutik Creek	10.6	
Nokotlek River	14.3	
Nucleus Creek	14.1	
Nuka River	22.4	
Okpiksak River	43.2	
Omalik River	10.5	
Omikmuktusuk River	52.0	
Ongorakvik River	15.4	
Oumalik River	23.0	

Table J-12 (continued)
Length of Rivers in the Planning Area

River	Length (Miles)	Total Length (Miles)
Oyagaruk Creek	4.9	
Oyagatut Creek	2.5	
Pahron Creek	16.4	
Panic Creek	8.9	
Papigak Creek	5.6	
Pattern Creek	2.0	
Piasuk River	5.9	
Pikroka Creek	33.3	
Piksiksak Creek	15.0	
Pilly Fork	20.7	
Pisiksagiavik Creek	8.3	
Plunge Creek	10.3	
Prince Creek	23.1	
Quartzite Creek	32.4	
Query Creek	5.5	
Rainy Creek	19.7	
Rampart Creek	10.2	
Recon Creek	7.8	
Reynard Creek	13.5	
Rhumba Creek	8.6	
Roger Creek	5.4	
Rolling Pin Creek	11.1	
Safari Creek	21.2	
Seabee Creek	7.9	
Section Creek	21.3	
Seismo Creek	17.4	
September Creek	22.3	
Shaningarok Creek	24.3	
Shulunarurak Creek	0.2	
Singaruak Creek	0.0	
Singat Creek	6.1	
Singayoak Creek	5.3	
Smith River	6.9	
Sorepaw Creek	18.8	
Spike Creek	6.9	
Storm Creek	25.4	
Story Creek	16.0	
Strident Creek	13.6	
Suvaloyuk Creek	6.9	

Table J-12 (continued)
Length of Rivers in the Planning Area

River	Length (Miles)	Total Length (Miles)
Swayback Creek	35.3	
Taffy Creek	6.4	
Thunder Creek	12.5	
Tikikluk Creek	22.6	
Tingmeachsiovik River	0.8	
Titaluk River	18.2	
Topagoruk River	62.4	
Tuapaktushak Creek	4.9	
Tukuto Creek	29.4	
Tunalik River	32.6	
Tupik Creek	6.9	
Tupikchak Creek	27.4	
Twistem Creek	4.5	
Ublutuoch River	50.7	
Usuktuk River	87.5	
Utukok River	2.8	
Wager Creek	4.4	
Walik Creek	7.3	
Weasel Creek	13.9	
West Branch Key Creek	6.8	
Wolf Creek	33.8	
Intermittent rivers and streams		9.58
Ephemeral rivers and streams		14.44
Non-BLM surface, BLM subsurface		526
Avak Creek	8.7	
Avalitkok Creek	0.0	
Beaded Creek	1.2	
Central Marsh Slough	2.5	
Garry Creek	0.6	
Inaru River	3.3	
Kucheak Creek	0.5	
Kukak Creek	1.2	
Kungok River	1.1	
Mayoeak River	3.5	
Mikigealiak River	0.1	
Oyagaruk Creek	0.4	
Seabee Creek	4.1	
Singaruak Creek	0.0	

Table J-12 (continued)
Length of Rivers in the Planning Area

River	Length (Miles)	Total Length (Miles)
Tikikluk Creek	2.8	
Usuktuk River	0.1	

Source: Adapted from BLM GIS 2019

Table J-13
Area of Lagoons of the Planning Area

Lagoons	Size (Acres)
Dease Inlet Admiralty Bay Elson	254,000
Kasegaluk Lagoon	56,000
Kogru River (NPR-A Harrison Bay)	14,000
Kuk River	30,000
Peard Bay	77,000
Wainwright Inlet	11,000
Grand Total	**443,000**

Source: Adapted from BLM GIS 2019

Table J-14
Measured Ice Thickness of Lakes in Regions of the Planning Area

Region	Maximum Ice Thickness (cm)	Average Thickness (cm)	Period of Record
Utqiagvik	211	162	1962–2017
Fish Creek	183	140	2006–17
Ikpikpuk Delta	183	145	2012–17
Inigok	170	133	2011–17
Teshekpuk	232	159	1976, 1979, 2007–17
Toolik	132	107	2011–17
Umiat	150	116	2012–17

Sources: Adapted from Bilello 1980; Morris and Jeffries 2019; Jones et al. 2009; Hinkel et al. 2012; Blackburn et al. 2007; Arp et al. 2012; ALISS 2018; Weeks et al. 1981

Table J-15
Measured Ice Thickness of Lakes in Regions of the Planning Area

Region	Area (km^2)	Lake Area (%)	Floating Ice % Mean (Max.-Min.)	Max. %	Min. %	Mean Ice Thickness (cm)	Max. (cm)	Min. (cm)
Utqiagvik	3,067	23	48	60	34	170	210	130
Lower Fish Creek	1,265	15	48	60	38	150	180	120
Upper Fish Creek	2,461	26	54	63	45	160	200	130
Umiat	1,099	1	86	96	70	150	180	110

Source: Adapted from Arp 2018

Table J-16
Suspended Sediment Concentration

Stream	Date	Discharge (Cubic Meters per Second)	Suspended Sediment Concentration (Milligram per Liter)	Suspended Sediment Load (Gallons per Second)
Fish Creek	June 2011	57.7	19.61	1,130.8
Ikpikpuk	June 2011	230.2	72.66	16,724.6
Judy	June 2011	126.3	152.2	192,225.8
Otuk	June 2011	2.1	0.51	1.1
Ublutuoch	June 2011	46.5	10.84	504.2

Source: Adapted from Toniolo et al. 2013

Table J-17
Summary of Water Quality for Lakes in the Planning Area

Date	Latitude	Longitude	Lake Depth	Lake Area	Water Temperature	Conductivity	Total Suspended Solids	Dissolved Organic Carbon	Calcium	Magnesium	Potassium	Sodium	Chloride	Total Phosphorus	Total Nitrate/Nitrite -N	Ammonia-N
			(m)	(ha)	(°C)	(µmhos/cm)	(mg/L)	(mg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
7/18/2013	69.99849	-152.62914	1.6	40	17.1	159	ND	4	1800	3060	ND	6170	12	ND	ND	ND
8/7/2013	70.03165	-159.3853	2.9	15	11.6	89	2	9	10400	3110	ND	2550	6	ND	ND	ND
8/7/2013	70.43883	-157.69014	1.1	2	10.8	57	4.8	15	2580	1450	ND	5750	14	0.016	ND	ND
7/28/2013	70.48553	-155.25554	4.4	60	12.1	149	0.7	5	15900	3580	837	6700	13	0.028	ND	ND
7/18/2013	69.87219	-151.92065	1.2	10	16.7	50	1.1	*	5560	1310	ND	2250	4	0.0103	ND	ND
7/19/2013	69.91393	-152.88249	2.8	62	15.7	95	0.8	5	14500	1700	ND	1870	2	0.0165	ND	ND
7/26/2013	70.52222	-154.14491	2.2	38	10.3	148	1.3	5	15500	3040	731	7820	15	0.0271	ND	ND
7/21/2013	70.0975	-154.3685	2	24	17.3	113	0.8	4	16000	2040	ND	2660	4	0.0103	ND	ND
7/26/2013	70.98017	-154.99397	1	12	12.6	226	11.3	13	4270	5020	1350	27800	60	0.0558	ND	ND
8/1/2013	70.83981	-156.4799	3.8	15	12.1	109	0.8	4	5820	3260	767	8740	19	0.0125	ND	ND
8/4/2013	70.61922	-158.58478	1.1	23	11.7	78	5.5	42	5830	1980	ND	5400	14	0.0231	ND	ND
8/4/2013	70.58076	-158.12752	1.1	5	12.3	54	3	12	3510	1340	ND	4310	11	0.0205	ND	ND
8/1/2013	70.80839	-155.73602	0.9	20	11.9	110	4	12	4790	2870	809	11600	19	0.0349	ND	ND
8/2/2013	70.86228	-157.33638	1.1	2	13.3	104	3.8	17	3300	2750	522	10500	26	0.0179	ND	0.218
8/1/2013	70.86295	-156.19334	2.1	7	11.9	193	0.7	5	9030	6720	736	14800	33	0.023	ND	ND
7/25/2013	70.64337	-154.35774	2.5	4	9.9	230	1.4	9	24800	6030	957	7200	16	0.0241	ND	ND
7/23/2013	69.92488	-153.17307	3.8	44	15.7	100	0.5	5	14700	1540	ND	1970	3	ND	ND	ND
7/21/2013	70.04831	-154.88457	1.5	7	18.5	48	0.5	6	5050	1160	ND	2130	3	0.018	ND	ND
8/7/2013	70.26069	-157.91049	1.4	10	10.7	62	2.1	10	5930	1660	ND	2970	9	ND	ND	ND
7/28/2013	70.4131	-155.2399	2.2	11	12.7	79	1.1	330	8190	2040	609	3640	7	0.0199	ND	ND
7/23/2013	70.1479	-153.71086	2.8	4	16.1	96	1.3	10	11800	2090	ND	3550	6	ND	ND	ND

Table J-17 (continued)
Summary of Water Quality for Lakes in the Planning Area

Date	Latitude	Longitude	Lake Depth	Lake Area	Water Temperature	Conductivity	Total Suspended Solids	Dissolved Organic Carbon	Calcium	Magnesium	Potassium	Sodium	Chloride	Total Phosphorus	Total Nitrate/Nitrite -N	Ammonia-N
			(m)	(ha)	(°C)	(μmhos/cm)	(mg/L)	(mg/L)	(μg/L)	(μg/L)	(μg/L)	(μg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
7/21/2013	70.05882	-155.26863	2.4	114	17.1	44	1.1	4	4390	860	ND	1910	3	0.0101	ND	ND
7/28/2013	70.56502	-154.90329	1.5	4	12.9	292	0.8	9	25600	14500	1150	8460	17	0.0113	ND	ND
7/19/2013	69.78346	-152.59473	1.8	4	16.6	55	2.4	10	6940	1550	ND	1740	2	0.0217	0.779	ND
7/20/2013	70.58317	-152.26645	1.1	65	13.7	855	9.7	7	47300	18000	3000	91800	218	0.0292	ND	ND
7/26/2013	70.97063	-154.6983	0.5	292	8.9	316	390.0**	12	18600	12100	4440	30900	54	0.798	ND	ND
7/22/2013	70.89959	-153.27155	0.8	4	14.8	514	1.6	27	16900	15000	3610	60800	112	0.0233	ND	ND
7/16/2013	71.27882	-156.63235	1.6	9	10.6	134	4.3	11	4350	3530	878	15700	30	0.0443	ND	ND
7/22/2013	70.01026	-153.09512	1.9	304	16.2	129	0.8	4	19000	1870	996	3550	5	ND	ND	ND
7/23/2013	69.95624	-152.93895	1.1	418	14.5	162	3.4	3	22600	2120	ND	2440	4	ND	ND	ND
7/27/2013	70.79057	-154.45638	2.8	69	10.9	1480	2.5	4	37400	26000	7490	223000	392	0.0316	ND	ND
7/27/2013	70.79496	-154.52078	3.1	11	10.3	4170	0.8	7	75600	71900	14500	739000	1360	0.0195	ND	ND
7/16/2013	71.25051	-156.77246	2	161	11.8	79	6.5	4	3800	2020	ND	7510	18	0.034	ND	ND
7/20/2013	70.22748	-153.15688	8.9	362	16	195	0.5	9	24500	2940	594	7770	16	ND	ND	ND

Source: Adapted from ADEC 2013
**Thermokarst features may have caused the elevated TSS and nutrients, eutrophic conditions.
M=meter; ha=hectare; °C=Celsius; μmhos/cm=micromhos per centimeter; mg/L=milligrams per liter; μg/L=microgram per liter, ND =none detected, quantity below limits of detection

Table J-18
Water Use (Million Gallons) by Development Scenario

Water use	Development Scenario		
	Low	Medium	High
Ice Roads (assuming 1,000,000 gallons/mile)	40	160	250
Ice Pads (assuming 1,500,000 gallons/6-acre pad)	3	15	30
Low use during drilling and completions (assuming 30 vertical wells/pad and 420,000 gallons/well)	25	126	252
High use during drilling and completions (assuming 40 horizontal wells/pad and 8,000,000 gallons/well)	640	3,200	6,400
Reservoir pressure (per day at peak production)	5	9	21

Source: Adapted from BLM GIS 2019

Table J-19
Water Use (Gallons/Day) by Alternative in Order to Maintain Production Pressure

Development Scenario				
Alternative	Low	Medium	High	Percent Change from Alternative A
A	2,584,204	4,522,357	10,767,516	-
B	2,815,091	4,926,409	11,729,544	9
C	3,783,066	6,620,418	15,762,852	46
D	5,040,000	8,820,000	21,000,000	95
E	5,040,000	8,820,000	21,000,000	95

Source: Adapted from BLM GIS 2019
"-" = not available (no rate of growth from zero)

Table J-20
Lake Area Open to Fluid Mineral Leasing by Alternative and Lake Depth

Lake Depth & Fluid Mineral Leasing Stipulations	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
Deep (>4m)	Acres												
Closed	343,000	346,000	213,000	0	400	3,000	-130,000	-343,000	-342,600	1	-38	-100	-100
Leased	2,000	22,000	0	0	0	20,000	-2,000	-2,000	-2,000	1000	-100	-100	-100
Unleased	341,000	324,000	213,000	0	400	-17,000	-128,000	-341,000	-340,600	-5	-38	-100	-100
Open, no surface occupancy	138,000	142,000	267,000	473,000	475,200	4,000	129,000	335,000	337,200	3	93	243	244
Leased	104,000	86,000	106,000	106,000	106,500	-18,000	2,000	2,000	2,500	-17	2	2	2
Unleased	34,000	56,000	161,000	367,000	368,700	22,000	127,000	333,000	334,700	65	374	979	984
Open, controlled surface use	0	0	0	1,000	1,000	0	0	1,000	1,000	0	0	-	-
Leased	0	0	0	0	0	0	0	0	0	0	0	0	0
Unleased	-	0	0	1,000	1,000	0	0	1,000	1,000	0	0	-	-
Open, timing limitation	0	0	5,000	8,000	9,100	0	5,000	8,000	9,100	0	-	-	-
Leased	0	0	0	0	400	0	0	0	400	0	0	0	-
Unleased	0	0	5,000	8,000	8,700	0	5,000	8,000	8,700	0	-	-	-
Open, standard terms & conditions	22,000	15,000	17,000	20,000	17,300	-7,000	-5,000	-2,000	-4,700	-32	-2	-9	-21
Leased	11,000	10,000	11,000	11,000	10,600	-1,000	0	0	-400	-9	0	0	-4
Unleased	11,000	5,000	6,000	9,000	6,700	-6,000	-5,000	-2,000	-4,300	-55	-45	-18	-39
Open, total	160,000	157,000	289,000	502,000	502,600	-3,000	129,000	342,000	342,600	-2	81	214	214

Table J-20 (continued)
Lake Area Open to Fluid Mineral Leasing by Alternative and Lake Depth

Lake Depth & Fluid Mineral Leasing Stipulations	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
Moderate (1.6-4m)	Acres												
Closed	304,000	369,000	105,000	4,000	3,100	65,000	-199,000	-300,000	-300,900	21	-65	-99	-99
Leased	3,000	62,000	0	0	0	59,000	-3,000	-3,000	-3,000	1967	-100	-100	-100
Unleased	301,000	307,000	105,000	4,000	3,100	6,000	-196,000	-297,000	-297,900	2	-65	-99	-99
Open, no surface occupancy	43,000	147,000	235,000	121,000	132,800	104,000	192,000	78,000	89,800	242	447	181	209
Leased	25,000	40,000	48,000	28,000	41,200	15,000	23,000	3,000	16,200	60	92	12	65
Unleased	18,000	107,000	187,000	93,000	91,600	89,000	169,000	75,000	73,600	494	939	417	409
Open, controlled surface use	0	0	0	52,000	52,100	0	0	52,000	52,100	0	0	-	-
Leased	0	0	0	0	0	0	0	0	0	0	0	0	0
Unleased	0	0	0	52,000	52,100	0	0	52,000	52,100	0	0	-	-
Open, timing limitation	0	0	56,000	153,000	158,500	0	56,000	153,000	158,500	0	-	-	-
Leased	0	0	24,000	37,000	33,000	0	24,000	37,000	33,000	0	-	-	-
Unleased	0	0	32,000	116,000	125,000	0	32,000	116,000	125,500	0	-	-	-
Open, standard terms & conditions	491,000	322,000	441,000	509,000	491,100	-169,000	-50,000	18,000	100	-34	-10	4	0
Leased	228,000	153,000	183,000	190,000	181,000	-75,000	-45,000	-38,000	-47,000	-33	-20	-17	-21
Unleased	263,000	169,000	258,000	319,000	310,100	-94,000	-5,000	56,000	47,100	-36	-2	21	18
Open, total	534,000	469,000	732,000	835,000	834,500	-65,000	198,000	301,000	89,900	-12	37	56	56

Table J-20 (continued)
Lake Area Open to Fluid Mineral Leasing by Alternative and Lake Depth

Lake Depth & Fluid Mineral Leasing Stipulations	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
Shallow (<1.6m)	Acres												
Closed	233,000	263,000	86,000	10,000	6,800	30,000	-147,000	-223,000	-226,200	13	-63	-96	-97
Leased	2,000	12,000	-	-	-	10,000	-2,000	-2,000	-2,000	500	-100	-100	-100
Unleased	231,000	251,000	86,000	10,000	6,800	20,000	-145,000	-221,000	-224,200	9	-63	-96	-97
Open, no surface occupancy	38,000	97,000	189,000	147,000	151,300	59,000	151,000	109,000	113,300	155	397	287	298
Leased	10,000	14,000	13,000	11,000	13,200	4,000	3,000	1,000	3,200	40	30	10	32
Unleased	28,000	83,000	176,000	136,000	138,100	55,000	148,000	108,000	110,100	196	529	386	393
Open, controlled surface use	0	0	0	53,000	55,000	0	0	53,000	55,000	0	0	-	-
Leased	0	0	0	0	0	0	0	0	0	0	0	0	0
Unleased	0	0	0	53,000	55,000	0	0	53,000	55,000	0	0	-	-
Open, timing limitation	0	0	29,000	53,000	54,100	0	29,000	53,000	54,100	0	-	-	-
Leased	0	0	7,000	8,000	7,800	0	7,000	8,000	7,800	0	-	-	-
Unleased	0	0	22,000	45,000	46,300	0	22,000	45,000	46,300	0	-	-	-
Open, standard terms & conditions	264,000	175,000	230,000	272,000	267,700	-89,000	-34,000	8,000	3,700	-34	-13	3	1
Leased	56,000	42,000	47,000	48,000	46,800	-14,000	-9,000	-8,000	-9,200	-25	-16	-14	-16
Unleased	208,000	133,000	183,000	224,000	220,900	-75,000	-25,000	16,000	12,900	-36	-12	8	6
Open, total	302,000	272,000	448,000	525,000	528,100	-30,000	146,000	223,000	226,100	-10	48	74	75

Table J-20 (continued)
Lake Area Open to Fluid Mineral Leasing by Alternative and Lake Depth

Lake Depth & Fluid Mineral Leasing Stipulations	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
	Acres												
Closed	880,000	978,000	404,000	14,000	10,300	98,000	-476,000	-866,000	-869,700	11	54	-98	-99
Open, No Surface Occupancy	219,000	386,000	691,000	741,000	759,300	167,000	472,000	522,000	540,300	76	216	238	267
Open, Controlled Surface Use	0	0	0	106,000	108,000	0	0	106,000	56000	0	0	-	-
Open, Timing Limitation	0	0	90,000	214,000	222,000	0	90,000	214,000	63,200	0	-	-	-
Open, Standard Terms & Conditions	777,000	512,000	688,000	801,000	776,100	-265,000	-89,000	24,000	-900	-34	-11	3	0
Open, Total	996,000	898,000	1,469,000	1,862,000	1,865,000	-98,000	473,000	866,000	658,600	-10	47	87	87

Source: Adapted from BLM GIS 2019
“-“ = not available (no rate of growth from zero)

Table J-21
Lake Area Open to New Infrastructure by Alternative and Lake Depth

Lake Depth & Infrastructure Availability	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
Deep (>4m)	**Acres**												
Available	281,000	16,000	278,000	281,000	276,000	-265,000	-3,000	0	-5,000	-94	-1	0	-2
Unavailable	213,000	481,000	216,000	213,000	211,000	268,000	3,000	0	-2,000	126	1	0	-1
Unavailable except Coastal	1,000	0	1,000	1,000	1,000	-1,000	0	0	0	-100	0	0	0
Unavailable except Roads & Pipeline Crossings	6,000	0	6,000	6,000	12,000	-6,000	0	0	6,000	-100	0	0	100
Unavailable except Pipeline Crossings	0	2,000	0	0	0	2,000	0	0	0	-	0	0	0
Pipeline Corridor	0	0	0	0	0	0	0	0	0	0	0	0	0
Moderate (1.6-4m)	**Acres**												
Available	644,000	426,000	645,000	713,000	715,000	-218,000	1,000	69,000	71,000	-34	0	11	11
Unavailable	107,000	329,000	97,000	27,000	16,000	222,000	-10,000	-80,000	-91,000	207	-9	-75	-85
Unavailable except Coastal	3,000	0	3,000	3,000	3,000	-3,000	0	0	0	-100	0	0	0
Unavailable except Roads & Pipeline Crossings	68,000	43,000	70,000	70,000	79,000	-25,000	2,000	2,000	11,000	-37	3	3	16
Unavailable except Pipeline Crossings	0	0	0	8,000	8,000	0	0	8,000	8,000	0	0	-	-
Pipeline Corridor	0	24,000	7,000	0	0	24,000	7,000	0	0	-	-	0	0

Table J-21 (continued)
Lake Area Open to New Infrastructure by Alternative and Lake Depth

Lake Depth & Infrastructure Availability	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
Shallow (<1.6m)	**Acres**												
Available	353,000	234,000	355,000	380,000	386,000	-119,000	2,000	27,000	33,000	-34	1	8	9
Unavailable	88,000	235,000	74,000	22,000	17,000	147,000	-14,000	-66,000	-71,000	167	-16	-75	-81
Unavailable except Coastal	18,000	5,000	18,000	19,000	19,000	-13,000	0	1,000	1,000	-72	0	6	6
Unavailable except Roads & Pipeline Crossings	64,000	38,000	67,000	67,000	67,000	-26,000	3,000	3,000	3,000	-41	5	5	5
Unavailable except Pipeline Crossings	1,000	0	1,000	35,000	35,000	-1,000	0	34,000	34,000	-100	0	3,400	3,400
Pipeline Corridor	0	10,000	7,000	0	0	10,000	7,000	0	0	-	-	0	0
All Lakes	**Acres**												
Available	1,278,000	676,000	1,278,000	1,374,000	1,377,000	-602,000	0	96,000	99,000	-47	0	8	8
Unavailable	408,000	1,045,000	387,000	262,000	244,000	637,000	-21,000	-146,000	-164,000	156	-5	-36	-40
Unavailable except Coastal	22,000	5,000	22,000	23,000	23,000	-17,000	0	1,000	1,000	-77	0	5	5
Unavailable except Roads & Pipeline Crossings	138,000	81,000	143,000	143,000	158,000	-57,000	5,000	5,000	20,000	-41	4	4	14
Unavailable except Pipeline Crossings	1,000	2,000	1,000	43,000	43,000	1,000	0	42,000	42,000	100	0	4,200	4,200
Pipeline Corridor	0	34,000	14,000	0	0	34,000	14,000	0	0	-	-	0	0

Source: Adapted from BLM GIS 2019
“-“ = not available (no rate of growth from zero)

Table J-22
Lake Area by Alternative

Lake Depth and Special Areas	Alternative A	Alternatives B, C, D, and E	Difference from Alternative A	% Change from Alternative A
Deep (>4m)	**Acres**			
Colville River*	0	0	0	0
Kasegaluk Lagoon	0	0	0	0
Peard Bay	0	0	0	0
Teshekpuk Lake	365,000	337,000	-28,000	-8
Utukok River Uplands*	2,000	5,000	3000	150
Moderate (1.6-4m)	**Acres**			
Colville River*	13,000	0	-13,000	-100
Kasegaluk Lagoon	0	0	0	0
Peard Bay	0	0	0	0
Teshekpuk Lake	363,000	339,000	6,000	3
Utukok River Uplands*	8,000	11,000	-105,000	-88
Shallow (<1.6m)	**Acres**			
Colville River*	10,000	0	-10,000	-100
Kasegaluk Lagoon	3,000	3,000	0	0
Peard Bay	1,000	1,000	0	0
Teshekpuk Lake	220,000	226,000	6,000	3
Utukok River Uplands*	120,000	15,000	-105,000	-9
All Lakes	**Acres**			
Colville River*	23,000	0	-23,000	-100
Kasegaluk Lagoon	3,000	3,000	0	0
Peard Bay	1,000	1,000	0	0
Teshekpuk Lake	948,000	902,000	-46,000	-5
Utukok River Uplands*	130,000	31,000	-99,000	-8

Source: Adapted from BLM GIS 2019
*Note: Colville River and Utukok River Uplands overlap under Alternative A

Table J-23
Lake Area Open to Sand and Gravel Mining by Alternative and Lake Depth

Lake Depth and Sand and Gravel Mining	Alternatives B, C, D, and E
Deep (>4m)	**Acres**
Closed	0
Open	503,000
Moderate (1.6-4m)	**Acres**
Closed	7,000
Open	831,000
Shallow (<1.6m)	**Acres**
Closed	1,000
Open	534,000

Source: Adapted from BLM GIS 2019

Table J-24
River Length Open to Sand and Gravel Mining by Alternative

River Length and Sand and Gravel Mining	Alternatives B, C, D, and E (Miles)
Closed	49
Open	2,664

Source: Adapted from BLM GIS 2019

Table J-25
River Length Open to Fluid Mineral Leasing by Alternative

River Length & Fluid Mineral Leasing Stipulations	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
	River Miles												
Unleased													
Closed	930	951	419	419	418	21	-511	-511	-512	2	-55	-55	-55
Open, No Surface Occupancy	1,168	1,132	1,649	1,647	1,648	-36	481	479	480	-3	41	41	41
Open, Standard Terms & Conditions	70	86	100	103	103	16	30	33	33	23	43	47	47
Open, Total	1,238	1,218	1749	1750	1,751	-20	511	512	513	-2	41	41	41
Leased													
Closed	0	88	0	0	0	88	0	0	0	-	0	0	0
Open, No Surface Occupancy	521	448	521	521	522	-73	0	0	1	-14	0	0	0
Open, Standard Terms & Conditions	25	10	25	25	23	-15	0	0	-2	-60	0	0	-8
Open, Total	546	458	546	546	545	-88	0	0	-1	-16	0	0	0
10-year lease deferred	0	184	0	0	0	184	0	0	0	-	0	0	0

Source: Adapted from BLM GIS 2019
"-" = not available (no rate of growth from zero)

Table J-26
River Length Open to New Infrastructure by Alternative

River Length and Infrastructure Availability	Alternative					Difference from Alternative A				% Change from Alternative A			
	A	B	C	D	E	B	C	D	E	B	C	D	E
	River Miles												
Available	121	102	129	129	138	-19	8	8	17	-16	7	7	17
Unavailable	660	939	425	425	418	279	-235	-235	-242	42	-36	-36	-26
Unavailable except roads and pipeline crossings	1,899	1633	2,126	2,126	2,125	-266	227	227	266	-14	12	12	14
Unavailable except pipeline crossings	1	0	1	1	1	-1	0	0	0	-100	0	0	0
Pipeline corridor	0	7	0	0	0	7	0	0	0	-	0	0	0
Number of major rivers in pipeline corridor	0	2	0	0	0	2	0	0	0	-	0	0	0

Source: Adapted from BLM GIS 2019
"-" = not available (no rate of growth from zero)

J.1 REFERENCES

ADEC (Alaska Department of Environmental Conservation). 2013. Field Report Alaska Monitoring and Assessment Program (AKMAP) 2013 Arctic Lakes Survey. Internet website: http://dec.alaska.gov/water/water-quality/monitoring/surveys/.

ALISS (Arctic Lake Ice System Science). 2018. ALISS Snow-Ice Buoy data. Internet website: http://arcticlakeice.org/. Last updated August 25, 2018.

Arp, C. D. 2018. Lake ice thickness observations for arctic Alaska from 1962 to 2017. Arctic Data Center. Internet website: https://arcticdata.io/catalog/view/doi:10.18739/A2G27V, last updated 01/19/2018.

Arp, C. D., M. S. Whitman, B. M. Jones, R. Kemnitz, G. Grosse, and F. E. Urban. 2012. Drainage Network Structure and Hydrologic Behavior of Three Lake-Rich Watersheds on the Arctic Coastal Plain, Alaska. Arctic, Antarctic, and Alpine Research 44(4): 385-398. Internet website: https://pubs.er.usgs.gov/publication/70045511.

Bilello, M. A. 1980. Maximum Thickness and Subsequent Decay of Lake, River, and Fast Sea Ice in Canada and Alaska (CRREL Report 80-6). Cold Regions Research and Engineering Lab. Hanover, New Hampshire.

Blackburn, A. J., H. M. Clilverd, K. Holland, and D. M. White. 2007. Chemistry of North Slope, Alaska, Lakes and Reservoirs: September 2005 to May 2007. University of Alaska Fairbanks, Water and Environmental Research Center INE/WERC 07.13:1-18.

BLM (U.S. Department of the Interior Bureau of Land Management) GIS (Geographic Information System). 2019. GIS data used in the NPR-A Oil and Gas Leasing Program EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Childers, J. M., D. R. Kernodle, and R. M. Loeffler. 1979. Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977 (No. 79-699). U.S. Geological Survey. Internet website: https://pubs.usgs.gov/of/1979/0699/report.pdf.

Hinkel, K., J. Lenters, C. D. Arp, and K. Frey. 2012. Collaborative Research: Toward a Circumarctic Lakes Observation Network (CALON)—Multiscale observations of lacustrine systems. Arctic Data Center. Internet website: https://arcticdata.io/catalog/view/urn:uuid:0bb9fd5a-1ea1-4253-9c84-fc5289c16c6f. Last updated November 1, 2012.

Hinzman, L. 2007. Otuk Creek Stream Discharge Data (ASCII) Version 1.0. University Corporation for Atmospheric Research and National Center for Atmospheric Research (UCAR/NCAR) Earth Observing Laboratory. Internet website: https://doi.org/10.5065/D60K26RW. Last updated November 5, 2007.

Jones, B. M., C. D. Arp, K. M. Hinkel, R. A. Beck, J. A. Schmutz, and B. Winston. 2009. "Arctic lake physical processes and regimes with implications for winter water availability and management in the National Petroleum Reserve Alaska." *Environmental Management* 43(6): 1071–1084.

Kemnitz, R., C. Arp, M. Whitman, and D. Vas. 2018. River discharge data, National Petroleum Reserve, Alaska, 2001–2017. Arctic Data Center. Internet website: https://arcticdata.io/catalog/view/doi:10.18739/A2G44HQ8W. Last updated December 31, 2017.

Morris, K., and M. Jeffries. 2019. ALISON (Alaska Lake and Ice and Snow Observatory Network) Project data, 1999–2011. Internet website: https://arcticdata.io/catalog/view/doi:10.18739/A2K35MD3N. Last updated February 12, 2019.

Toniolo, H., D. Vas, P. Prokein, R. Kemnitz, E. Lamb, and D. Brailey. 2013. "Hydraulic characteristics and suspended sediment loads during spring break-up in several streams located on the National Petroleum Reserve in Alaska, USA." *Natural Resources* 4(02): 220–228. Internet website: http://file.scirp.org/pdf/NR_2013061315224996.pdf.

Urban, F. E. 2017. Data Release associated with Data Series - DOI/GTN-P Climate and Active-Layer Data Acquired in the National Petroleum Reserve-Alaska and the Arctic National Wildlife Refuge, 1998–2016: U.S. Geological Survey data release. Internet website: https://www.sciencebase.gov/catalog/item/59d6a458e4b05fe04cc6b47e.

USGS (United States Geological Survey). 2019. National Water Information System (NWIS) data; USGS Water Data for the Nation. Internet website: https://waterdata.usgs.gov/ak/nwis/sw. Last updated August 1, 2019.

Weeks, W. F., A. J. Gow, and R. J. Schertler. 1981. Ground-truth observations of ice-covered North Slope lakes imaged by radar (CRREL Report 81-19). Cold Regions Research and Engineering Lab. Hanover, New Hampshire. Internet website: https://apps.dtic.mil/dtic/tr/fulltext/u2/a108342.pdf.

Whitman, M., and C. D. Arp. 2018. Fish Creek Watershed Observatory data. Internet website: http://ine.uaf.edu/werc/projects/arp-fishcreek/data.html. Last updated September 10, 2018.

Appendix K
Vegetation and Wetlands

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ACRONYMS AND ABBREVIATIONS — Full Phrase

BLM	Bureau of Land Management
BMP	best management practice
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska
NSO	no surface occupancy
ROP	required operating procedure

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Appendix K. Vegetation and Wetlands

Table K-1
Description of Vegetation Classes Mapped in the NPR-A

Vegetation Class (Wetland Type)[a]	Description	Typical Species
Open Water (Waters of the U.S.)	• Marine nearshore water and estuarine waters along the Beaufort Sea and Chukchi Sea coasts • Freshwater lakes and ponds and permanently flooded riverine channels throughout the NPR-A	NA
Marine Beach/Beach Meadow (Marine Intertidal)	**Distribution:** Interspersed with bare ground on coastal dunes, spits, and barrier islands **Soils:** Sand or cobbles **Hydrology:** Dry to mesic **Slope:** Flat to moderate **Permafrost:** Typically present **Patch Size:** Typically small, often linear **Vegetation:** Typically dominated by *Leymus mollis* or *Honckenya peploides*	• *Leymus mollis* and *Honckenya peploides* occur with the highest frequency • Other species that may be present include *Lathyrus japonicas*, *Senecio pseudoarnica*, and *Mertensia maritima* • Nonvascular cover is rare
Coastal Marsh (Estuarine Intertidal Vegetated)	**Distribution:** Primarily occurs as a narrow fringe along the coastline; tidal river channels and tidal lagoons protected by barrier islands **Soils:** Marine silts and clay **Hydrology:** Semi-permanently flooded **Slope:** Flat **Permafrost:** Typically present **Patch Size:** Small to moderate, often linear **Vegetation:** Total vascular cover greater than or equal to 10 percent; sites subject to regular to frequent tidal inundation, including storm surges	**Shrubs:** *Salix ovalifolia* **Sedges:** *Carex subspathacea* and *C. ursina* **Grasses:** *Dupontia fisheri*, *Puccinellia phryganodes*, *P. andersonii*, *Deschampsia cespitosa*, *Arctagrostis latifolia*, and *Alopecurus magellanicus* **Other Herbaceous:** *Cochlearia officinalis*, *Stellaria humifusa*, *Sedum rosea*, and *Chrysanthemum bipinnatum*

Vegetation Class (Wetland Type)[a]	Description	Typical Species
Freshwater Marsh: *Arctophila fulva* (Freshwater Emergent Wetland)	**Distribution:** Widespread on the coastal plain; less common in foothills and Brooks Range; margins of ponds and lakes, low-centered polygons, and beaded streams **Soils:** Muck or mineral **Hydrology:** Semi-permanently (sometimes seasonally) flooded; water greater than 10 centimeters deep **Slope:** Flat **Permafrost:** Present **Patch Size:** Small to large **Vegetation:** Dominant vegetation is emergent, dominated by *Arctophila fulva*; species diversity is low	• Often a monoculture of *A. fulva* • Other emergent species that may be present include *Carex aquatilis*, *Eriophorum angustifolium*, and *Hippuris vulgaris*
Freshwater Marsh: *Carex aquatilis* (Freshwater Emergent Wetland)	**Distribution:** Common on the coastal plain, foothills, and Brooks Range; margins of ponds and lakes, low-centered polygons, and beaded streams **Soils:** Muck or mineral **Hydrology:** Semi-permanently (sometimes seasonally) flooded; water greater than 10 centimeters deep **Slope:** Flat **Permafrost:** Present **Patch Size:** Small to large **Vegetation:** Dominant vegetation is emergent, not dominated by *Arctophila fulva*; often grades into the wet sedge class, with similar species composition	• Typically dominated by *Carex aquatilis* or *Eriophorum angustifolium* • Other emergent species may occur, including *C. utriculata*, *C. rotundata*, *C. saxatilis*, *E. russeolum*, *E. scheuchzeri*, *Menyanthes trifoliata*, and *Equisetum fluviatile*
Wet Sedge (Freshwater Emergent Wetland)	**Distribution:** Margins of ponds, lakes, and streams in floodplains; low-centered polygons on the coastal plain; water tracks in foothills and valley bottoms; wet slopes in the Brooks Range **Soils:** Typically silt or sand with an organic horizon, acidic to non-acidic **Hydrology:** Saturated **Slope:** Flat to sloping **Permafrost:** Typically present, but may be absent on floodplains **Patch Size:** Small to moderate, may be linear in shape **Vegetation:** Cover of sedge species is greater than or equal to 25 percent; cover of *Sphagnum* is less than or equal to 25 percent; shrubs may be present on raised microsites; often grades into the freshwater marsh *Carex aquatilis* class, with similar species composition	**Shrubs:** *Betula* spp., *Salix fuscescens*, *Vaccinium uliginosum*, and *Andromeda polifolia*. **Sedges:** *Carex aquatilis*, *C. chordorrhiza*, and *Eriophorum angustifolium* **Mosses:** *Scorpidium scorpioides*, *Drepanocladus* spp., and *Sphagnum* spp.

Vegetation Class (Wetland Type)[a]	Description	Typical Species
Wet Sedge-Sphagnum (Freshwater Emergent Wetland)	**Distribution:** Primarily occurs near Point Hope and on the coastal plain; low-centered polygons, wet depressions, and beaded streams **Soils:** Acidic, typically with a well-developed peat layer **Hydrology:** Wet, poorly drained **Slope:** Flat **Permafrost:** Present **Patch Size:** Small to large **Vegetation:** Cover of sedge species (typically *Carex aquatilis*) is greater than or equal to 25 percent; cover of *Sphagnum* is greater than or equal to 25 percent	**Shrubs:** *Salix pulchra* and *S. fuscescens* **Sedges:** *Carex aquatilis* and *Eriophorum angustifolium* **Mosses:** *Sphagnum tundra* and *S. fimbriatum*
Mesic Herbaceous (Freshwater Emergent Wetland)	**Distribution:** Common on sideslopes, foothills, and in the Brooks Range **Soils:** Calcareous to acidic **Hydrology:** Dry to mesic **Slope:** Moderate to steep **Permafrost:** Typically present **Patch Size:** Small to large **Vegetation:** Cover of shrubs in <25 percent; herbaceous cover is greater than or equal to 25 percent; nonvascular cover often high; high diversity and species richness	**Shrubs:** *Dryas octopetala*, *Ledum decumbens*, *Salix arctica*, *S. phlebophylla*, *S. reticulata*, *S. rotundata*, *Vaccinium uliginosum* **Sedges:** *Carex bigelowii*, *C. aquatilis*, *C. microchaeta* **Other Herbaceous:** *Equisetum arvense*, *Poa arctica* **Mosses & Liverworts:** *Hylocomium splendens*, *Aulacomnium turgidum*, *Scorpidium cossonii*, *Sanionia uncinatum*, *Ptlidium ciliare*
Mesic Sedge-Dwarf Shrub Tundra (Freshwater Emergent Wetland)	**Distribution:** Floodplain terraces, ridges in the foothills, and sideslopes and ridges in the Brooks Range; also sporadically on flat-topped polygons on the coastal plain and on dune slacks **Soils:** Calcareous to acidic **Hydrology:** Mesic, sometimes wet **Slope:** Flat to steep **Permafrost:** Typically present **Patch Size:** Small to matrix-forming **Vegetation:** Cover of shrubs less than or equal to 20 centimeters tall is greater than or equal to 25 percent; sedge cover is less than 25 percent, codominated by sedges and dwarf or low shrubs, high diversity, and species richness	**Shrubs:** *Arctostaphylos rubra*, *Dryas octopetala*, *D. integrifolia*, *Ledum decumbens*, *Salix arctica*, *S. phlebophylla*, *S. pulchra*, *S. reticulata*, and *S. rotundifolia, Vaccinium uliginosum* **Sedges:** *Carex aquatilis*, *C. bigelowii.*, and *C. microchaeta* **Other Herbaceous:** *Equisetum* spp., *Hierochlöe alpina*, and *Arnica lessingii* **Mosses & Liverworts:** *Scorpidium cossonii*, *Hylocomium splendens*, *Ptilidium ciliare*, *Sanionia uncinata*, and *Aulocomnium turgidum*

Vegetation Class (Wetland Type)[a]	Description	Typical Species
Tussock Tundra (Freshwater Emergent Wetland)	**Distribution:** Coastal plain; foothills and valley bottoms in the Brooks Range; ancient (inactive) river terraces **Soils:** Silty to sandy with thin surface organic layer surrounding the sedge tussocks **Hydrology:** Poorly drained, mesic to wet **Slope:** Flat to moderate **Permafrost:** Present **Patch Size:** Small to matrix forming **Vegetation:** Cover of shrubs greater than 20 centimeters tall is less than 25 percent; cover of shrubs less than 20 centimeters tall typically greater than 25 percent; cover of tussocks greater than or equal to 35 percent	**Shrubs:** *Betula nana*, *Salix pulchra*, *Ledum decumbens*, *Vaccinium uliginosum*, *V. vitis-idaea*, and *Empetrum nigrum* **Sedges:** *Eriophorum vaginatum* and *Carex bigelowii* **Other Herbaceous:** *Equisetum arvense* and *Rubus chamaemorus* **Mosses:** *Sphagnum* spp., *Hylocomium splendens*, and *Aulacomnium turgidum*
Tussock Shrub Tundra (Freshwater Emergent Wetland)	**Distribution:** Coastal plain; foothills and valley bottoms in the Brooks Range; ancient (inactive) river terraces **Soils:** Silty to sandy with thin surface organic layer surrounding the sedge tussocks **Hydrology:** Poorly drained, mesic to wet **Slope:** Flat to moderate **Permafrost:** Present **Patch Size:** Small to matrix forming **Vegetation:** Cover of shrubs greater than 20 centimeters tall is greater than or equal to 25 percent; cover of tussocks greater than or equal to 35 percent	**Shrubs:** *Betula nana*, *Salix pulchra*, *Ledum decumbens*, *Vaccinium uliginosum*, *V. vitis-idaea*, and *Empetrum nigrum* **Sedges:** *Eriophorum vaginatum* and *Carex bigelowii* **Other Herbaceous:** *Equisetum arvense* and *Rubus chamaemorus* **Mosses:** *Sphagnum* spp., *Hylocomium splendens*, *Aulacomnium turgidum*, and *Dicranum elongatum*
Dwarf Shrub (Freshwater Shrub Wetland)	**Distribution:** Floodplain terraces, ridges in the foothills, and sideslopes and ridges in the Brooks Range; high-centered polygons on the coastal plain **Soils:** Bedrock to lithosols, silt, sand **Hydrology:** Mesic **Slope:** Flat to steep; can be unstable **Permafrost:** Typically present, but active layer may be deep on south-facing slopes and sandy soils **Patch Size:** Small to large **Vegetation:** Cover of shrubs less than or equal to 20 centimeters tall is greater than or equal to 25 percent; *Dryas* is not dominant or codominant; sedge cover is less than 25 percent	**Shrubs:** *Cassiope tetragona*, *Empetrum nigrum*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Arctostaphylos* spp., *Harrimanella stelleriana*, *Betula nana*, *Diapensia lapponica*, *Dryas octopetala*, *Loiseleuria procumbens*, *Ledum decumbens*, *Salix reticulata*, *S. arctica*, *S. phlebophylla*, and *S. rotundifolia* **Sedges:** *Carex bigelowii* **Other Herbaceous:** *Equisetum* spp., *Hierochlöe alpina*, and *Arnica lessingii* **Mosses:** *Aulacomnium spp.*, *Hylocomium splendens*, *Rhytidium rugosum*, and *Racomitrium lanuginosum* **Lichens:** *Cetraria* spp. and *Cladina* spp.

Vegetation Class (Wetland Type)[a]	Description	Typical Species
Birch Ericaceous Low Shrub (Freshwater Shrub Wetland)	**Distribution:** Brooks Range and its foothills; occasionally on the coastal plain; common on ancient (inactive) river terraces, sideslopes, alluvial fans, mesic high-centered polygons, valley bottoms, and mesic portions of water tracks in tussock tundra. **Soils:** Bedrock to silt and sand **Hydrology:** Mesic **Slope:** Flat to steep **Permafrost:** Present **Patch Size:** Small to large **Vegetation:** Total cover of shrubs greater than 20 centimeters tall is greater than or equal to 25 percent; dominated by species other than alder and willow	**Shrubs:** *Betula nana*, *Salix pulchra*, *S. glauca*, *Ledum decumbens*, and *Dryas octopetala* **Sedges** (in polygon troughs)**:** *Carex aquatilis*, *Eriophorum angustifolium*, and *E. russeolum* **Other Herbaceous:** *Hierochlöe alpina* **Lichens:** *Cladonia rangiferina*
Low-Tall Willow (Freshwater Shrub Wetland)	**Distribution:** Along rivers and streams of the coastal plain, foothills, and Brooks Range; sand sheet lake bluffs, inland dunes, low-centered polygons, flat wetlands, and water tracks in tussock tundra **Soils:** No description provided **Hydrology:** Mesic to wet **Slope:** Flat to steep **Permafrost:** No description provided **Patch Size:** Small to large, often linear in shape. **Vegetation:** Total cover of shrubs greater than 20 centimeters tall is greater than or equal to 25 percent; dominated by willows	**Shrubs:** *Salix alaxensis*, *S. glauca*, *S. pulchra*, *S. niphoclada*, and *S. richardsonii* **Sedges:** *Eriophorum angustifolium* and *Carex aquatilis*
Alder (Freshwater Shrub Wetland)	**Distribution:** Primarily in the Brooks Range foothills along the Colville River; on floodplains, bluffs above floodplains, sand dunes, and rolling hills **Soils:** No description provided **Hydrology:** Mesic to wet **Slope:** Flat to steep **Permafrost:** No description provided **Patch Size:** Small to large **Vegetation:** Total shrub cover is greater than or equal to 25 percent; dominated by alder. On wetter sites, tussock tundra is common in the gaps between alder patches	**Shrubs:** *Alnus viridis* ssp. *crispa*, *Salix alaxensis*, *S. pulchra*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Betula nana*, *Ledum decumbens*, and *Empetrum nigrum* **Sedges** (where mixed with tussock tundra)**:** *Eriophorum vaginatum* and *Carex bigelowii* **Other Herbaceous:** *Equisetum* spp. **Mosses:** *Hylocomium splendens* and *Dicranum* spp.

Vegetation Class (Wetland Type)[a]	Description	Typical Species
***Dryas* Dwarf Shrub** (Upland)	**Distribution:** Floodplain terraces, ridges in the foothills, side slopes, and ridges in the Brooks Range **Soils:** Bedrock to lithosols, silt, sand **Hydrology:** Dry to mesic **Slope:** Flat to steep **Permafrost:** Typically present, but active layer may be deep on south-facing slopes and sandy soils **Patch Size:** Small to large **Vegetation:** Cover of shrubs less than or equal to 20 centimeters tall is greater than or equal to 25 percent; *Dryas* is dominant or codominant; sedge cover is less than 25 percent	**Shrubs:** *Dryas octopetala*, *D. integrifolia*, *Cassiope tetragona*, *Arctostaphylos alpina*, *Vaccinium uliginosum*, and *Salix reticulata* **Sedges:** *Carex scirpoidea* **Other Herbaceous:** *Equisetum arvense* **Mosses:** *Hylocomium splendens*, *Rhytidium rugosum*, and *Racomitrium lanuginosum* **Lichens:** *Umbilicaria* spp.
Sparsely Vegetated (Upland)	**Distribution:** Recently deposited alluvium or recently disturbed river channels in floodplains and deltas; coastal dunes; upper elevations in Brooks Range and foothills **Soils:** Sand or cobble in floodplains and deltas, sand on coastal dunes, thin and stony on slopes in Brooks Range and foothills **Hydrology:** Mesic to dry; floodplain sites are wet when flooded **Slope:** Flat to steep **Permafrost:** Typically absent **Patch Size:** Small to matrix-forming, may be linear in shape **Vegetation:** Total canopy cover of vascular plants is 10–25 percent; bryophyte cover may be greater than or equal to 25 percent. Lichen-dominated sites are uncommon in the region and were included in this class	**Shrubs:** *Salix alaxensis*, *S. glauca*, *Dryas octopetala*, *D. integrifolia*, *Cassiope tetragona*, *Arctostaphylos alpina*, *Vaccinium uliginosum*, and *Salix reticulata* **Grasses:** *Festuca rubra*, *F. brachyphylla*, *Leymus mollis*, *Deschampsia cespitosa*, *Elymus alaskanus*, and *Poa pratensis* ssp. *alpigena*, **Other Herbaceous:** *Epilobium angustifolium*, *Artemisia alaskana*, *A. borealis*, *A. tilesii*, *Hedysarum mackenzii*, *Honckenya peploides*, *Astragalus alpinus*, and *Taraxacum ceratophorum* **Mosses:** *Hylocomium splendens*, *Rhytidium rugosum*, and *Racomitrium lanuginosum* **Lichens:** *Umbilicaria* spp.
Bare Ground (Upland)	• Distribution and characteristics similar to Sparsely Vegetated • Total canopy cover of vascular plants greater than 10 percent • Bryophyte cover may be greater than or equal to 10 percent	N/A
Ice/Snow	• Cover of perennial ice and/or snow generally greater than or equal to 25 percent • Typically a mixture of rocky barrens with ice and snow	N/A
Burned Area	• No information in map summary	N/A
Unclassified (e.g., cloud and terrain shadow)	• No information in map summary	N/A

[a]Vegetation classes derived from the North Slope Science Initiative landcover map for the North Slope (Ducks Unlimited 2013); wetland types derived by crosswalking vegetation classes to National Wetland Inventory types and then to broad-scale wetland types (see **Table K-2**).

Table K-2
Crosswalk Between Broad-scale Vegetation Classes and Broad-scale Wetland Types Mapped in the NPR-A

NSSI Vegetation Class[1]	Vegetation Characteristics	NWI Wetland Class[2]	Broad-scale Wetland Type
Open Water	N/A	PUBH, L1UBH, M1UBL, E1UBL, R2UBH, R1UBV	Open Water
Marine Beach/Beach Meadow	Coastal beaches, dunes, spits, and barrier islands typically dominated by *Leymus mollis* or *Honckenya peploides*	E2USN	Marine Intertidal
Coastal Marsh	Sites are subject to regular to infrequent tidal inundation, including storm surges; vascular plant cover is greater than or equal to 10 percent	E2EM1N	Estuarine Intertidal Vegetated
Freshwater Marsh: *Arctophila fulva*	Dominant vegetation is emergent, dominated by *Arctophila fulva*	PEM2H, PABH	Freshwater Emergent
Freshwater Marsh: *Carex aquatilis*	Dominant vegetation is emergent, not dominated by *Arctophila fulva*	PEM1G	Freshwater Emergent
Wet Sedge	Site is wet; cover of sedge species is greater than or equal to 25 percent; *Sphagnum* cover is greater than or equal to 25 percent	PEM1F	Freshwater Emergent
Wet Sedge-*Sphagnum*	Site is wet; cover of sedge species is greater than or equal to 25 percent; *Sphagnum* cover is less than 25 percent	PEM1F	Freshwater Emergent
Mesic Herbaceous	Site is dry to mesic; cover of shrubs is less than 25 percent; herbaceous cover is greater than or equal to 25 percent	PEM1B, PEM1D	Freshwater Emergent
Mesic Sedge-Dwarf Shrub Tundra	Cover of shrubs less than or equal to 20 centimeters tall is greater than or equal to 25 percent; sedge cover is greater than or equal to 25 percent	PEM1/SS1B, PEM1/SS3B	Freshwater Emergent
Tussock Tundra	Cover of shrubs less than or equal to 20 centimeters tall is less than 25 percent; cover of tussocks is greater than or equal to 35 percent	PEM1/SS1B	Freshwater Shrub
Tussock Shrub Tundra	Cover of shrubs greater than 20 centimeters tall is greater than or equal to 25 percent; cover of tussocks is greater than or equal to 35 percent	PSS1/EM1B	Freshwater Shrub

NSSI Vegetation Class[1]	Vegetation Characteristics	NWI Wetland Class[2]	Broad-scale Wetland Type
Dwarf Shrub	Cover of shrubs less than or equal to 20 centimeters tall is greater than or equal to 25 percent; sedge cover less than 25 percent; *Dryas* does not dominate or codominate dwarf shrub layer	PSS1B, PSS3B	Freshwater Shrub
Birch Ericaceous Low Shrub	Cover of shrubs greater than 20 centimeters tall is greater than or equal to 25 percent; species other than alder and willow dominate	PSS1B	Freshwater Shrub
Low-Tall Willow	Cover of shrubs >20 centimeters tall is >25% and willow comprises at least 25% of the total cover or dominates the low-tall shrub layer.	PSS1B	Freshwater Shrub
Alder	Shrub cover 25–50 percent, alder greater than or equal to 25 percent of total cover or dominates low-tall shrub layer	PSS1B	Freshwater Shrub
Dryas Dwarf Shrub	Cover of shrubs less than or equal to 20 centimeters tall is greater than or equal to 25 percent; sedge cover less than 25 percent; *Dryas* dominates or codominates dwarf shrub layer	U	Uplands
Sparsely Vegetated	Total canopy cover of vascular plants is 10–25 percent; bryophyte cover is sometimes greater than or equal to 25 percent	U	Uplands
Bare Ground	Total canopy cover of vascular plants is less than 10 percent; bryophyte cover is sometimes greater than or equal to 10 percent	U	Uplands
Ice/Snow	N/A	N/A	None
Burned Area	N/A	N/A	Freshwater Emergent
Unclassified (e.g., cloud, terrain shadow)	N/A	N/A	None

[1]Vegetation classes derived from the North Slope Science Initiative (NSSI) landcover map for the North Slope (Ducks Unlimited 2013)
[2]National Wetland Inventory (NWI) wetland classes from Federal Geographic Data Committee (2013)

Table K-3
Applicable Required Operating Procedures and Lease Stipulations under Standard Terms and Conditions, No Surface Occupancy, Controlled Surface Use, and Closed to Leasing Management Categories: Effects on Wetlands, Waters, and Vegetation

Best Management Practice (BMP) or Lease Stipulation #	ROP or Lease Stipulation Number	Title	Management Category	Effects on Wetlands, Waters, and Vegetation
BMP A-3	ROP A-3	Hazardous Subsstances Contingency Plans	Standard Terms and Conditions	Reduce wetland and vegetation degradation and pollution of waters with effective contingency planning
BMP A-4	ROP A-4	Spill Prevention	Standard Terms and Conditions	Reduce wetland and vegetation degradation and pollution of waters with effective spill response planning
BMP A-5	ROP A-5	Refueling and Fuel Storage	Standard Terms and Conditions	Reduce pollutants to waters by prohibiting refueling within 100 feet (30.48 meters) of a floodplain or water
BMP B-1	ROP B-1	Water Use from Rivers and Streams	Standard Terms and Conditions	Maintain aquatic habitats by prohibiting unfrozen water withdrawal from rivers and streams during winter
BMP B-2	ROP B-2	Water Use from Lakes	Standard Terms and Conditions	Prevent degradation of aquatic habitats and lacustrine fringe wetlands and vegetation by limiting removal of unfrozen water and grounded ice in winter
BMP C-2	ROP C-2	Winter Tundra Travel	Standard Terms and Conditions	Reduce long-term vegetation damage and soil compaction with specific operating criteria (e.g., use of low ground pressure vehicles, snow depth requirements, and avoidance of sensitive areas)
BMP C-3	ROP C-3	Ice Bridges	Standard Terms and Conditions	Reduce the degradation of lotic waters and floodplains by reducing the risk of flooding
BMP C-4	ROP C-4	Winter Travel Along Streambeds	Standard Terms and Conditions	Reduce impacts on fish habitat in lotic waters from the construction of ice roads along streambeds
Stipulation E-3	ROP E-3	Shoreline Infrastructure	Standard Terms and Conditions	Reduce impacts on fish habitat in lotic and marine waters
BMP E-5	ROP E-5	Minimize Development Footprint	Standard Terms and Conditions	Reduce permanent impacts on wetlands and waters from placement of fill, compliance with avoidance and minimization requirements of the Clean Water Act
BMP E-6	ROP E-6	Stream Crossing Design	Standard Terms and Conditions	Reduce degradation of lotic waters and floodplain wetlands and vegetation

Best Management Practice (BMP) or Lease Stipulation #	ROP or Lease Stipulation Number	Title	Management Category	Effects on Wetlands, Waters, and Vegetation
BMP E-8	ROP E-8	Sand and Gravel Mining	Standard Terms and Conditions	Ensure that mine site construction and reclamation complies with state and federal requirments including permitting under the Clean Water Act
BMP E-11	ROP E-11	Protections for Sensitive Bird Species	Standard Terms and Conditions	Reduces impacts on high-value Eider and Loon wetland habitats and vegetation
BMP E-12	ROP E-12	Use of Ecological Mapping	Standard Terms and Conditions	Provides planning level information on wetland vegetation and soils
BMP E-19	ROP E-19	GIS Files for Proposed Infrastructure	Standard Terms and Conditions	Provides planning level information for use with Ecological Mapping as advance compliance to the Clean Water Act
Stipulation G-1	ROP G-1	Reclamation of BLM Managed Land	Standard Terms and Conditions	Contribution to potential mitigation planning required for the Clean Water Act permitting process. Not included for Alternative E but similar requirements listed in Lease Notice 3
BMP L-1	ROP L-1	Tundra Travel	Standard Terms and Conditions	Reduce degradation of lotic waters and floodplain wetlands and vegetation by reviewing plans for non-winter tundra travel
BMP M-2	ROP M-2	Invasive Species Prevention Plan	Standard Terms and Conditions	Reduce degradation of wetland vegetation communities through development of an invasive species prevention plan, compliance in mitigation planning for Clean Water Act permitting requirements
BMP M-3	ROP M-3	Surveys for Sensitive Plant Species	Standard Terms and Conditions	Minimize the loss of populations of and habitat for sensitive plant species. Not applicable to Alternative E, similar requirments provided in ROP E-12
No similar requirement.	ROP M-5	Minimize Bare Soil	Standard Terms and Conditions	Reduce degradation of wetlands and vegetation from fugitive dust deposition
Stipulation K-1	Stipulation K-1	River Setbacks	No surface occupancy (NSO)	Reduce footprints of gravel fill in the highest value wetlands and vegetation along riparian corridors
Stipulation K-2	Stipulation K-2	Deep Water Lakes	NSO	Reduce or restrict impacts on the highest value littoral fringe wetlands and vegetation
Stipulation K-3	Stipulation K-3	Waterbodies and Riparian Areas	Standard Terms and Conditions	Prevent impacts on waterbodies and riparian areas due to exploratory drilling

Best Management Practice (BMP) or Lease Stipulation #	ROP or Lease Stipulation Number	Title	Management Category	Effects on Wetlands, Waters, and Vegetation
Stipulation K-4	Stipulation K-4	Kogru River, Dease Inlet, Admiralty Bay, Elson Lagoon, Peard Bar, Wainwright Intlet/Kuk River, and Kasegaluk Lagoon, and their associated islands	Closed to Leasing and NSO, variable by alternative	Preserve or reduce impacts on high-value riparian and estuarine wetlands and waters
Stipulation K-5	Stipulation K-5	Coastal Area Setback	Closed to Leasing and NSO	Preserve or reduce impacts on high-value nearshore coastal waters
Stipulation K-6	Stipulation K-6	Goose Molting Area	Closed to Leasing, NSO, and contolled surface use, variable by alternative	Preserve high-value wetland habitat important for goose molting
No similar requirement.	Stipulation K-7	Goose Molting Lakes	NSO	Preserve high-value littoral fringe wetlands and vegetation surrounding goose molting lakes in Alternative D only
Stipulation K-8	Stipulation K-8	Brant Survey Area	Closed to Leasing, NSO, and contolled surface use, variable by alternative	Reduces or restricts impacts on littoral areas within Brant colony areas
Stipulation K-9	Stipulation K-9	Teshekpuk Caribou Habitat Area	Closed to Leasing and NSO, variable by alternative	Preserves or restricts impacts on high-value freshwater emergent wetlands and vegetation in the Teshekpuk Lake Special Area or specified buffers around the lake
Stipulation K-13	Stipulation K-13	Pik Dunes	Closed to Leasing and NSO, variable by alternative	Preserves or restricts impacts on sensitive wetland areas and vegetation within the Pik Dunes
Stipulation K-14	Stipulation K-14	Utukok River Uplands Special Area	Closed to Leasing	Preserves wetlands and vegetation within special area boundaries
No similar requirement.	Stipulation K-15	Federal Mineral Estate under Allotments	NSO	Reduces impacts on wetlands and vegetation within specified buffer distances from native allotments
Stipulation K-17	Stipulation K-17	Federal Mineral Estate under Native Lands	Closed to Leasing and NSO, variable by alternative	Reduces impacts on wetlands and vegetation within native lands

Table K-4
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to Standard Terms and Conditions within the High Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	Standard Terms and Conditions									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	184,000	13	155,000	13	203,000	13	210,000	13	197,000	13
Marine Beach/Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	4,000	0	4,000	0	4,000	0	5,000	0	5,000	0
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	163,000	11	120,000	10	178,000	11	183,000	12	163,000	11
Wet Sedge	Freshwater Emergent	221,000	15	153,000	13	217,000	14	221,000	14	201,000	13
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	8,000	1	3,000	0	7,000	0	7,000	0	4,000	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	42,000	3	18,000	2	37,000	2	37,000	2	27,000	2
Tussock Tundra	Freshwater Emergent	458,000	32	471,000	39	542,000	35	544,000	35	530,000	36
Tussock Shrub Tundra	Freshwater Emergent	280,000	20	222,000	19	285,000	18	285,000	18	282,000	19
Dwarf Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Birch Ericaceous Low Shrub	Freshwater Shrub	20,000	1	15,000	1	20,000	1	20,000	1	22,000	1
Low-Tall Willow	Freshwater Shrub	27,000	2	20,000	2	27,000	2	27,000	2	28,000	2
Alder	Freshwater Shrub	7,000	0	1,000	0	5,000	0	5,000	0	8,000	1
Dryas Dwarf Shrub	Upland	9,000	1	7,000	1	10,000	1	10,000	1	9,000	1
Sparsely Vegetated	Upland	4,000	0	3,000	0	3,000	0	4,000	0	4,000	0
Bare Ground	Upland	10,000	1	7,000	1	9,000	1	9,000	1	8,000	1
Ice/Snow	Unknown	1,000	0	0	0	1,000	0	1,000	0	1,000	0
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	0	0	0	0
Totals		**1,436,000**	**100**	**1,199,000**	**100**	**1,547,000**	**100**	**1,567,000**	**100**	**1,487,000**	**100**

Source: BLM GIS 2019

Table K-5
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to Standard Terms and Conditions within the Medium Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	Standard Terms and Conditions									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	408,000	9	227,000	7	329,000	8	418,000	9	405,000	9
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	28,000	1	16,000	0	22,000	1	27,000	1	26,000	1
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	350,000	8	168,000	5	266,000	6	346,000	8	334,000	7
Wet Sedge	Freshwater Emergent	457,000	10	274,000	8	365,000	9	444,000	10	428,000	9
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	2,000	0	1,000	0	2,000	0	2,000	0	2,000	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	33,000	1	31,000	1	33,000	1	33,000	1	34,000	1
Tussock Tundra	Freshwater Emergent	1,112,000	24	802,000	23	993,000	24	1,089,000	24	1,094,000	24
Tussock Shrub Tundra	Freshwater Emergent	1,852,000	40	1,636,000	48	1,850,000	44	1,859,000	41	1,906,000	42
Dwarf Shrub	Freshwater Shrub	16,000	0	13,000	0	15,000	0	16,000	0	17,000	0
Birch Ericaceous Low Shrub	Freshwater Shrub	37,000	1	31,000	1	37,000	1	37,000	1	39,000	1
Low-Tall Willow	Freshwater Shrub	251,000	5	191,000	6	233,000	6	245,000	5	249,000	5
Alder	Freshwater Shrub	23,000	0	16,000	0	23,000	1	23,000	1	26,000	1
Dryas Dwarf Shrub	Upland	5,000	0	4,000	0	5,000	0	6,000	0	6,000	0
Sparsely Vegetated	Upland	5,000	0	3,000	0	4,000	0	4,000	0	4,000	0
Bare Ground	Upland	11,000	0	7,000	0	8,000	0	8,000	0	8,000	0
Ice/Snow	Unknown	2,000	0	0	0	0	0	1,000	0	0	0
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	0	0	0	0
Totals		**4,591,000**	**100**	**3,420,000**	**100**	**4,186,000**	**100**	**4,558,000**	**100**	**4,578,000**	**100**

Source: BLM GIS 2019

Table K-6
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to Standard Terms and Conditions within the Low Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	Standard Terms and Conditions									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	208,000	6	129,000	6	170,000	6	221,000	7	194,000	6
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	25,000	1	17,000	1	22,000	1	24,000	1	24,000	1
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	311,000	10	200,000	9	259,000	9	295,000	10	294,000	10
Wet Sedge	Freshwater Emergent	445,000	14	264,000	12	340,000	12	391,000	13	391,000	13
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	19,000	1	20,000	1	25,000	1	25,000	1	26,000	1
Tussock Tundra	Freshwater Emergent	899,000	28	555,000	26	693,000	25	785,000	26	782,000	26
Tussock Shrub Tundra	Freshwater Emergent	1,170,000	36	849,000	40	1,081,000	40	1,114,000	37	1,155,000	38
Dwarf Shrub	Freshwater Shrub	21,000	1	19,000	1	23,000	1	24,000	1	24,000	1
Birch Ericaceous Low Shrub	Freshwater Shrub	51,000	2	15,000	1	17,000	1	18,000	1	18,000	1
Low-Tall Willow	Freshwater Shrub	90,000	3	74,000	3	98,000	4	102,000	3	107,000	4
Alder	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Dryas Dwarf Shrub	Upland	3,000	0	3,000	0	3,000	0	4,000	0	4,000	0
Sparsely Vegetated	Upland	4,000	0	3,000	0	4,000	0	4,000	0	4,000	0
Bare Ground	Upland	2,000	0	1,000	0	1,000	0	2,000	0	2,000	0
Ice/Snow	Unknown	0	0	0	0	0	0	0	0	0	0
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	**Unknown**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Totals		**3,247,000**	**100**	**2,149,000**	**100**	**2,735,000**	**100**	**3,009,000**	**100**	**3,024,000**	**100**

Source: BLM GIS 2019

Table K-7
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to No Surface Occupancy Stipulations within the High Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	No Surface Occupancy									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	84,000	13	101,000	13	295,000	21	425,000	27	427,000	26
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	1,000	0	0	0	3,000	0	5,000	0	5,000	0
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	55,000	9	60,000	8	197,000	14	217,000	14	231,000	14
Wet Sedge	Freshwater Emergent	61,000	10	56,000	7	216,000	16	232,000	15	249,000	15
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	6,000	1	10,000	1	7,000	0	7,000	0	9,000	1
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	34,000	5	54,000	7	39,000	3	39,000	2	49,000	3
Tussock Tundra	Freshwater Emergent	145,000	23	152,000	19	288,000	21	223,000	14	237,000	15
Tussock Shrub Tundra	Freshwater Emergent	160,000	25	234,000	30	192,000	14	178,000	11	181,000	11
Dwarf Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Birch Ericaceous Low Shrub	Freshwater Shrub	15,000	2	20,000	3	16,000	1	15,000	1	14,000	1
Low-Tall Willow	Freshwater Shrub	37,000	6	46,000	6	43,000	3	43,000	3	42,000	3
Alder	Freshwater Shrub	7,000	1	12,000	2	8,000	1	8,000	1	6,000	0
Dryas Dwarf Shrub	Upland	15,000	2	17,000	2	20,000	1	19,000	1	20,000	1
Sparsely Vegetated	Upland	7,000	1	6,000	1	14,000	1	14,000	1	15,000	1
Bare Ground	Upland	11,000	2	9,000	1	40,000	3	47,000	3	48,000	3
Ice/Snow	Unknown	2,000	0	2,000	0	5,000	0	98,000	6	98,000	6
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	1,000	0	1,000	0
Totals		**638,000**	**100**	**779,000**	**100**	**1,381,000**	**100**	**1,571,000**	**100**	**1,631,000**	**100**

Source: BLM GIS 2019

Table K-8
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to No Surface Occupancy Stipulations within the High Development Potential Zone (showing acres with existing leases, which may be open subject only to Standard Terms and Conditions): All Alternatives

Vegetation Class	Wetland Type	No Surface Occupancy (Showing Acres with Existing Leases)									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Total	**Leased**	**Total**	**Leased**	**Total**	**Leased**	**Total**	**Leased**	**Total**	**Leased**
Open Water	Open Water	84,000	80,000	101,000	73,000	295,000	99,000	425,000	82,000	427,000	102,000
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	1,000	1,000	0	0	3,000	1,000	5,000	1,000	5,000	1,000
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	55,000	50,000	60,000	55,000	197,000	65,000	217,000	54,000	231,000	81,000
Wet Sedge	Freshwater Emergent	61,000	57,000	56,000	52,000	216,000	84,000	232,000	60,000	249,000	96,000
Mesic Herbaceous	Freshwater Emergent	6,000	5,000	10,000	9,000	7,000	6,000	7,000	6,000	9,000	8,000
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	34,000	28,000	54,000	47,000	39,000	33,000	39,000	33,000	49,000	43,000
Tussock Tundra	Freshwater Emergent	145,000	102,000	152,000	96,000	288,000	121,000	223,000	104,000	237,000	140,000
Tussock Shrub Tundra	Freshwater Emergent	160,000	97,000	234,000	135,000	192,000	106,000	178,000	106,000	181,000	111,000
Dwarf Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Birch Ericaceous Low Shrub	Freshwater Shrub	15,000	8,000	20,000	11,000	16,000	9,000	15,000	9,000	14,000	8,000
Low-Tall Willow	Freshwater Shrub	37,000	25,000	46,000	29,000	43,000	26,000	43,000	26,000	42,000	26,000
Alder	Freshwater Shrub	7,000	3,000	12,000	5,000	8,000	4,000	8,000	4,000	6,000	2,000
Dryas Dwarf Shrub	Upland	15,000	12,000	17,000	13,000	20,000	12,000	19,000	12,000	20,000	13,000
Sparsely Vegetated	Upland	7,000	6,000	6,000	5,000	14,000	7,000	14,000	7,000	15,000	7,000
Bare Ground	Upland	11,000	9,000	9,000	7,000	40,000	10,000	47,000	9,000	48,000	11,000
Ice/Snow	Unknown	2,000	2,000	2,000	2,000	5,000	2,000	98,000	2,000	98,000	2,000
Totals		**638,000**	**485,000**	**779,000**	**537,000**	**1,381,000**	**585,000**	**1,571,000**	**514,000**	**1,631,000**	**651,000**

Source: BLM GIS 2019
Note: Vegetation classes with no acres subject to no surface occupancy within the high development potential zone are not shown in this table.

Table K-9
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to No Surface Occupancy Stipulations within the Medium Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	No Surface Occupancy									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	154,000	13	244,000	13	282,000	26	423,000	21	436,000	22
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	8,000	1	14,000	1	5,000	0	12,000	1	13,000	1
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	100,000	9	184,000	10	165,000	15	262,000	13	275,000	14
Wet Sedge	Freshwater Emergent	156,000	13	236,000	13	168,000	16	282,000	14	298,000	15
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	1,000	0	1,000	0	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	9,000	1	11,000	1	8,000	1	10,000	0	9,000	0
Tussock Tundra	Freshwater Emergent	282,000	24	464,000	25	242,000	22	363,000	18	358,000	18
Tussock Shrub Tundra	Freshwater Emergent	306,000	26	518,000	28	101,000	9	311,000	15	264,000	13
Dwarf Shrub	Freshwater Shrub	9,000	1	11,000	1	1,000	0	10,000	0	9,000	0
Birch Ericaceous Low Shrub	Freshwater Shrub	9,000	1	15,000	1	7,000	1	9,000	0	7,000	0
Low-Tall Willow	Freshwater Shrub	78,000	7	119,000	6	34,000	3	97,000	5	92,000	5
Alder	Freshwater Shrub	10,000	1	16,000	1	4,000	0	10,000	0	6,000	0
Dryas Dwarf Shrub	Upland	3,000	0	4,000	0	9,000	1	8,000	0	8,000	0
Sparsely Vegetated	Upland	8,000	1	7,000	0	9,000	1	18,000	1	18,000	1
Bare Ground	Upland	27,000	2	28,000	1	39,000	4	63,000	3	63,000	3
Ice/Snow	Unknown	1,000	0	0	0	2,000	0	145,000	7	147,000	7
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	0	0	0	0
Totals		**1,159,000**	**100**	**1,873,000**	**100**	**1,077,000**	**100**	**2,022,000**	**100**	**2,004,000**	**100**

Source: BLM GIS 2019

Table K-10
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to No Surface Occupancy Stipulations within the Medium Development Potential Zone (showing acres with existing leases,which may be open subject only to Standard Terms and Conditions): All Alternatives

Vegetation Class	Wetland Type	No Surface Occupancy (Showing Acres with Existing Leases)									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Total	Leased	Total	Leased	Total	Leased	Total	Leased	Total	Leased
Open Water	Open Water	154,000	76,000	244,000	80,000	282,000	87,000	423,000	80,000	436,000	78,000
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	8,000	2,000	14,000	4,000	5,000	3,000	12,000	2,000	13,000	2,000
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	100,000	28,000	184,000	35,000	165,000	33,000	262,000	30,000	275,000	28,000
Wet Sedge	Freshwater Emergent	156,000	32,000	236,000	41,000	168,000	36,000	282,000	33,000	298,000	31,000
Mesic Herbaceous	Freshwater Emergent	0	0	1,000	0	1,000	0	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	9,000	2,000	11,000	3,000	8,000	2,000	10,000	2,000	9,000	2,000
Tussock Tundra	Freshwater Emergent	282,000	62,000	464,000	93,000	242,000	75,000	363,000	65,000	358,000	60,000
Tussock Shrub Tundra	Freshwater Emergent	306,000	14,000	518,000	20,000	101,000	15,000	311,000	14,000	264,000	12,000
Dwarf Shrub	Freshwater Shrub	9,000	0	11,000	0	1,000	0	10,000	0	9,000	0
Birch Ericaceous Low Shrub	Freshwater Shrub	9,000	0	15,000	0	7,000	0	9,000	0	7,000	0
Low-Tall Willow	Freshwater Shrub	78,000	15,000	119,000	19,000	34,000	17,000	97,000	15,000	92,000	14,000
Alder	Freshwater Shrub	10,000	0	16,000	0	4,000	0	10,000	0	6,000	0
Dryas Dwarf Shrub	Upland	3,000	2,000	4,000	2,000	9,000	2,000	8,000	2,000	8,000	2,000
Sparsely Vegetated	Upland	8,000	2,000	7,000	2,000	9,000	2,000	18,000	2,000	18,000	2,000
Bare Ground	Upland	27,000	9,000	28,000	9,000	39,000	9,000	63,000	9,000	63,000	9,000
Ice/Snow	Unknown	1,000	0	0	0	2,000	0	145,000	0	147,000	0
Totals		**1,159,000**	**244,000**	**1,873,000**	**307,000**	**1,077,000**	**585,000**	**2,022,000**	**254,000**	**1,631,000**	**242,000**

Source: BLM GIS 2019
Note: Vegetation classes with no acres subject to no surface occupancy within the medium development potential zone are not shown in this table.

Table K-11
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to No Surface Occupancy Stipulations within the Low Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	No Surface Occupancy									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	38,000	6	104,000	7	18,000	1	65,000	6	106,000	5
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	1,000	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	1,000	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	3,000	0	9,000	1	5,000	0	3,000	0	3,000	0
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	30,000	4	121,000	8	74,000	5	37,000	3	51,000	2
Wet Sedge	Freshwater Emergent	74,000	11	197,000	13	0	0	127,000	11	251,000	11
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	0	0	20,000	1	1,000	0	13,000	1
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	8,000	1	12,000	1	117,000	8	19,000	2	77,000	3
Tussock Tundra	Freshwater Emergent	198,000	29	401,000	27	182,000	13	253,000	22	436,000	19
Tussock Shrub Tundra	Freshwater Emergent	269,000	39	518,000	35	352,000	24	455,000	40	665,000	29
Dwarf Shrub	Freshwater Shrub	9,000	1	13,000	1	36,000	2	34,000	3	210,000	9
Birch Ericaceous Low Shrub	Freshwater Shrub	17,000	2	9,000	1	22,000	2	15,000	1	18,000	1
Low-Tall Willow	Freshwater Shrub	38,000	5	76,000	5	85,000	6	80,000	7	118,000	5
Alder	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Dryas Dwarf Shrub	Upland	3,000	0	4,000	0	11,000	1	10,000	1	84,000	4
Sparsely Vegetated	Upland	2,000	0	5,000	0	502,000	35	18,000	2	151,000	7
Bare Ground	Upland	4,000	1	10,000	1	22,000	2	21,000	2	120,000	5
Ice/Snow	Unknown	0	0	0	0	0	0	0	0	0	0
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	0	0	1,000	0
Totals		**691,000**	**100**	**1,479,000**	**100**	**1,446,000**	**100**	**1,138,000**	**100**	**2,304,000**	**100**

Source: BLM GIS 2019
Note: No existing leases are present within the low development potential zone.

Table K-12
Acres of Vegetation and Wetland Classes in Areas Open to Leasing and Subject to Contolled Surface Use Stipulations within the High and Medium Development Potential Zones: Alternatives D and E

Vegetation Class	Wetland Type	Contolled Surface Use Stipulations							
		Alternative D				Alternative E			
		High Development Potential Zone		Medium Development Potential Zone		High Development Potential Zone		Medium Development Potential Zone	
		Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	55,000	30	50,000	20	57,000	31	50,000	27
Marine Beach/Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	1,000	1	3,000	1	2,000	1	3,000	1
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	41,000	22	79,000	31	42,000	22	79,000	42
Wet Sedge	Freshwater Emergent	49,000	27	70,000	28	49,000	26	70,000	38
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	0	0	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	0	0	0	0	0	0	0	0
Tussock Tundra	Freshwater Emergent	17,000	10	34,000	14	18,000	10	34,000	18
Tussock Shrub Tundra	Freshwater Emergent	0	0	1,000	0	0	0	1,000	0
Dwarf Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0
Birch Ericaceous Low Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0
Low-Tall Willow	Freshwater Shrub	1,000	0	3,000	1	1,000	0	3,000	2
Alder	Freshwater Shrub	0	0	0	0	0	0	0	0
Dryas Dwarf Shrub	Upland	1,000	0	0	0	1,000	0	0	0
Sparsely Vegetated	Upland	0	0	2,000	1	0	0	2,000	1
Bare Ground	Upland	5,000	3	2,000	1	5,000	3	2,000	1
Ice/Snow	Unknown	12,000	6	7,000	3	12,000	6	7,000	4
Burned Area	Unknown	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	0	0
Totals		**183,000**	**100**	**251,000**	**100**	**187,000**	**100**	**251,000**	**100**

Source: BLM GIS 2019
Note: No acres are subject to contolled surface use stipulations under Alternative A, B, or C.

Table K-13
Acres of Vegetation and Wetland Classes in Areas Closed to Leasing within the High Development Potential Zone (showing acres with existing leases, which may be open subject only to Standard Terms and Conditions): Alternatives A, B, and C

Vegetation Class	Wetland Type	Closed to Leasing (showing acres with existing leases)							
		Alternative A			Alternative B			Alternative C[a]	
		Leased	Total	%	Leased	Total	%	Total	%
Open Water	Open Water	3,000	577,000	29	66,000	588,000	28	317,000	31
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	0	9,000	0	1,000	9,000	0	6,000	1
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	10,000	375,000	19	55,000	413,000	20	185,000	18
Wet Sedge	Freshwater Emergent	4,000	442,000	22	95,000	515,000	24	251,000	25
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	0	0	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	0	0	0	2,000	4,000	0	0	0
Tussock Tundra	Freshwater Emergent	0	376,000	19	72,000	356,000	17	119,000	12
Tussock Shrub Tundra	Freshwater Emergent	0	40,000	2	1,000	24,000	1	3,000	0
Dwarf Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0
Birch Ericaceous Low Shrub	Freshwater Shrub	0	1,000	0	0	1,000	0	0	0
Low-Tall Willow	Freshwater Shrub	0	9,000	0	1,000	9,000	0	4,000	0
Alder	Freshwater Shrub	0	0	0	0	0	0	0	0
Dryas Dwarf Shrub	Upland	0	10,000	0	1,000	10,000	0	3,000	0
Sparsely Vegetated	Upland	0	10,000	0	3,000	13,000	1	3,000	0
Bare Ground	Upland	0	50,000	2	6,000	55,000	3	19,000	2
Ice/Snow	Unknown	0	107,000	5	0	107,000	5	105,000	10
Burned Area	Unknown	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	2,000	0	0	2,000	0	2,000	0
Totals		**17,000**	**2,008,000**	**100**	**302,000**	**2,103,000**	**100**	**1,017,000**	**100**

Source: BLM GIS 2019
Note: No areas are closed to leasing within the high development potential zone under Alternative D or E.
[a]No existing leases are present in areas closed to leasing under Alternative C within the high development potential zone.

Table K-14
Acres of Vegetation and Wetland Classes in Areas Closed to Leasing within the Medium Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	Closed to Leasing									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	391,000	27	481,000	25	118,000	46	1,300	36	900	100
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0	0	0	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	9,000	1	14,000	1	0	0	0	0	0	0
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	326,000	23	425,000	22	1,000	0	200	6	0	0
Wet Sedge	Freshwater Emergent	253,000	18	356,000	19	1,000	0	400	11	0	0
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Tussock Tundra	Freshwater Emergent	194,000	14	322,000	17	1,000	0	1,100	31	0	0
Tussock Shrub Tundra	Freshwater Emergent	26,000	2	29,000	2	0	0	400	11	0	0
Dwarf Shrub	Freshwater Shrub	0	0	2,000	0	0	0	0	0	0	0
Birch Ericaceous Low Shrub	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Low-Tall Willow	Freshwater Shrub	29,000	2	47,000	2	0	0	100	3	0	0
Alder	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Dryas Dwarf Shrub	Upland	7,000	0	7,000	0	0	0	0	0	0	0
Sparsely Vegetated	Upland	12,000	1	14,000	1	1,000	0	0	0	0	0
Bare Ground	Upland	37,000	3	40,000	2	3,000	1	100	3	0	0
Ice/Snow	Unknown	151,000	11	154,000	8	133,000	51	0	0	0	0
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	0	0	0	0	0	0	0	0	0	0
Totals		**1,434,000**	**100**	**1,890,000**	**100**	**258,000**	**100**	**4,000**	**100**	**900**	**100**

Source: BLM GIS 2019

Table K-15
Acres of Vegetation and Wetland Classes in Areas Closed to Leasing within the Medium Development Potential Zone (showing acres with existing leases, which may be open subject only to Standard Terms and Conditions): Alternatives A and B

Vegetation Class	Wetland Type	Closed to Leasing (showing acres with existing leases)			
		Alternative A		Alternative B	
		Total	Leased	Total	Leased
Open Water	Open Water	391,000	4,000	481,000	42,000
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	0	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	9,000	0	14,000	1,000
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	326,000	4,000	425,000	35,000
Wet Sedge	Freshwater Emergent	253,000	3,000	356,000	30,000
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	0	0	0	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	0	0	0	0
Tussock Tundra	Freshwater Emergent	194,000	3,000	322,000	63,000
Tussock Shrub Tundra	Freshwater Emergent	26,000	0	29,000	7,000
Dwarf Shrub	Freshwater Shrub	0	0	2,000	0
Birch Ericaceous Low Shrub	Freshwater Shrub	0	0	0	0
Low-Tall Willow	Freshwater Shrub	29,000	0	47,000	9,000
Alder	Freshwater Shrub	0	0	0	0
Dryas Dwarf Shrub	Upland	7,000	0	7,000	0
Sparsely Vegetated	Upland	12,000	0	14,000	0
Bare Ground	Upland	37,000	0	40,000	1,000
Ice/Snow	Unknown	151,000	0	154,000	0
Burned Area	Unknown	0	0	0	0
Unclassified	Unknown	0	0	0	0
Totals		**1,434,000**	**15,000**	**1,890,000**	**189,000**

Source: BLM GIS 2019
Note: No existing leases are present in areas closed to leasing under Alternative C, D, or E within the medium development potential zone.

Table K-16
Acres of Vegetation and Wetland Classes in Areas Closed to Leasing within the Low Development Potential Zone: All Alternatives

Vegetation Class	Wetland Type	Closed to Leasing									
		Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
		Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Open Water	Open Water	222,000	3	235,000	3	159,000	4	159,000	4	150,000	4
Marine Beach/ Beach Meadow	Marine Intertidal	0	0	0	0	0	0	0	0	0	0
Coastal Marsh	Estuarine Intertidal Vegetated	1,000	0	1,000	0	1,000	0	1,000	0	0	0
Freshwater Marsh (*Arctophila fulva*)	Freshwater Emergent	2,000	0	3,000	0	2,000	0	2,000	0	1,000	0
Freshwater Marsh (*Carex aquatilis*)	Freshwater Emergent	45,000	1	64,000	1	34,000	1	34,000	1	23,000	1
Wet Sedge	Freshwater Emergent	514,000	7	571,000	7	271,000	6	271,000	6	253,000	6
Wet Sedge-Sphagnum	Freshwater Emergent	0	0	0	0	0	0	0	0	0	0
Mesic Herbaceous	Freshwater Emergent	25,000	0	25,000	0	3,000	0	3,000	0	3,000	0
Mesic Sedge-Dwarf Shrub Tundra	Freshwater Emergent	369,000	5	363,000	5	233,000	6	233,000	6	232,000	6
Tussock Tundra	Freshwater Emergent	1,247,000	17	1,388,000	18	765,000	18	765,000	18	744,000	18
Tussock Shrub Tundra	Freshwater Emergent	3,467,000	46	3,539,000	45	1,948,000	47	1,948,000	47	1,945,000	47
Dwarf Shrub	Freshwater Shrub	656,000	9	654,000	8	369,000	9	369,000	9	368,000	9
Birch Ericaceous Low Shrub	Freshwater Shrub	79,000	1	122,000	2	77,000	2	77,000	2	77,000	2
Low-Tall Willow	Freshwater Shrub	390,000	5	369,000	5	198,000	5	198,000	5	196,000	5
Alder	Freshwater Shrub	0	0	0	0	0	0	0	0	0	0
Dryas Dwarf Shrub	Upland	179,000	2	178,000	2	68,000	2	68,000	2	68,000	2
Sparsely Vegetated	Upland	200,000	3	198,000	3	21,000	1	21,000	1	21,000	1
Bare Ground	Upland	154,000	2	149,000	2	21,000	1	21,000	1	18,000	0
Ice/Snow	Unknown	0	0	0	0	0	0	0	0	0	0
Burned Area	Unknown	0	0	0	0	0	0	0	0	0	0
Unclassified	Unknown	1,000	0	1,000	0	0	0	0	0	0	0
Totals		**7,550,000**	**100**	**7,860,000**	**100**	**4,170,000**	**100**	**4,170,000**	**100**	**4,100,000**	**100**

Source: BLM GIS 2019

K.1 REFERENCES

BLM (U.S. Department of the Interior Bureau of Land Management) GIS (Geographic Information System). 2019. GIS data used in the NPR-A Oil and Gas Leasing Program EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Ducks Unlimited. 2013. North Slope Science Initiative Landcover Mapping Summary Report. Rancho Cordova, CA. 51 pp.

FGDC (Federal Geographic Data Committee). 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STC-004-2013. 2nd edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.

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Appendix L
Supplementary Fish Information

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TABLES

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ACRONYMS AND ABBREVIATIONS

Acronym	Full Phrase
AWC	anadromous water catalogue
BLM	Bureau of Land Management
EFH	essential fish habitat
EIS	environmental impact statement
IAP	integrated activity plan
NPR-A	National Petroleum Reserve in Alaska
NSO	no surface occupancy
STC	standard terms and conditions
TL	time limitation

Appendix L. Supplementary Fish Information

Table L-1
Descriptions of Fish Habitat Units in the Planning Area

Fish Habitat Unit Description
Coastal Marine: This unit includes nearshore marine waters of the northeast Chukchi Sea and western Beaufort Sea, which are an extension of the inland fish habitat for many species within the National Petroleum Reserve in Alaska (NPR-A). The outer boundary of the unit is defined as 6.21 miles offshore and includes both brackish and marine waters. Shallow (less than 6.56 feet deep), nearshore waters of this zone are habitat to the highest fish densities, most of which also inhabit freshwater during their lifecycle. The unit's waters lie mostly outside of the NPR-A, though many larger bays and lagoons, including Kasegaluk and Elson lagoons, Peard and Admiralty bays, and Dease Inlet are part of the NPR-A. Tidal fluctuations are low, with amplitude rarely exceeding 1 foot along the Chukchi and Beaufort Sea coastlines. Water levels are affected more by winds than tides and can cause lagoons to rise or fall by 2 to 3 feet. Salinity may vary greatly, ranging from about 10 to 35 parts per thousand, depending on distance from the coast, depth, wind speed and direction and local freshwater input. Nearshore waters are frozen for eight to ten months annually, up to 6.56 feet thick by late winter. Highly saline, colder pockets of unfrozen water are formed due to salt exclusion during the coldest periods. Limited, deep overwintering holes may be present in coastal water or in adjacent river deltas for some species, depending on tolerance to temperature and salinity extremes. The Chukchi Sea coastline adjacent to the NPR-A is typically colder, more saline, and less biologically productive than the western Beaufort Sea coast due to a comparative lack of freshwater input and its distance from the warmer Alaska Coastal Current. The western Beaufort Sea coastline receives warmer marine currents and more freshwater inputs, resulting in a warmer, less saline and more productive feeding habitat for fish. The Beaufort Sea coast has more irregular shoreline, abundant mud flats, and protected lagoons and inlets compared to the Chukchi Sea coast. As a result the Beaufort Sea provides more overwintering refuge for fish and more anadromous fish compared to more marine fish along the Chukchi Sea.
Coastal Plain: This unit is the largest fish habitat unit in the NPR-A. Primary systems include Fish Creek, Teshekpuk Lake/Miguakiak River, and the Ikpikpuk, Chipp, Oumalik, Topagoruk, Meade, Inaru, Kugrua, and Kuk rivers. The unit terrain is low gradient, leading to generally slow-moving streams, unstable banks, and predominately sand and silt substrates. Most annual flow occurs at spring breakup after which flow is reduced significantly. During winter, deep river pools and extensive deltas provide overwintering habitat. After river corridors, the predominant aquatic habitat type is a landscape dominated by a dense concentration of lakes covering ~20 percent of the unit's surface area. A majority of the deepest lakes are concentrated in the central Coastal Plain Unit (see Appendix A, Map 3-7 in the Final IAP/EIS); however, lakes deep enough to provide overwintering habitat are present throughout the unit. Beaded streams with deep overwintering pools are common in this unit and represent important, extensive fish habitats in the Coastal Plain Unit.
Foothills: This unit is comprised of higher gradient waters that flow into the Coastal Plain Unit. Substrates are generally coarser (gravel and sand) and riverine waterbodies generally shallow. Overwintering habitat in channels is absent or sparse. A majority of flow occurs during breakup and some streams can cease flowing or become discontinuous prior to freeze-up. There are relatively few lakes compared to the Coastal Plain Unit and most shallow, providing only seasonal feeding habitat. Deep, overwintering lakes are scant.

Fish Habitat Unit Description
Lower Colville: This unit consists of the Colville River from the mouth of the Etivluk River downstream to its delta on the Beaufort Sea (see Appendix M, Map M-1 in the Final IAP/EIS). The Colville River is the largest river draining the Alaskan Arctic. The unit is marked by high bluffs, frequent rock outcroppings, and coarse substrate throughout much of the landscape. However, due to its length, some habitat transitions occur along its course. From the Etivluk River down to the Killik River, the Colville River is predominantly a single, narrow channel with few deep pools and an abundance of gravel. Downstream of the Killik River to Ocean Point, the Colville River is less confined and is characterized by braided channels, numerous deep pools, and gravel and sand substrate. Between Ocean Point and the terminus of the Colville River in the Beaufort Sea, the river is dominated by fine sediments and a single, deep channel that transitions into several channels in its delta. While most of the Colville River watershed downstream from the Etivluk River is outside of the NPR-A boundary, the lands to north and west of the river are managed by the Bureau of Land Management (BLM). Fish resources on BLM lands are heavily influenced by the Colville River and major tributaries flowing into it. Lake habitat is sparse relative to riverine habitat in the unit.
Mountain Headwaters: This unit includes the upper Colville River, upstream of the Etivluk River mouth, and its tributaries and is distinguished by major river tributaries that originate on the northern slopes of the Brooks Range. These tributaries are typically high-gradient and flow as single channels over gravel in narrow valleys. Additionally, their flow and turbidity fluctuate considerably during summer months as a response to precipitation. These rivers, including the upper portion of the Colville River may therefore become intermittent or discontinuous during drier periods. There are approximately 10 lakes with depths sufficient to provide fish overwintering habitat (>7 ft).Fish overwintering habitat is limited in the Mountain Headwaters Unit. Shallower lakes as well as small ponds and potholes with connectivity to major drainages may provide some spawning and feeding/rearing habitat during spring and summer months.
Utukok/Kokolik: This unit includes the portions of the Utukok and Kokolik river drainages that are within the NPR-A boundary. The upper Utukok River channel alternates between braided sections in flat landscape topography areas to more incised stream channels in the foothills. The lower river from Carbon Creek meanders in a single channel to the coast. Carbon Creek is the largest tributary to the Utukok River and together they provide may provide the bulk of available fish habitat in the Utukok watershed. Large gravel is abundant in the incised sections but smaller-sized substrate is more common in the rest of the river. Similar to the Utokok, the upper Kokolik River is more incised and flows through hilly landscapes to Avingak Creek. The substrate here is unique for the NPR-A, with cobble and boulders present, and includes several stretches of bedrock. The lower section is a standard meandering tundra river, with substrate transitioning toward sands and silt near the outlet. Overwintering habitat in the Utukok River is likely available only downstream of Carbon Creek, aside from an isolated spring found in the upper basin. The delta and a few deep pools in the upper reaches likely provide the bulk of the overwintering habitat in the Kokolike River. Most lakes in the unit are located in proximity to the lower portions of these rivers but tend to lack well-defined connectivity to the main river channels. The degree to which these lakes provide fish habitat is poorly documented.

Table L-2
Extent of Potential Fish Habitat within Fish Habitat Units in the Planning Area

Fish Habitat Unit	Surface Area in NPR-A (acres)[1]	Stream Miles[1]	Number of Lakes >10 Acres in Size	Surface Area (acres) of Lakes >10 Acres in Size
Coastal Marine	428,600	(Coastline length = 1,154 miles)		
Coastal Plain	8,986,800	9,900	14,397	1,758,500
Foothills	4,673,900	7,200	403	24,700
Lower Colville	1,128,200	3,400	615	31,400
Mountain Headwaters	4,201,000	7,700	328	14,700
Utukok/Kokolik	3,126,700	5,900	581	49,700

Source: Section 3.3.4.2 in BLM (2012); BLM-managed lands only; surface area, stream, and lake calculations from National Hydrography Dataset; coastline length derived from 1:63,360 U.S. Geological Survey quadrangle topographic map.
[1]Rounded to the nearest hundred

Table L-3
Fish Species Known to Occur in the Planning Area and Adjacent Coastal Waters

Common Name	Scientific Name	Iñupiaq Name
Freshwater species		
Alaska blackfish	*Dallia pectoralis*	Iłuuqiniq
Arctic char	*Salvelinus alpinus*	—
Arctic grayling	*Thymallus arcticus*	Sulukpaugaq
Burbot	*Lota lota*	Tittaaliq
Lake trout	*Salvelinus namaycush*	Iqaluaqpak
Longnose sucker	*Catostomus catostomus*	Milugiaq
Ninespine stickleback	*Pungitius pungitius*	Kakalisaauraq
Northern pike	*Esox lucius*	Siulik
Round whitefish	*Prosopium cylindraceum*	Savigunnaq
Slimy sculpin	*Cottus cognatus*	Kanayuq
Anadromous species		
Arctic cisco	*Coregonus autumnalis*	Qaataq
Arctic lamprey	*Lampetra japonica*	Nimigiaq
Bering cisco	*Coregonus laurettae*	Tiipuq
Broad whitefish	*Coregonus nasus*	Aanaaqłiq
Chinook salmon	*Oncorhynchus tschawytscha*	—
Chum salmon	*Oncorhynchus keta*	Iqalugruaq
Coho salmon	*Oncorhynchus kisutch*	—
Dolly varden	*Salvelinus malma*	Iqalukpik
Humpback whitefish	*Coregonus pidschian*	Piquktuuq
Least cisco	*Coregonus sardinella*	Iqalusaaq
Pink salmon	*Oncorhynchus gorbuscha*	Amaqtuuq
Rainbow smelt	*Osmerus mordax*	Iłhauġniq
Sockeye salmon	*Oncorhynchus nerka*	—
Threespine stickleback	*Gasterosteus aculatus*	—
Coastal marine species[1]		
Arctic cod	*Boregogadus saida*	Uugaq
Arctic flounder	*Liopsetta glacialis*	Nataaġnaq/Puyyagiaq
Capelin	*Mallotus villosus*	Panmigriq
Fourhorn sculpin	*Myoxocephalus quadricornus*	Kanayuq
Pacific herring	*Clupea harengus*	Uqsruqtuuq
Saffron cod	*Eleginus gracilis*	Uugaq

Source: Section 3.3.4.3 in BLM (2012)
[1]Principal (most commonly caught) coastal fish only

Table L-4
Acreage within Fish Habitat Units Open, Open under Specific Lease Stipulations, and Closed to Fluid Mineral Leasing by Alternative (Existing Lease Acreage in Parentheses)

Fish Habitat Unit	Alternative [acres x 1000]				
	A	B	C	D	E
Coastal Marine	**429**	**429**	**429**	**429**	**429**
Open-CSU[1]	–	–	–	–	–
Open-NSO[2]	3	–	34	289	295
Open-STC[3]	–	–	–	7	–
Open-TL[4]	–	–	–	–	
Closed	425	429	394	133	133
Coastal Plain	**9,193**	**9,193**	**9,193**	**9,193**	**9,193**
Open-CSU	–	–	–	434	438
Open-NSO	1,245 (481)	2,045 (539)	3,427 (602)	2,744 (503)	2,927 (634)
Open-STC	4,730 (1,672)	3, 293 (1,157)	4,247 (1,369)	4, 826 (1,401)	4,653 (1,311)
Open-TL	–	–	479 (216)	1,159 (284)	1,176 (242)
Closed	3,218 (34)	3,855 (491)	1,041	31	–
Foothills	**4,674**	**4,674**	**4,674**	**4,674**	**4,674**
Open-NSO	527	464	551	517	514
Open-STC	2,857	2,301	2,360	2,368	2,371
Open-TL	–	–	534	560	560
Closed	1,289	1,909	1,229	1,229	1,229
Lower Colville	**1,128**	**1,128**	**1,128**	**1,128**	**1,128**
Open-NSO	485 (247)	811 (305)	516 (265)	514 (264)	446 (259)
Open-STC	643 (174)	317 (116)	612 (157)	614 (157)	682 (162)
Closed	–	–	–	–	–
Mountain Headwaters	**4,201**	**4,201**	**4,201**	**4,201**	**4,201**
Open -NSO	95	561	511	491	1,297
Open-STC	444	545	850	867	930
Open-TL	–	–	2,058	2,061	1,192
Closed	3,663	3,095	782	782	782
Utukok/Kokolik	**3,127**	**3,127**	**3,127**	**3,127**	**3,127**
Open-NSO	133	251	229	177	459
Open-STC	599	310	398	451	451
Open-TL	–	–	502	502	260
Closed	2,395	2,566	1,997	1,197	1,956
Grand Total	**22,752,000**	**22,752,000**	**22,752,000**	**22,752,000**	**22,752,000**

Source: BLM GIS 2019
[1]Open subject to controlled surface use
[2]Open subject to no surface occupancy
[3]Open subject to standard terms and conditions (no special management protections for resources)
[4]Open subject to timing limitation

Table L-5
Anadromous Stream (AWC) Miles Open, Open under Specific Lease Stipulations, and Closed to Fluid Mineral Leasing by Alternative (Existing Lease Miles in Parentheses)

Leasing Status	Alternative (miles)				
	A	B	C	D	E
Open-CSU[1]	–	–	–	17	17
Open-NSO[2]	825 (327)	684 (255)	1,439 (367)	1,287 (329)	1,393 (407)
Open-STC[3]	419 (275)	316 (144)	423 (187)	490 (187)	437 (170)
Open-TL[4]	–	–	80 (51)	243 (89)	190 (29)
Closed	974 (4)	1,217 (206)	276	181	181
Total	**2,218**	**2,218**	**2,218**	**2,218**	**2,218**

Source: Johnson and Blossom 2019
[1]Open subject to controlled surface use
[2]Open subject to no surface occupancy
[3]Open subject to standard terms and conditions (no special management protections for resources)
[4]Open subject to timing limitation

Table L-6
Anadromous Stream (AWC) and Essential Fish Habitat (EFH) Coastline Miles Available, Conditionally Available (Available with Restrictions), and Unavailable for New Infrastructure by Alternative

Leasing Status	Alternative (miles)				
	A	B	C	D	E
Available[1] AWC	722	364	718	780	717
Available[1] EFH	75	15	15	19	29
Conditional[2] AWC	1,196	727	1,156	1,173	1,239
Conditional[2] EFH	412	485	549	370	532
Unavailable AWC	224	1,050	268	189	189
Unavailable EFH	80	67	67	–	–
Total	**2,709**	**2,647**	**2,756**	**2,531**	**2,145**

Source: Johnson and Blossom 2019
[1]Includes areas available for pipeline corridors; approximate pipeline corridor locations were defined for analysis, however, actual locations may differ
[2]Includes areas which are closed to new infrastructure development except for essential pipeline crossings, essential road crossings, or essential coastal infrastructure.

Table L-7
Acreage within Fish Habitat Units Available, Unavailable with Exceptions, and Unavailable for New Infrastructure by Alternative

Alternative [acres x 1000]									
A		**B**		**C**		**D**		**E**	
Available		**Available**		**Available**		**Available**		**Available**	
Coastal Marine Unit	17	Coastal Marine Unit	–	Coastal Marine Unit	–	Coastal Marine Unit	12	Coastal Marine Unit	12
Coastal Plain Unit	6,253	Coastal Plain Unit	4,143	Coastal Plain Unit	6,226	Coastal Plain Unit	6,666	Coastal Plain Unit	6,662
Foothills Unit	2,858	Foothills Unit	2,318	Foothills Unit	2,930	Foothills Unit	2,930	Foothills Unit	2,933
Lower Colville Unit	643	Lower Colville Unit	317	Lower Colville Unit	614	Lower Colville Unit	614	Lower Colville Unit	689
Mountain Headwaters Unit	444	Mountain Headwaters Unit	586	Mountain Headwaters Unit	2,934	Mountain Headwaters Unit	2,934	Mountain Headwaters Unit	2,128
Utukok/Kokolik Unit	599	Utukok/Kokolik Unit	455	Utukok/Kokolik Unit	958	Utukok/Kokolik Unit	958	Utukok/Kokolik Unit	716
Unavailable except CI[1]		**Unavailable except CI[1]**		**Unavailable except CI[1]**		**Unavailable except CI[1]**		**Unavailable except CI[1]**	
Coastal Marine Unit	1	Coastal Marine Unit	5	Coastal Marine Unit	18	Coastal Marine Unit	22	Coastal Marine Unit	22
Coastal Plain Unit	221	Coastal Plain Unit	72	Coastal Plain Unit	215	Coastal Plain Unit	230	Coastal Plain Unit	228
Utukok/Kokolik Unit	38	Utukok/Kokolik Unit	38	Utukok/Kokolik Unit	38	Utukok/Kokolik Unit	38	Utukok/Kokolik Unit	38
Unavailable except P[2]		**Unavailable except P[2]**		**Unavailable except P[2]**		**Unavailable except P[2]**		**Unavailable except P[2]**	
Coastal Marine Unit	398	Coastal Marine Unit	393	Coastal Marine Unit	398	Coastal Marine Unit	389	Coastal Marine Unit	389
Coastal Plain Unit	44	Coastal Plain Unit	30	Coastal Plain Unit	44	Coastal Plain Unit	188	Coastal Plain Unit	189
Unavailable except RP[3]		**Unavailable except RP[3]**		**Unavailable except RP[3]**		**Unavailable except RP[3]**		**Unavailable except RP[3]**	
Coastal Marine Unit	5	Coastal Marine Unit	–	Coastal Marine Unit	5	Coastal Marine Unit	5	Coastal Marine Unit	6
Coastal Plain Unit	1,448	Coastal Plain Unit	1,033	Coastal Plain Unit	1,464	Coastal Plain Unit	1,474	Coastal Plain Unit	1,540
Foothills Unit	526	Foothills Unit	446	Foothills Unit	514	Foothills Unit	514	Foothills Unit	511
Lower Colville Unit	484	Lower Colville Unit	809	Lower Colville Unit	513	Lower Colville Unit	513	Lower Colville Unit	437
Mountain Headwaters Unit	95	Mountain Headwaters Unit	520	Mountain Headwaters Unit	485	Mountain Headwaters Unit	485	Mountain Headwaters Unit	1,290
Utukok/Kokolik Unit	134	Utukok/Kokolik Unit	108	Utukok/Kokolik Unit	172	Utukok/Kokolik Unit	172	Utukok/Kokolik Unit	415
Unavailable		**Unavailable**		**Unavailable**		**Unavailable**		**Unavailable**	
Coastal Marine Unit	7	Coastal Marine Unit	28	Coastal Marine Unit	6	Coastal Plain Unit	406	Coastal Plain Unit	347
Coastal Plain Unit	998	Coastal Plain Unit	3,499	Coastal Plain Unit	943	Foothills Unit	1,229	Foothills Unit	1,229
Foothills Unit	1,289	Foothills Unit	1,909	Foothills Unit	1,229	Mountain Headwaters Unit	782	Mountain Headwaters Unit	782
Mountain Headwaters Unit	3,663	Lower Colville Unit	–	Mountain Headwaters Unit	782	Utukok/Kokolik Unit	1,956	Utukok/Kokolik Unit	1,956
Utukok/Kokolik Unit	2,354	Mountain Headwaters Unit	3,095	Utukok/Kokolik Unit	1,956				
		Utukok/Kokolik Unit	2,525						
		Corridor		**Corridor**					
		Coastal Marine Unit	3	Coastal Marine Unit	1				
		Coastal Plain Unit	187	Coastal Plain Unit	72				

[1]Acreage closed to new infrastructure except for essential coastal infrastructure
[2]Acreage closed to new infrastructure except for essential pipeline crossings
[3]Acreage closed to new infrastructure except for essential road and pipeline crossings

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Table L-8
Acreage of Lake Habitats Open, Open under Specific Lease Stipulations, and Closed to Fluid Mineral Leasing by Alternative (Existing Lease Acreage in Parentheses)

Alternative [acres x 1000]									
A		B		C		D		E	
Lake depth >4 m									
Open-NSO[1]	138 (104)	Open-NSO	142 (86)	Open-NSO	267 (106)	Open-NSO	473 (106)	Open-NSO	475 (107)
Open-STC[2]	22 (11)	Open-STC	15 (10)	Open-STC	17 (11)	Open-STC	20 (11)	Open-STC	17(11)
Open-TL[3]	–	Open-TL	–	Open-TL	5	Open-TL	8	Open-TL	9.1 (0.4)
Open-CSU[4]	–	Open-CSU	–	Open-CSU	–	Open-CSU	1	Open-CSU	1
Closed	342 (2)	Closed	346 (22)	Closed	213	Closed	–	Closed	0.4
Lake depth 1.6–4 m									
Open-NSO	43 (25)	Open-NSO	147 (40)	Open-NSO	235 (48)	Open-NSO	121 (28)	Open-NSO	133 (41)
Open-STC	491 (228)	Open-STC	322 (153)	Open-STC	441 (183)	Open-STC	509 (190)	Open-STC	491 (181)
Open-TL	–	Open-TL	–	Open-TL	56 (24)	Open-TL	153 (37)	Open-TL	159 (33)
Open-CSU	–	Open-CSU	–	Open-CSU		Open-CSU	52	Open-CSU	52
Closed	304 (3)	Closed	369 (62)	Closed	105	Closed	4	Closed	3
Lake depth 0–1.6 m									
Open-NSO	38 (10)	Open-NSO	97 (14)	Open-NSO	189 (13)	Open-NSO	147 (11)	Open-NSO	151 (13)
Open-STC	264 (56)	Open-STC	175 (42)	Open-STC	230 (47)	Open-STC	272 (48)	Open-STC	268 (47)
Open-TL	–	Open-TL	–	Open-TL	29 (7)	Open-TL	53 (8)	Open-TL	54 (8)
Open-CSU	–	Open-CSU	–	Open-CSU	–	Open-CSU	53	Open-CSU	55
Closed	233 (2)	Closed	263 (12)	Closed	86	Closed	10	Closed	7

[1]Open subject to controlled surface use
[2]Open subject to no surface occupancy
[3]Open subject to standard terms and conditions (no special management protections for resources)
[4]Open subject to timing limitation

Table L-9
Acreage of Lake Habitats Available, Conditionally Available (Available with Restrictions), and Unavailable for New Infrastructure by Alternative

Lake Depth	Alternative [acres x 1000]				
	A	B	C	D	E
>4 m					
Available[1]	281	16	278	281	276
Conditional[2]	7	2	7	7	13
Unavailable	213	481	216	213	211
1.6–4 m					
Available	644	426	645	713	715
Conditional	71	67	80	81	90
Unavailable	107	329	97	27	16
0–1.6 m					
Available	353	234	355	380	386
Conditional	83	53	93	121	120
Unavailable	88	235	74	22	17

[1]Includes areas available for pipeline corridors; approximate pipeline corridor locations were defined for analysis; however, actual locations may differ
[2]Includes areas which are closed to new infrastructure development except for essential pipeline crossings, essential road crossings, or essential coastal infrastructure.

L.1 REFERENCES

BLM. 2012. National Petroleum Reserve-Alaska (NPR-A) Final Integrated Activity Plan/Environmental Impact Statement. In cooperation with the North Slope Borough, U.S. Bureau of Ocean Energy Management, and U.S. Fish and Wildlife Service. Anchorage, Alaska: U.S. Department of Interior, Bureau of Land Management. Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=14702.

BLM (U.S. Department of the Interior Bureau of Land Management) GIS (Geographic Information System). 2019. GIS data used in the NPR-A Oil and Gas Leasing Program EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Johnson, J., and B. Blossom. 2019. Catalog of waters important for spawning, rearing, or migration of anadromous fishes—arctic region, effective June 1, 2019. 19-01, Special Publication. Anchorage, AK: Alaska Department of Fish and Game, Divisions of Sport Fish and Habitat.

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Appendix M

Essential Fish Habitat Assessment

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations	Full Phrase
AWC	Anadromous Waters Catalog
BLM	Bureau of Land Management
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	environmental impact statement
IAP	Integrated Activity Plan
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NPR-A	National Petroleum Reserve in Alaska
ROP	required operating procedure

Appendix M. Essential Fish Habitat Assessment

M.1 Regulatory Background

The 1996 Sustainable Fisheries Act (Public Law 104-297) enacted additional management measures to protect commercially harvested fish species from overfishing. Along with reauthorizing the Magnuson-Stevens Fishery Conservation and Management Act (MSA; Public Law 94-265), one of those added measures is to describe, identify, and minimize adverse effects to Essential Fish Habitat (EFH). Definitions and rules involving EFH are in 50 CFR Part 600. The National Marine Fisheries Service (NMFS) implements the requirements of the MSA.

> **EFH definition:** "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle" (50 CFR 600.10).

> **Adverse effect definition:** "…any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions" (50 CFR 600.810).

> **Federal action requirement:** "For any Federal action that may adversely affect EFH, Federal agencies must provide NMFS with a written assessment of the effects of that action on EFH…. Federal agencies may incorporate an EFH Assessment into documents prepared for other purposes such as…the National Environmental Policy Act" (50 CFR 600.920).

After an interim rule was issued in 1997 (62 FR 66531), the National Marine Fisheries Service (NMFS) issued a final rule (67 FR 2343) in 2002 to implement the essential fish habitat provisions of the Magnuson-Stevens Act. This included the clarification that Regional Fishery Management Councils would describe and identify EFH in fishery management plans. In Alaska, fishery management plans are developed by the North Pacific Fishery Management Council (NPFMC) and are approved by the Secretary of Commerce. The NMFS is responsible for implementing the EFH requirements of the Magnuson-Stevens Act.

M.2 Essential Fish Habitat in the National Petroleum Reserve - Alaska

The most current EFH descriptions and designations for salmon in Alaska, including the Arctic, are detailed in the Fishery Management Plan for the Salmon Fisheries in the EEZ off the Coast of Alaska (Salmon Fishery Management Plan; NPFMS 2018). The Salmon Fishery Management Plan includes designations for (1) EFH in marine waters of the U.S. Exclusive Economic Zone (EEZ) in Alaska, which includes the Chukchi and

Beaufort seas and extends 200 nautical miles offshore; and (2) EFH for salmon in freshwater habitats that are identified in the Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (Anadromous Waters Catalog; Johnson and Blossom 2017). EFH for the remaining species that use marine waters in the Arctic is described and designated in the Fishery Management Plan for Fish Resources of the Arctic Management Area (Arctic Fishery Management Plan; NPFMC 2009). The EFH descriptions for marine species in the Arctic have been updated by amendment 2 to the Arctic Fishery Management Plan, as described in the Essential Fish Habitat 5-year Review Summary Report, 2010 through 2015 (Simpson et al. 2017). Maps and data describing the EFH distribution for some species in the Arctic have also been updated on the Alaska Essential Fish Habitat (EFH) Mapper maintained by the NMFS (2019).

The six species for which EFH is currently designated in freshwater, estuarine, and/or marine waters in or near the Coastal Plain are pink salmon, chum salmon, Chinook, sockeye, arctic cod, and saffron cod.

M.2.1 Pacific Salmon

A new methodology was initiated in 2012 by the NMFS Alaska Fisheries Science Center to refine the EFH distribution of Pacific salmon in marine waters off Alaska. Previously, the marine EFH distribution of all five Pacific salmon species was designated broadly by the NPFMC (2006) as encompassing all waters in the U.S. EEZ, which extends 200 nautical miles offshore. Using catch, maturity, salinity, temperature, and station depth data from the Bering Sea and the Gulf of Alaska, Echave et al. (2012) modeled the distributions of all five Pacific salmon species in marine waters off Alaska and mapped the 95 percent spatial distributions for each species. This information was used along with additional habitat preference analyses of available biophysical data and catch information to substantially refine the EFH distributions for all life history stages of all Pacific salmon species in marine waters off Alaska. On average, the spatial extent of EFH in marine waters of the EEZ off Alaska was reduced by 71 percent across all species and life-history stages. Distribution modeling data are not available for the Beaufort Sea (where no commercial fishing occurs), and for areas "Where information is insufficient and a suitable proxy cannot be inferred, EFH is not described." (p. A-40 in NPFMC 2018). For areas adjacent to the Coastal Plain, the result is that EFH is no longer designated for any life history stages of any Pacific salmon species in the marine and estuarine waters of the Beaufort Sea (Simpson et al. 2017; NPFMC 2018; NMFS 2019).

However, it is well known that several Pacific salmon species occur in freshwater streams in Arctic Alaska. As early as 1881, pink salmon were recorded in the Colville River (Bean 1883), and it is likely that at least pink and chum salmon have established small, but sustainable spawning populations in a number of streams on the North Slope of Alaska (Craig and Haldorson 1986; Carothers et al. 2019). There is strong evidence that a population of chum salmon spawns in the Mackenzie River watershed (Irvine et al. 2009), which drains into the Beaufort Sea east of the National Petroleum Reserve – Alaska (NPR-A) in the Northwest Territories, Canada. For Alaska, the salmon occurrence data in the Anadromous Waters Catalog (Johnson and Blossom 2017) were used by the NPFMC to determine the extent of freshwater EFH for Pacific salmon species in Arctic Alaska, including the freshwater streams on the Coastal Plain (NPFMC 2018).

The four salmon species that have been recorded in NPR-A streams have anadromous life histories that are described in general terms in **Table M-1**. More detailed life-history information can be found in Meckelenburg et al. (2002) and Quinn (2005).

Table M-1
Pacific Salmon Life History Characteristics

Species	Spawning Habitat	Migration to Sea from Spawning Habitat	Time at Sea
Chum salmon	Freshwater	Immediately	3 to 5 years
Pink salmon	Freshwater or intertidal zone	Immediately	18 months
Chinook salmon	Freshwater	3 months to 2 years	1 to 5 years
Sockeye salmon	Freshwater (lakes)	1 to two years	1 to 4 years

In the northeast Chukchi Sea and western Beaufort Sea, all five species of Pacific salmon have been reported (Craig and Haldorson 1986). However, salmon have a very difficult time establishing sustainable runs in the Arctic, most likely because of marginal freshwater habitats (Craig 1989; Fechhelm and Griffiths 2001). Pink and chum salmon occur in the greatest numbers. They are fairly abundant in the Chukchi Sea (Moss et al. 2009), but much more limited in the Beaufort Sea. Conclusions based on a survey of available information describing salmon stocks in the Beaufort Sea (Fechhelm and Griffiths 2001) indicate only a few isolated spawning stocks of chum and pink salmon that might occur in the region.

Chinook and sockeye salmon are much more uncommon in the NPR-A region and coho salmon are rare. Due to the colder temperatures in the Beaufort Sea, these salmon species are more likely to be present in the northeast Chukchi Sea, although captures anywhere north of Point Hope are most commonly limited to only one or a few individuals (Craig and Haldorson 1986). In 17 years of summer coastal sampling in the Prudhoe Bay region of the Beaufort Sea (1981-1997), only one king salmon and zero sockeye or coho salmon were captured (Fechhelm and Griffiths 2001). However, in the recent decades there have been some years with notable increases in king salmon captured in the Elson Lagoon subsistence fishery further to the west (personal communication, Craig George 2006).

The freshwater streams in which salmon have been recorded in the NPR-A, and for which EFH has been designated, are listed in **Table M-2**. In all cases, only adult salmon have been recorded as present in these waterbodies. The segments of the streams in which EFH for pink and chum salmon has been designated are illustrated on **Map M-1**.

M.2.2 Arctic Cod

Arctic cod are one of the most abundant fish species in coastal waters of the Beaufort Sea where they occur in a diversity of habitats, including nearshore and offshore waters, brackish lagoons and inlets, and river mouths (Moulton and Tarbox 1987; Johnson et al. 2010). They are considered semi-pelagic because of their common occurrence in both demersal (seabed) and pelagic (open water) habitats. Fish mature from 2–3 years of age, spawning occurs only once in a lifetime, and the maximum age spans a narrow range of 6–7 years (Cohen et al. 1990). Abundance tends to be greatest in nearshore habitats during the summer and in offshore habitats during winter (Craig et al. 1982). Arctic cod are believed to be the most important consumer of secondary production in the Alaskan Beaufort Sea (Frost and Lowry 1983) and are an important prey item for other fishes, birds, and marine mammals (Bradstreet and Cross 1982; Frost 1984).

The current extent of EFH for arctic cod in the offshore, nearshore, and estuarine waters adjacent to the Coastal Plain has been described for eggs, larvae, early juveniles, late juveniles, and adults (Simpson et al. 2017; NMFS 2019). The spatial extent of EFH for arctic cod in waters near the NPR-A is illustrated on **Map M-1**.

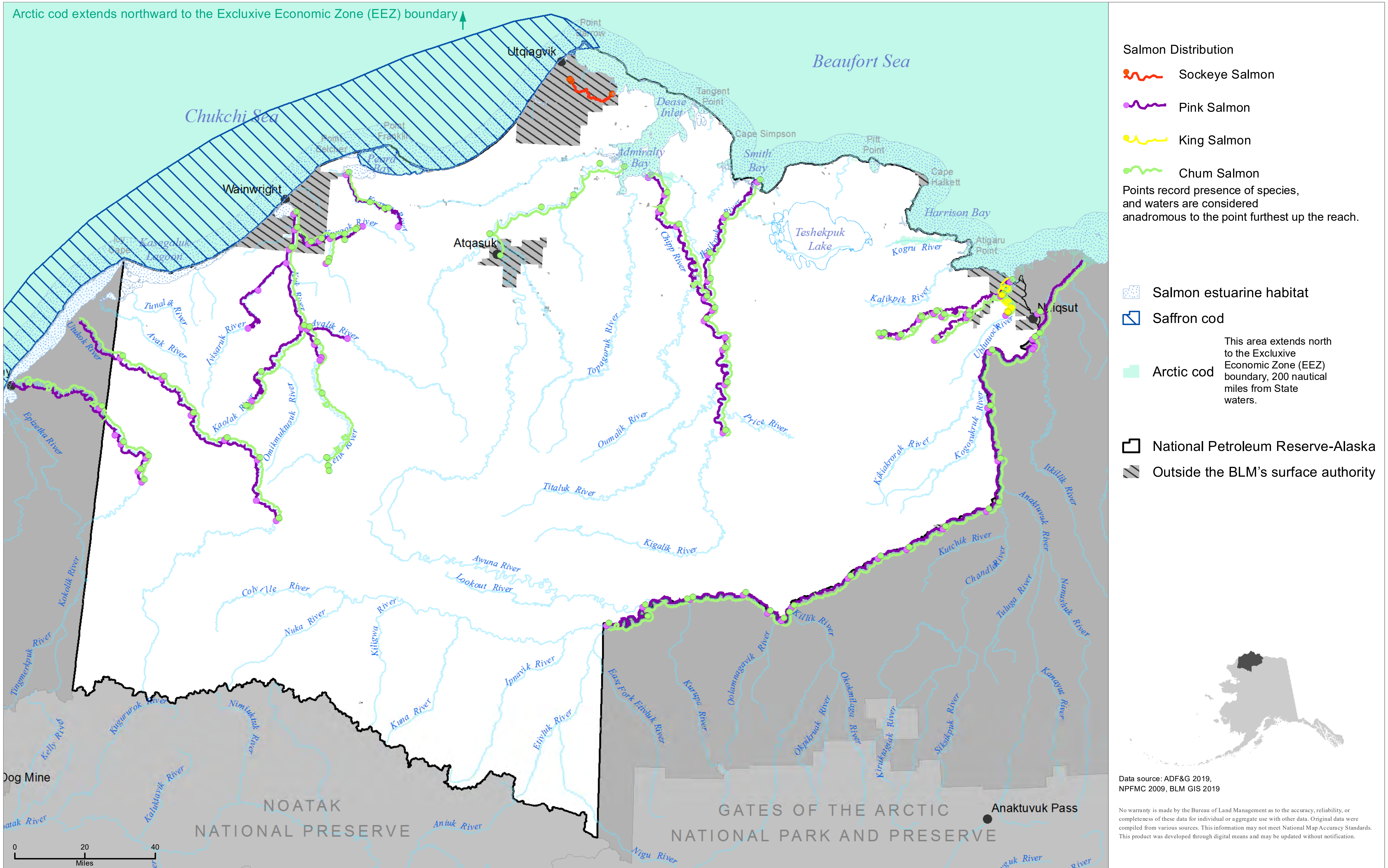
Table M-2
Stream and River Systems in the NPR-A with Freshwater EFH based on the Anadromous Waters Catalog (AWC; ADFG 2019)

Stream System	AWC Code	Salmon Species Utilizing
Colville River	330-00-10700	pink, chum
Fish Creek	330-00-10840	pink, chum, Chinook
Ublutuoch River	330-00-10840-2017	pink, chum, Chinook
Judy Creek	330-00-10840-2043	pink, chum
Ikpikpuk River	330-00-10900	pink, chum
Chipp River	330-00-10915	pink, chum
Meade River	330-00-10920	chum
Avak Creek	333-00-10931	sockeye
Kugrua River	330-00-10940	pink, chum
Kuk River	330-00-10980	pink
Ketik River	330-00-10980-2100-3010	pink, chum
Avalik River	330-00-10980-2100	pink
Maguriak Creek	330-00-30980-2004-3017	chum
Kungok River	330-00-10980-2004	pink
Mikigealiak River	330-00-10980-2004-3009	pink
Ivisaruk	330-00-10980-2009	pink
Kaolak River	330-00-10980-2101	pink
Utukok River	330-00-11100	pink, chum
Kokolik River	330-00-11200	pink, chum

M.2.3 Saffron Cod

Saffron cod are considered to be at the northern extent of their range in the Beaufort Sea, but the species is caught commonly in the western Beaufort Sea (Logerwell et al. 2015) and was also caught commonly in nearshore fish surveys at Point Thomson, approximately 8 miles to the west of the Coastal Plain boundary (Burril and Nemeth 2014). In contrast to arctic cod, adult saffron cod are completely demersal. Individuals mature around 2–3 years of age, after which they spawn once a year; adults live to be 10–14 years of age (Cohen et al. 1990). Saffron cod occur primarily in moderately saline nearshore habitats for much of the year, although they are known to migrate during summer to feed in brackish coastal habitats or move up rivers within the zone of tidal influence (Fechhelm et al. 1984; Mecklenburg et al. 2002). As with arctic cod, saffron cod are also a chief prey item for other fishes, birds, and marine mammals, (Frost 1984).

The extent of EFH for saffron cod in the marine waters adjacent to the Coastal Plain has not been specifically described and mapped, but the EFH text description for the species in the Arctic Fishery Management Plan (NPFMC 2009) indicates that saffron cod occur throughout Arctic waters. The specific language indicates that adults and late juveniles are "…located in pelagic and epipelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 miles) shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel." (NPFMC 2009, p. 81). The spatial extent of EFH for saffron cod in waters near the NPR-A is illustrated on **Map M-1**.


Arctic cod extends northward to the Exclusive Economic Zone (EEZ) boundary
Beaufort Sea
Chukchi Sea
Point Barrow
Utqiagvik
Tangent Point
Dease Inlet
Cape Simpson
Pitt Point
Admiralty Bay
Smith Bay
Cape Halkett
Harrison Bay
Teshekpuk Lake
Kogru River
Atigaru Point
Point Franklin
Point Belcher
Peard Bay
Wainwright
Atqasuk
Kasegaluk Lagoon
Icy Cape
Nuiqsut
Kalikpik River
Chipp River
Ikpikpuk River
Topagoruk River
Oumalik River
Price River
Titaluk River
Kigalik River
Awuna River
Lookout River
Colville River
Nuka River
Kiligwa River
Ipnavik River
Kuna River
Etivluk River
Kokolik River
Utukok River
Tunalik River
Avak River
Ivisaruk River
Avalik River
Kaolak River
Omikmuktusuk River
Epizetka River
Kuk River
Kugrua River
Ketik River
Ublutuoch River
Kikiakrorak River
Kogosukruk River
Itkillik River
Anaktuvuk River
Kuchik River
Chandler River
Tuluga River
Nanushuk River
Killik River
Kanayut River
East Fork Etivluk River
Oolamnagavik River
Okokmilaga River
Kurupa River
Okpikruak River
Kiruktagiak River
Siksikpuk River
Nimiuktuk River
Kugururok River
Kelly River
Tingmerkpuk River
Kaluktavik River
Aniuk River
Nigu River
Red Dog Mine
Anaktuvuk Pass
NOATAK NATIONAL PRESERVE
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
0
20
40
Miles
Salmon Distribution
Sockeye Salmon
Pink Salmon
King Salmon
Chum Salmon
Points record presence of species, and waters are considered anadromous to the point furthest up the reach.
Salmon estuarine habitat
Saffron cod
Arctic cod
This area extends north to the Exclusive Economic Zone (EEZ) boundary, 200 nautical miles from State waters.
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data source: ADF&G 2019, NPFMC 2009, BLM GIS 2019
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

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M.3 PROPOSED ACTION

The NPR-A consists of 23 million acres located on the North Slope of Alaska. The Bureau of Land Management (BLM) is undertaking the NPR-A Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) to determine the appropriate management of all BLM-managed lands in the NPR-A in light of new information about surface and subsurface resources and in a manner consistent with existing statutory direction from the Naval Petroleum Reserves Production Act of 1976, as amended. The BLM will consider consistent oil and gas leasing stipulations and required operating procedures across the entire NPR-A, while providing special protections for specific habitats and site-specific resources and uses. The BLM will also provide an opportunity, subject to appropriate conditions developed through a NEPA process, to construct necessary onshore infrastructure, including pipelines, pads, airstrips, and roads, to bring oil and gas resources from the NPR-A to the Trans-Alaska Pipeline System.

M.4 POTENTIAL ADVERSE EFFECTS ON EFH

The potential adverse effects on EFH from oil and gas activities would be the same as those described for other fish habitat in Chapter 3 in the Final IAP/EIS. No effects on marine EFH would be expected. Potential effects on estuarine EFH would primarily be related to causeways, or other similar structures, described in detail in Section 3.3.3 in the Final IAP/EIS. Ineffective design of coastal structures can lead to substantially altered water quality and create barriers to fish movements. Potential effects on freshwater EFH from a variety of oil and gas activities described in detail in Section 3.3.3 in the Final IAP/EIS broadly include altered water quality, physical habitat changes (water quantity, flow patterns, and geomorphology), point and non-point source pollution, increased turbidity and sedimentation, and barriers to fish movements.

The primary difference among alternatives is the level of anticipated oil and gas development. Based on the extent of coastline susceptible to development, the greatest potential impacts to estuarine EFH would occur under Alternative E, with increasingly less risk under Alternative D, C, A, and B. Based on the distribution of lands available for oil and gas leasing relative to waters listed for salmon in the AWC (ADFG 2019), the greatest potential impacts to freshwater EFH would similarly occur under Alternative E, with increasingly less risk under Alternatives D, C, A, and B.

M.5 PROPOSED MITIGATION MEASURES

Lease stipulations for all alternatives would mitigate potential effects on EFH. Proper implementation of these protective measures should ensure that impacts to EFH are avoided or minimized. The following list summarizes the mitigation measures; details for each measure can be found in Tables 2-2 and 2-3 in Chapter 2 in the Final IAP/EIS. These mitigation procedures largely address the relevant and comparable "Recommended Conservation Measures" identified in Impacts to Essential Fish Habitat from Non-fishing Activities in Alaska, EFH 5-year Review: 2010 through 2015 (Limpinsel et al. 2017).

- **ROP A-2:** Requires comprehensive waste management plan.
- **ROP A-3:** Requires a hazardous substances contingency plan.
- **ROP A-4:** Requires a spill prevention, control, and countermeasure plan.
- **ROP A-5:** Establishes refueling setbacks from waterbodies.
- **ROP A-6:** Prohibits discharge of reserve-pit fluids.
- **ROP A-7:** Prohibits discharge of produced water in upland areas and marine waters.
- **ROP B-1:** Prohibits water withdrawals from rivers and streams during winter.
- **ROP B-2:** Establishes lake water withdrawal limits and practices to protect fish.

- **ROP C-2:** Requires sufficient ground frost and snow cover prior to winter overland moves, contributing to the protection of stream banks and frozen waterbodies.
- **ROP C-3:** Establishes winter river and stream crossing guidelines related to protecting runoff patterns, fish passage, and natural channel characteristics, including the requirement that crossings reinforced with additional snow or ice ("bridges") be removed, breached, or slotted before spring breakup.
- **ROP C-4:** Establishes winter river and stream crossing guidelines related to avoiding additional freeze-down into fish habitat, including restrictions on traveling up and down streambeds.
- **ROP D-1:** Prohibits construction of permanent or gravel facilities (including pads, roads, and airstrips) for exploratory drilling.
- **ROP E-2:** Prohibits permanent facilities (including pads, roads, airstrips, and pipelines) within 500 feet of fish-bearing waterbodies, except for essential road and pipeline crossings that will be permitted on a case-by-case basis.
- **ROP E-3:** Prohibits causeways, docks, artificial gravel islands, and bottom-founded structures in river mouths or deltas. Requires that the design of any coastal structure ensures free fish passage and doesn't cause significant changes to nearshore oceanographic circulation patterns and water quality characteristics.
- **ROP E-4:** Requires that pipelines be designed, constructed, and operated according to the best available technology for detecting and preventing corrosion that can lead to leaks.
- **ROP E-5:** Establishes guidelines to minimize the development footprint, which would minimize the total impervious surface area within individual drainages.
- **ROP E-6:** Requires that stream and marsh crossings be designed and constructed to ensure free fish passage, reduce erosion, maintain natural drainage, and minimize effects to natural stream flow.
- **ROP E-8:** Establishes gravel mine guidelines for design that will minimize negative effects on fish habitat and for reclamation that will promote potential positive effects on fish habitat.
- **Stipulation K-1:** Establishes setback distances for permanent facilities (including pads, roads, airstrips, and pipelines) from major streams and rivers, except for essential road and pipeline crossings that will be permitted on a case-by-case basis.
- **Stipulation K-3:** Prohibits exploratory drilling within the floodplain of rivers and streams and within fish-bearing lakes.
- **Stipulation K-4:** Establishes additional protective measurements for "major coastal waterbodies" regarding exploration and development.
- **Stipulation K-4:** Prohibits permanent facilities within the existing Kasegaluk Lagoon.

M.6 EFH FINDING

No offshore marine EFH impacts are probable based on the scope of the likely post-leasing actions. Nearshore and estuarine EFH would receive sufficient protections under Stipulation K-4, and ROPs E-3 and E-4, which substantially restrict and/or mitigate oil and gas activities in and around marine waters. The only other activities authorized in nearshore and estuarine waters are the construction and use of barge landings and docking structures, which should result in small, localized impacts to marine EFH. For freshwater EFH, the comprehensive lease stipulations and ROPs listed above would provide substantial environmental protections to minimize or avoid effects on EFH. Although unavoidable impacts may occur in some freshwater habitats in the Coastal Plain, those streams and rivers that provide freshwater EFH would be protected with setback distances for the construction of most permanent oilfield infrastructure (essential pipelines, road crossings, and possibly gravel mines could be permitted within the setback buffers). Also, since streams and rivers comprising freshwater EFH are listed in the Anadromous Waters Catalog, they are granted further regulatory protection under the Anadromous Fish Act (AS 16.05.871), which requires additional review and permitting of development activities by the ADFG. Based on these considerations, oil and gas exploration and development in the Coastal Plain planning area is assigned the EFH assessment determination: May affect, not likely to adversely affect.

No offshore marine EFH impacts are probable based on the scope of the proposed action. Nearshore marine and estuarine EFH would receive sufficient protection by considerations for coastal structures under Stipulation E-3 which would avoid impacts such as those caused by causeways in the Prudhoe Bay area. The only other activities authorized in nearshore and estuarine waters are the construction and use of barge landings and docking structures, which should result in small, localized impacts to marine EFH. The other lease stipulations and ROPs/BMPs listed above would provide substantial environmental protections that would minimize or avoid effects on freshwater EFH. Although unavoidable impacts will occur to some freshwater habitat in the NPR-A, those streams and rivers with freshwater EFH are much less likely to experience those impacts. For example, all streams and rivers currently considered freshwater EFH (**Table M-2**) are provided an additional safeguard through infrastructure setbacks included in Stipulation K-1. Also, since streams and rivers comprising freshwater EFH are listed within the AWC, they are granted further regulatory protection under the Anadromous Fish Act (AS 16.05.871) which requires additional review and permitting of activities by the Alaska Department of Fish and Game. Based on these considerations, oil and gas exploration and development in the NPR-A is assigned the EFH assessment determination: *May affect, not likely to adversely affect.*

M.7 References

Bean, T. H. 1883. List of fishes known to occur in the Arctic Ocean north of Bering Strait. Pp. 118–120 *in* I. C. Rosse, editor. Cruise of the Revenue-Steamer Corwin in Alaska in the N.W. Arctic Ocean in 1881. Government Printing Office, Washington, DC.

Bradstreet, M. S. W. and W. E. Cross. 1982. Trophic relationships at high Arctic ice edges. Arctic 35: 1–12.

Burril, S. E. and M. J. Nemeth. 2014. Composition and Relative Abundance of Fish Species near Point Thomson, Alaska, 2010, 2013, and 2014, with Comparison to Past Studies. Prepared by LGL Alaska Research Associates, Inc. for ExxonMobil Development Company, Anchorage, AK. 69 pp.

Carothers, C. T.L. Sformo, S. Cotton, J.C. George, and P.A.H. Westley. 2019. Pacific Salmon in the rapidly changing Arctic: exploring local knowledge and emerging fisheries in Utqiagvik and Nuiqsut, Alaska. Arctic 72(3): 273-288.

Cohen, D. M., T. Inada, T. Iwamoto, and N. Scialabba. 1990. FAO Species Catalogue: Vol. 10. Gadiform Fishes of the World (Order Gadiformes): An Annotated and Illustrated Catalogue of Cods, Hakes, Grenadiers and Other Gadiform Fishes Known to Date. FAO Fisheries Synopsis No. 125, Volume 10. Food and Agriculture Organization (FAO) of the United Nations, Rome.

Craig, P. C. 1989. An introduction to anadromous fishes in the Alaskan Arctic. Biological Papers of the University of Alaska 24: 27– 54.

Craig, P. C., W. B. Griffiths, L. Haldorson, and H. McElderry. 1982. Ecological studies of Arctic Cod (Boreogadus saida) in Beaufort Sea coastal waters, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 39: 395–406.

Craig, P., and L. Haldorson. 1986. Pacific salmon in the North American Arctic. Arctic 39: 2–7.

Echave, K., M. Eagleton, E. Farley, and J. Orsi. 2012. A Refined Description of Essential Fish Habitat for Pacific Salmon within the U.S. Exclusive Economic Zone in Alaska. U.S. Department Commerce, NOAA Technical Memorandum NMFS-AFSC-236.

Fechhelm, R. G, P. C. Craig, J. S. Baker, and B. J. Gallaway. 1984. Fish Distribution and Use of Nearshore Waters in the Northeastern Chukchi Sea. LGL Ecological Research Associates, Inc. Prepared for the National Oceanic and Atmospheric Administration, Juneau, AK.

Fechhelm, R. G., and W. B. Griffiths. 2001. Status of Pacific salmon in the Beaufort Sea, 2001. LGL Alaska Research Associates, Inc., Anchorage, AK.

Frost, K J. 1984. Trophic relationships of vertebrate consumers in the Alaskan Beaufort Sea. Pp. 381–401 *in* P. W. Barnes, D. M. Schell & E. Reimnitz, editors. The Alaskan Beaufort Sea. Ecosystem and Environments. Academic Press, London.

Frost, K. J., and L. F. Lowry. 1983. Demersal Fishes and Invertebrates Trawled in the Northeastern Chukchi and Western Beaufort Seas, 1976-77. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Technical Report NMFS SSRF-764.

Irvine, J. R., R. W. Macdonald, R. J. Brown, L. Godbout, J. D. Reist, and E. C. Carmack. 2009. Salmon in the Arctic and how they avoid lethal low temperatures. North Pacific Anadromous Fish Commission Bulletin No. 5: 39–50.

Johnson, J., and B. Blossom. 2017. Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes—Arctic Region, Effective June 1, 2017. Alaska Department of Fish and Game, Special Publication No. 17-01, Anchorage, AK. 131 pp. Internet website: https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=main.home.

Johnson, S. W., J. F. Thedinga, A. D. Neff, and C. A. Hoffman. 2010. Fish Fauna in Nearshore Waters of a Barrier Island in the Western Beaufort Sea, Alaska. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center. NOAA Technical Memorandum NMFS-AFSC-210.

Limpinsel, D. E., Eagleton, M. P., and Hanson, J. L. 2017. Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska. EFH 5 Year Review: 2010 through 2015. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/AKR-14. 229 pp.

Logerwell, E., M. Busby, C. Carothers, S. Cotton, J. Duffy-Anderson, E. Farley, P. Goddard, R. Heintz, B. Holladay, J. Hornea, S .Johnson, B. Lauth, L. Moulton, D. Neff, B. Norcross, S. Parker-Stetter, J. Seigle, and T. Sformo. 2015. Fish communities across a spectrum of habitats in the western Beaufort Sea and Chukchi Sea. Progress in Oceanography 136: 115–132.

Mecklenburg, C. W., T. A. Mecklenburg, and L. K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, MD.

Moulton, L. L., and K. E. Tarbox. 1987. Analysis of arctic cod movements in the Beaufort Sea nearshore region, 1978–79. Arctic 40: 43–49.

NMFS (National Marine Fisheries Service). 2019. Alaska Essential Fish Habitat (EFH) Mapper. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service - Alaska Region, Anchorage, AK. Internet website: https://www.fisheries.noaa.gov/resource/map/alaska-essential-fish-habitat-efh-mapper.

NPFMC (North Pacific Fishery Management Council). 2006. Amendments 7 and 8 to the Fishery Management Plan for the Salmon Fisheries in the EEZ off the Coast of Alaska. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service - Alaska Region, North Pacific Fishery Management Council, Anchorage, AK.

NPFMC. 2009. Fishery Management Plan for Fish Resources of the Arctic Management Area. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service - Alaska Region, North Pacific Fishery Management Council, Anchorage, AK.

NPFMC. 2018. Fishery Management Plan for the Salmon Fisheries in the EEZ off Alaska. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service - Alaska Region, North Pacific Fishery Management Council, and Alaska Department of Fish and Game, Anchorage, AK.

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. American Fisheries Society, Bethesda, MD, and University of Washington Press, Seattle, WA.

Simpson, S. C., Eagleton, M. P., Olson, J. V., Harrington, G. A., and Kelly, S. R. 2017. Final Essential Fish Habitat (EFH) 5-year Review, Summary Report: 2010 through 2015. U.S. Department of Commerce, NOAA Techinal Memorandum NMFS-F/AKR-15. 115 pp.

Appendix N

List of Bird Species that may occur in the NPR-A

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Appendix N. List of Bird Species that may occur in the NPR-A

Table N-1
List of Bird Species that may occur in the National Planning Reserve in Alaska

Type	Common Name	Iñupiaq Name	Scientific Name	Relative Abundance[a]	Status	Conservation Status[b]
Waterfowl	Greater White-fronted Goose	Niġlivik or Niġlivialuk	*Anser albifrons*	Common	Breeder	–
	Snow Goose	Kaŋuq	*Anser caerulescens*	Common	Breeder	–
	Brant	Niġlinġaq	*Branta bernicla*	Common	Breeder	Y
	Cackling Goose/ Canada Goose	Iqsraġutilik	*Branta hutchinsii/ Branta canadensis*	Common	Breeder	–
	Tundra Swan	Qugruk	*Cygnus columbianus*	Common	Breeder	–
	Gadwall	NA	*Mareca strepera*	Casual	Visitor	–
	American Wigeon	Kurugaġnaq	*Mareca americana*	Uncommon	Breeder	–
	Mallard	Kurugaqtaq	*Anas platyrhynchos*	Uncommon	Breeder	–
	Northern Shoveler	Qaqlutuuq or Alluutaq	*Spatula clypeata*	Uncommon	Breeder	–
	Northern Pintail	Kurugaq	*Anas acuta*	Common	Breeder	–
	Green-winged Teal	Qaiŋŋiq or Kurukaałhusiq	*Anas crecca*	Uncommon	Breeder	Y
	Canvasback	NA	*Aythya valisineria*	Casual	Visitor	–
	Greater Scaup	Qaqłukpalik	*Aythya marila*	Uncommon	Breeder	R
	Lesser Scaup	Qaqłutuuq	*Aythya affinis*	Casual	Breeder	–
	Steller's Eider	Igniqauqtuq	*Polysticta stelleri*	Rare (uncommon near Utqiaġvik)	Breeder	T, S, A, R, VU
	Spectacled Eider	Qavaasuk	*Somateria fischeri*	Uncommon	Breeder	T, S, A, R, NT
	King Eider	Qiŋalik	*Somateria spectabilis*	Common	Breeder	Y
	Common Eider	Amauligruaq	*Somateria mollissima*	Rare (uncommon along coast)	Breeder	NT
	Surf Scoter	Aviḷuqtuq	*Melanitta perspicillata*	Rare	Breeder	–
	White-winged Scoter	Killalik	*Melanitta fusca*	Rare	Breeder	–
	Black Scoter	Tuungaagrupiaq	*Melanitta americana*	Casual	Visitor	A, R, NT
	Long-tailed Duck	Aaqhaaliq	*Clangula hyemalis*	Common	Breeder	VU
	Red-breasted Merganser	Paisugruk or Aqpaqsruayuuq	*Mergus serrator*	Rare	Breeder	–

Type	Common Name	Iñupiaq Name	Scientific Name	Relative Abundance[a]	Status	Conservation Status[b]
Loons and Grebes	Red-necked Grebe	Aqpaqsruayuuq	*Podiceps grisegena*	Rare	Breeder	R
	Red-throated Loon	Qaqsrauq	*Gavia stellata*	Common	Breeder	C, S, A
	Pacific Loon	Malġi	*Gavia pacifica*	Common	Breeder	–
	Common Loon	Taasiŋiq	*Gavia immer*	Casual/ Accidental	Visitor	–
	Yellow-billed Loon	Tuullik	*Gavia adamsii*	Common	Breeder	C, S, A, R, NT
Seabirds	Pomarine Jaeger	Isuŋŋaġluk	*Stercorarius pomarinus*	Uncommon	Breeder	–
	Parasitic Jaeger	Migiaqsaayuk	*Stercorarius parasiticus*	Uncommon	Breeder	–
	Long-tailed Jaeger	Isuŋŋaq	*Stercorarius longicaudus*	Uncommon	Breeder	–
	Black-legged Kittiwake	NA	*Rissa tridactyla*	Casual	Visitor	R, VU
	Sabine's Gull	Iqirgagiaq	*Xema sabini*	Common	Breeder	–
	Ross's Gull	Qagmaqluaq	*Rhodostethia rosea*	Casual/ Accidental	Visitor	Y
	Herring Gull	Nauyavaaq	*Larus argentatus*	Casual/ Accidental	Visitor	–
	Thayer's Gull	NA	*Larus thayeri*	Casual/ Accidental	Visitor	–
	Glaucous-winged Gull	NA	*Larus glaucescens*	Casual/ Accidental	Visitor	–
	Glaucous Gull	Nauyavasrugruk	*Larus hyperboreus*	Common	Breeder	–
	Arctic Tern	Mitqutaiḷaq	*Sterna paradisaea*	Common	Breeder	C
	Kittlitz's Murrelet	NA	*Brachyramphus brevirostris*	Casual	Breeder	C, S, A, R, NT
	Black Guillemot	Iŋaġiq	*Cepphus grylle*	Rare	Breeder	–
Shorebirds	Black-bellied Plover	Tullivak	*Pluvialis squatarola*	Uncommon	Breeder	MC
	American Golden-Plover	Tullik	*Pluvialis dominica*	Uncommon	Breeder	W, A, HC, R
	Semipalmated Plover	Kurraquraq	*Charadrius semipalmatus*	Rare	Breeder	–
	Upland Sandpiper	NA	*Bartramia longicauda*	Casual/ Accidental	Visitor	A
	Whimbrel	Sigguktuvak	*Numenius phaeopus*	Rare	Breeder	C, S, A, HC,Y
	Bar-tailed Godwit	Turraaturaq	*Limosa lapponica*	Uncommon	Breeder	C, S, A, GC, R, NT
	Ruddy Turnstone	Tullignaq	*Arenaria interpres*	Rare	Breeder	MC
	Red Knot	NA	*Calidris canutus roselaari*	Rare/ Casual	Breeder	C, S, A, GC, R, NT
	Stilt Sandpiper	NA	*Calidris himantopus*	Uncommon	Breeder	–
	Sanderling	Kimmitquilaq	*Calidris alba*	Casual	Breeder	A, MC
	Dunlin	Qayuuttavak	*Calidris alpina*	Common	Breeder	C, S, A, HC, R
	Baird's Sandpiper	Puviaqtuuyaaq	*Calidris bairdii*	Rare	Breeder	–
	Least Sandpiper	Livilivillauraq	*Calidris minutilla*	Casual/ Accidental	Visitor	–
	White-rumped Sandpiper	NA	*Calidris fuscicollis*	Rare	Breeder	–
	Buff-breasted Sandpiper	Satqagiiḷaq	*Calidris subruficollis*	Rare	Breeder	C, S, A, HC, R, NT

Type	Common Name	Iñupiaq Name	Scientific Name	Relative Abundance[a]	Status	Conservation Status[b]
Shorebirds *(cont.)*	Pectoral Sandpiper	Puvviaqtuuq	*Calidris melanotos*	Common	Breeder	A, HC, R
	Semipalmated Sandpiper	Livalivaq	*Calidris pusilla*	Common	Breeder	A, HC, NT
	Western Sandpiper	NA	*Calidris mauri*	Uncommon/ Rare	Breeder	A, MC, Y
	Long-billed Dowitcher	Kilyaktalik or Siyukpalik	*Limnodromus scolopaceus*	Common	Breeder	MC
	Wilson's Snipe	Saavġaq or Kuukukiaq	*Gallinago delicata*	Rare	Breeder	–
	Lesser Yellowlegs	Uviñŋuayuuq	*Tringa flavipes*	Rare/ Casual	Breeder	A, HC, R
	Red-necked Phalarope	Qayyiuġun	*Phalaropus lobatus*	Common	Breeder	MC
	Red Phalarope	Auksruaq	*Phalaropus fulicarius*	Common	Breeder	MC
Cranes	Sandhill Crane	Tatirgaq	*Mareca americana*	Rare	Breeder	–
Raptors	Bald Eagle	Tiŋmiaqpak	*Haliaeetus leucocephalus*	Casual	Visitor	–
	Northern Harrier	Papiktuuq	*Circus hudsonius*	Rare	Breeder	A
	Rough-legged Hawk	Qiḷġiq	*Buteo lagopus*	Uncommon	Breeder	–
	Golden Eagle	Tiŋmiaqpak	*Aquila chrysaetos*	Uncommon	Breeder	W, A
	Snowy Owl	Ukpik	*Bubo scandiacus*	Uncommon	Breeder	C, A, R, VU
	Short-eared Owl	Nipaiḷuktaq	*Asio flammeus*	Uncommon	Breeder	W, A
	Merlin	Kirgaviatchauraq	*Falco columbarius*	Rare	Visitor	–
	Gyrfalcon	Aatqarruaq	*Falco rusticolus*	Rare	Breeder	A
	Arctic Peregrine Falcon	Kirgavik or Kirgavigruaq	*Falco peregrinus tundrius*	Uncommon	Breeder	C
Ptarmigan	Willow Ptarmigan	Aqargiq or Nasaullik	*Lagopus lagopus*	Common	Breeder	–
	Rock Ptarmigan	Niksaaktuŋiq	*Lagopus muta*	Uncommon	Breeder	–
Passerines	Common Raven	Tulugaq	*Corvus corax*	Uncommon	Breeder	–
	Arctic Warbler	Suŋaqpaluktuŋiq	*Phylloscopus borealis*	Rare	Breeder	–
	Bluethroat	NA	*Luscinia svecica*	Rare	Breeder	–
	Gray-cheeked Thrush	NA	*Catharus minimus*	Rare/ Casual	Breeder	–
	Eastern Yellow Wagtail	Misiqqaaqauraq or Piiġaq	*Motacilla tschutschensis*	Uncommon	Breeder	–
	Redpoll (Common and Hoary)	Saqsakiq	*Acanthis flammea and A. hornemanni*	Uncommon	Breeder	–
	Lapland Longspur	Qupałuk or Putukiułuk	*Calcarius lapponicus*	Common	Breeder	–
	Smith's Longspur	Qalġuusiqsuuq	*Calcarius pictus*	Casual/ Accidental	Breeder	C, S, A
	Snow Bunting	Amaułłigaaluq	*Plectrophenax nivalis*	Uncommon (common around infrastructure)	Breeder	A
	American Tree Sparrow	Misapsaq	*Spizelloides arborea*	Uncommon/ Rare	Breeder	–
	Savannah Sparrow	Ukpisiuyuk	*Passerculus sandwichensis*	Uncommon	Breeder	A
	Fox Sparrow	Ikłiġvik	*Passerella iliaca*	Casual/ Accidental	Visitor	A

Type	Common Name	Iñupiaq Name	Scientific Name	Relative Abundance[a]	Status	Conservation Status[b]
Passerines *(cont.)*	Lincoln's Sparrow	NA	*Melospiza lincolnii*	Casual/ Accidental	Visitor	–
	White-crowned Sparrow	Nuŋaktuaġruk	*Zonotrichia leucophrys*	Uncommon/ Rare	Breeder	A

Sources: Johnson et al. 2005; Johnson et al. 2007; BLM 2012a; BLM 2018; Johnson and Herter 1989.
[a]Common—occurs in all or nearly all proper habitats, but some areas are occupied sparsely or not at all; uncommon—occurs regularly but uses little of the suitable habitat or occurs regularly in relatively small numbers; rare—occurs within normal range, regularly, in very small numbers; casual—beyond its normal range but irregular observations are likely over years; accidental—so far beyond its normal range that future observations are unlikely (Johnson and Herter 1989).
[b]E = Endangered species; T = Threatened species (Endangered Species Act, 1973)
C = Birds of Conservation Concern in Bird Conservation Region 3 (USFWS 2008)
S = Sensitive Animals; W = watchlist species (BLM 2019)
A = At-risk species (ADFG 2015)
GC = Greatest Concern; HC = High Concern; MC = Moderate Concern (Senner et al. 2016)
R = Red-list species; Y = Yellow-list species (Warnock 2017)
EN = Endangered; VU = Vulnerable; NT = Near threatened (IUCN 2018)

Table N-2
Number of Birds on the Arctic Coastal Plain, in NPR-A, and Teshekpuk Lake Special Area

Common Name	Arctic Coastal Plain (ACP)	NPR-A		Teshekpuk Lake Special Area	
	Estimate of birds	Estimate of birds	% of total on ACP	Estimate of birds	% of total on ACP
Greater White-fronted Goose	72,571	53,977	74	11,413	16
Snow Goose	1,434	1,018	71	524	37
Brant	4,255	3,250	76	1,550	36
Cackling/Canada Goose	4,281	1,590	37	422	10
Steller's Eider	285	268	94	45	16
Spectacled Eider	6,177	5,454	88	818	13
King Eider	16,384	12,179	74	3,294	20
Red-throated Loon	2,805	2,081	74	422	15
Pacific Loon	30,430	25,075	82	3,177	10
Yellow-billed Loon	1,595	1,456	91	242	15
Total	140,216	106,349	76	21,906	21

Sources: Data from Amundson et al. 2019. Based on average densities from June aerial surveys of the Arctic Coastal Plain (Wilson et al. 2018) calculated for 6 x 6 km grid cells, 1992–2016, and acreages within planning area boundaries under Alternative A.

N.1 References

ADFG (Alaska Department of Fish and Game). 2015. Alaska wildlife action plan. Juneau.

Amundson, C. L., P. L. Flint, R. A. Stehn, R. M. Platte, H. M. Wilson, W. W. Larned. and J. B. Fischer. 2019. “Spatio-temporal population change of Arctic-breeding waterbirds on the Arctic Coastal Plain of Alaska”. Avian Conservation and Ecology 14(1):18.

BLM. (Bureau of Land Management) 2012a. National Petroleum Reserve-Alaska (NPR-A) Final Integrated Activity Plan/Environmental Impact Statement. In cooperation with the North Slope Borough, U.S. Bureau of Ocean Energy Management, and U.S. Fish and Wildlife Service. Anchorage, Alaska: U.S. Department of Interior, Bureau of Land Management. Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=14702.

_____. 2018. Willow Master Development Plan EIS - ConocoPhillips Alaska, Inc.'s Proposed Action. https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/154307/188924/Willow_Detials_for_ePlanning.pdf

_____. 2019. Willow Master Development Plan Environmental Impact Statement, ConocoPhillips Alaska, Inc. Proposed Action Summary. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/154307/188924/Willow_Detials_for_ePlanning.pdf

IUCN (International Union for Conservation of Nature). 2018. IUCN Red List of threatened species. Version 2018-1. Internet website: http://www.iucnredlist.org/.

Johnson, C. B., R. M. Burgess, A. M. Wildman, A. A. Stickney, P.E. Seiser, B. E. Lawhead, T. J Mabee, A. K. Prichard, and J. R. Rose. 2005. Wildlife Studies for the Alpine Satellite Development Project, 2004. Second annual report for ConocoPhillips Alaska, Inc., and Anadarko Petroleum Corporation, Anchorage, AK, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 129 pp.

Johnson J. A., R. B. Lanctot, B. A. Andres, J. R. Bart, S. C. Brown, S. J. Kendall, and D. C. Payer. 2007. “Distribution of breeding shorebirds on the Arctic Coastal Plain of Alaska”. Arctic 60:77–9.

Johnson, S. R., and D. R. Herter. 1989. *The birds of the Beaufort Sea*. BP Exploration (Alaska), Inc., Anchorage, AK. 372 pp.

Senner, S. E. B. A. Andres, and H. R. Gates (Editors). 2016. Pacific Americas shorebird conservation strategy. National Audubon Society, New York, New York, USA. http://www.shorebirdplan.org.

USFWS (U.S. Fish and Wildlife Service). 2008. Birds of conservation concern 2008. Division of Migratory Bird Management, Arlington, VA.

Warnock, N. 2017. The Alaska WatchList 2017. Audubon Alaska, Anchorage, AK. Internet website: https://ak.audubon.org/sites/default/files/static_pages/attachments/2017_watchlist_final_panels_highres.pdf.

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Appendix O

List of Birds and their Conservation Status for Species that may occur along the Shipping Route between NPR-A and Dutch Harbor

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Appendix O. List of Birds and their Conservation Status for Species that may occur along the Shipping Route between NPR-A and Dutch Harbor

Type	Common Name	Scientific Name	ESA[a]	USFWS[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]
Waterfowl	Emperor Goose	*Anser canagicus*	–	–	S	A	Y	NT
	Snow Goose	*Anser caerulescens*	–	–	–	–	–	–
	Brant	*Branta bernicla*	–	–	–	–	Y	–
	Cackling Goose (Taverner's)	*Branta hutchinsii taverneri*	–	–	–	–	Y	–
	Steller's Eider	*Polysticta stelleri*	T	–	–	A	R	VU
	Spectacled Eider	*Somateria fischeri*	T	–	–	A	R	–
	King Eider	*Somateria spectabilis*	–	–	–	–	Y	–
	Common Eider	*Somateria mollissima*	–	–	–	–	–	NT
	Harlequin Duck	*Histrionicus histrionicus*	–	–	–	–	–	–
	Surf Scoter	*Melanitta perspicillata*	–	–	–	–	–	–
	White-winged Scoter	*Melanitta fusca*	–	–	–	–	–	–
	Black Scoter	*Melanitta americana*	–	–	–	–	R	NT
	Long-tailed Duck	*Clangula hyemalis*	–	–	–	–	–	VU
	Common Goldeneye	*Bucephala clangula*	–	–	–	–	–	–
	Barrow's Goldeneye	*Bucephala islandica*	–	–	–	–	–	–
	Common Merganser	*Mergus merganser*	–	–	–	–	–	–
	Red-breasted Merganser	*Mergus serrator*	–	–	–	–	–	–
Loons and Grebes	Red-throated Loon	*Gavia stellata*	–	C	S	A	–	–
	Arctic Loon	*Gavia arctica*	–	–	–	–	–	–
	Pacific Loon	*Gavia pacifica*	–	–	–	–	–	–
	Common Loon	*Gavia immer*	–	–	–	–	–	–
	Yellow-billed Loon	*Gavia adamsii*	–	C	S	A	R	NT
	Horned Grebe	*Podiceps auritus*	–	C	–	–	–	VU
	Red-necked Grebe	*Podiceps grisegena*	–	–	–	–	R	–

Type	Common Name	Scientific Name	ESA[a]	USFWS[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]
Shorebirds	Black Oystercatcher	*Haematopus bachmani*	–	C	–	A	–	–
	Semipalmated Plover	*Charadrius semipalmatus*	–	–	–	–	–	–
	Ruddy Turnstone	*Arenaria interpres*	–	–	–	–	–	–
	Rock Sandpiper	*Calidris ptilocnemis*	–	–	C	–	Y	–
	Least Sandpiper	*Calidris minutilla*	–	–	–	–	–	–
	Pectoral Sandpiper	Calidris melanotos	–	–	–	A	R	–
	Wandering Tattler	Tringa incana	–	–	–	–	Y	–
	Red-necked Phalarope	*Phalaropus lobatus*	–	–	W	–	–	–
	Red Phalarope	*Phalaropus fulicarius*	–	–	–	–		–
Seabirds	Pomarine Jaeger	*Stercorarius pomarinus*	–	–	–	–	–	–
	Parasitic Jaeger	*Stercorarius parasiticus*	–	–	–	–	–	–
	Long-tailed Jaeger	*Stercorarius longicaudus*	–	–	–	–	–	–
	Black-legged Kittiwake	*Rissa tridactyla*	–	–	–	–	R	VU
	Red-legged Kittiwake	*Rissa brevirostris*	–	C	–	A	R	VU
	Ivory Gull	*Pagophila eburnea*	–	–	–	–	R	NT
	Sabine's Gull	*Xema sabini*	–	–	–	–	–	–
	Bonaparte's Gull	*Chroicocephalus philadelphia*	–	–	–	–	–	–
	Ross's Gull	*Rhodostethia rosea*	–	–	–	–	Y	–
	Mew Gull	*Larus canus*	–	–	–	–	–	–
	Ring-billed Gull	*Larus delawarensis*	–	–	–	–	–	–
	Herring Gull	*Larus argentatus*	–	–	–	A	–	–
	Iceland Gull	*Larus glaucoides*	–	–	–	–	–	–
	Slaty-backed Gull	*Larus schistisagus*	–	–	–	–	–	–
	Glaucous-winged Gull	*Larus glaucescens*	–	–	–	–	–	–
	Glaucous Gull	*Larus hyperboreus*	–	–	–	–	–	–
	Aleutian Tern	*Onychoprion aleuticus*	–	C	–	A	R	VU
	Caspian Tern	*Hydroprogne caspia*	–	C	–	–	–	–
	Arctic Tern	*Sterna paradisaea*	–	C	–	–	–	–
	Dovekie	*Alle alle*	–	–	–	–	–	–
	Common Murre	*Uria aalge*	–	–	–	–	–	–
	Thick-billed Murre	*Uria lomvia*	–	–	–	–	–	–
	Black Guillemot	*Cepphus grylle*	–	–	–	–	–	–
	Pigeon Guillemot	*Cepphus columba*	–	–	–	–	–	–
	Marbled Murrelet	*Brachyramphus marmoratus*	–	C	S	A	R	EN
	Kittlitz's Murrelet	*Brachyramphus brevirostris*	–	C	S	A	R	NT

Type	Common Name	Scientific Name	ESA[a]	USFWS[b]	BLM[c]	ADF&G[d]	AUD[e]	IUCN[f]
Seabirds *(cont.)*	Ancient Murrelet	*Synthliboramphus antiquus*	–	–	–	A	–	–
	Cassin's Auklet	*Ptychoramphus aleuticus*	–	–	–	A	–	NT
	Parakeet Auklet	*Aethia psittacula*	–	–	–	–	–	–
	Least Auklet	*Aethia pusilla*	–	–	–	–	–	–
	Whiskered Auklet	*Aethia pygmaea*	–	C	–	–	Y	–
	Crested Auklet	*Aethia cristatella*	–	–	–	–	–	–
	Rhinoceros Auklet	*Cerorhinca monocerata*	–	–	–	–	–	–
	Horned Puffin	*Fratercula corniculata*	–	–	–	–	R	–
	Tufted Puffin	*Fratercula cirrhata*	–	–	–	–	R	–
	Laysan Albatross	*Phoebastria immutabilis*	–	C	–	A	–	NT
	Black-footed Albatross	*Phoebastria nigripes*	–	C	–	A	–	NT
	Short-tailed Albatross	*Phoebastria albatrus*	E	–	–	A	R	VU
	Northern Fulmar	*Fulmarus glacialis*	–	–	–	–	–	–
	Short-tailed Shearwater	*Ardenna tenuirostris*	–	–	–	–	–	–
	Sooty Shearwater	*Ardenna grisea*	–	–	–	–	–	NT
	Fork-tailed Storm-Petrel	*Oceanodroma furcata*	–	–	–	–	–	–
	Leach's Storm-Petrel	*Oceanodroma leucorhoa*	–	–	–	–	–	VU
	Double-crested Cormorant	*Phalacrocorax auritus*	–	–	–	–	Y	–
	Red-faced Cormorant	*Phalacrocorax urile*	–	C	–	A	R	–
	Pelagic Cormorant	*Phalacrocorax pelagicus*	–	C	–	A	–	–

Sources: BLM 2018; BLM 2019a; Johnson and Herter 1989.
ESA=Endangered Species Act of 1973
USFWS=U.S. Fish and Wildlife Service
BLM =Bureau of Land Management
ADF&G=Alaska Department of Fish and Game
AUD=Audubon
ICUN=International Union for Conservation of Nature and Natural Resources
[a] E = Endangered species; T = Threatened species (Endangered Species Act, 1973)
[b]C = Birds of conservation concern in Bird Conservation Region 3 (USFWS 2008)
[c]S = Sensitive animals; W = watchlist species (BLM 2019b)
[d]A = At-risk species (ADFG 2015)
[e]R = Red-list species; Y = Yellow-list species (Warnock 2017)
[f]EN = Endangered; VU = Vulnerable; NT = Near threatened (IUCN 2018)

O.1 References

ADFG (Alaska Department of Fish and Game). 2015. Alaska wildlife action plan. Juneau.

BLM (Bureau of Land Management). 2018. Willow Master Development Plan EIS - ConocoPhillips Alaska, Inc.'s Proposed Action. https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/154307/188924/Willow_Detials_for_ePlanning.pdf

_____. 2019a. Willow Master Development Plan Environmental Impact Statement, ConocoPhillips Alaska, Inc. Proposed Action Summary. Internet website: https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/154307/188924/Willow_Detials_for_ePlanning.pdf

_____. 2019b. Alaska special status species list – 2019. Bureau of Land Management, Alaska State Office, Anchorage, AK.

IUCN (International Union for Conservation of Nature). 2018. IUCN Red List of threatened species. Version 2018-1. Internet website: http://www.iucnredlist.org/.

Johnson, S. R., and D. R. Herter. 1989. *The birds of the Beaufort Sea*. BP Exploration (Alaska), Inc., Anchorage, AK. 372 pp.

USFWS (U.S. Fish and Wildlife Service). 2008. Birds of conservation concern 2008. U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, VA.

Warnock, N. 2017. The Alaska WatchList 2017. Audubon Alaska, Anchorage, AK. Internet website: https://ak.audubon.org/sites/default/files/static_pages/attachments/2017_watchlist_final_panels_highres.pdf.

Appendix P

Effects on Birds by Alternative in Areas Allocated to Fluid Mineral Development under Three Development Potentials in the NPR-A

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
BLM	Bureau of Land Management
NPR-A	National Petroleum Reserve in Alaska

Appendix P. Effects on Birds by Alternative in Areas Allocated to Fluid Mineral Development under Three Development Potentials in the NPR-A

Table P-1
Number of Birds by Alternative in Areas Allocated to Fluid Mineral Development[1] under Three Development Potentials in the National Petroleum Reserve in Alaska (NPR-A)

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Greater White-fronted Goose	Low	7,603	14	5,023	9	6,578	12	7,631	14	7,497	14	9,617
Snow Goose	Low	35	3	16	2	29	3	35	3	34	3	48
Brant	Low	90	3	45	1	72	2	89	3	89	3	144
Cackling/ Canada Goose	Low	57	4	37	2	48	3	58	4	56	4	72
Steller's Eider	Low	22	8	14	5	21	8	22	8	22	8	27
Spectacled Eider	Low	1,298	24	836	15	1,123	21	1,303	24	1,278	23	1,581
King Eider	Low	1,335	11	974	8	1,179	10	1,332	11	1,325	11	1,660
Red-throated Loon	Low	234	11	101	5	176	8	253	12	228	11	368
Pacific Loon	Low	3,777	15	2,626	10	3,355	13	3,805	15	3,744	15	4,616
Yellow-billed Loon	Low	79	5	54	4	71	5	84	6	78	5	105
Subtotal	**Low**	**14,530**	**14**	**9,727**	**9**	**12,653**	**12**	**14,613**	**14**	**14,351**	**13**	**18,238**
Greater White-fronted Goose	Medium	10,936	20	5,757	11	11,145	21	16,922	31	16,711	31	24,951
Snow Goose	Medium	46	5	16	2	43	4	104	10	101	10	177
Brant	Medium	214	7	68	2	199	6	588	18	559	17	1,002
Cackling/ Canada Goose	Medium	217	14	160	10	232	15	303	19	304	19	473

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Steller's Eider	Medium	61	23	22	8	41	15	99	37	83	31	146
Spectacled Eider	Medium	1,219	22	459	8	962	18	1,619	30	1,518	28	2,352
King Eider	Medium	2,825	23	1,166	10	2,512	21	3,778	31	3,720	31	5,176
Red-throated Loon	Medium	339	16	200	10	367	18	608	29	598	29	927
Pacific Loon	Medium	6,966	28	3,883	15	6,576	26	9,138	36	9,002	36	13,107
Yellow-billed Loon	Medium	350	24	254	17	453	31	595	41	605	42	879
Subtotal	**Medium**	**23,172**	**22**	**11,985**	**11**	**22,531**	**21**	**33,753**	**32**	**33,201**	**31**	**49,191**
Greater White-fronted Goose	High	3,881	7	2,423	4	4,771	9	9,301	17	9,153	17	16,623
Snow Goose	High	18	2	8	1	87	9	248	24	246	24	724
Brant	High	59	2	4	0	131	4	781	24	808	25	1,836
Cackling/ Canada Goose	High	330	21	227	14	333	21	504	32	459	29	972
Steller's Eider	High	13	5	8	3	18	7	33	12	34	13	61
Spectacled Eider	High	105	2	21	0	154	3	507	9	516	9	1,021
King Eider	High	1,462	12	599	5	1,387	11	3,154	26	3,169	26	4,787
Red-throated Loon	High	163	8	117	6	197	9	361	17	355	17	604
Pacific Loon	High	2,788	11	2,123	8	2,914	12	4,304	17	4,130	16	6,238
Yellow-billed Loon	High	205	14	184	13	242	17	325	22	309	21	435
Subtotal	**High**	**9,024**	**8**	**5,712**	**5**	**10,234**	**10**	**19,519**	**18**	**19,180**	**18**	**33,303**
Total	**All**	**46,726**	**44**	**27,423**	**26**	**45,417**	**43**	**67,884**	**64**	**66,732**	**63**	**100,732**

Sources: Data from Amundson et al. 2019. Based on average densities from June aerial surveys of the Arctic Coastal Plain (Wilson et al. 2018) calculated for 6 x 6 kilometer grid cells, 1992–2016, and acreages within allocations under each alternative within the high development scenario.

[1]Allocated to fluid mineral development includes open to leasing with standard terms and conditions, open with timing limitations, and open with controlled surface use.

[2]Areas within the Amundson et al. 2019 study area and the low development potential area = 1,866,186 acres, medium development potential area = 4,869,862, and high development potential area = 2,954,081 acres.

Table P-2
Number of Birds in Areas of Pre-existing Leases[1] and Co-located in Closed to Fluid Mineral Leasing or No Surface Occupancy Allocations under Three Development Potentials in the NPR-A

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Greater White-fronted Goose	Medium	1,070	2	2,243	4	1,094	2	953	2	925	2	24,951
Snow Goose	Medium	2	0	4	0	2	0	2	0	2	0	177
Brant	Medium	7	0	17	1	4	0	3	0	3	0	1,002
Cackling/ Canada Goose	Medium	43	3	69	4	46	3	44	3	42	3	473
Steller's Eider	Medium	2	1	6	2	2	1	2	1	2	1	146
Spectacled Eider	Medium	42	1	147	3	44	1	36	1	36	1	2,352
King Eider	Medium	166	1	638	5	245	2	170	1	169	1	5,176
Red-throated Loon	Medium	50	2	99	5	54	3	47	2	44	2	927
Pacific Loon	Medium	729	3	1,465	6	798	3	690	3	664	3	13,107
Yellow-billed Loon	Medium	83	6	147	10	80	5	74	5	71	5	879
Subtotal	**Medium**	**2,195**	**2**	**4,836**	**5**	**2,370**	**2**	**2,021**	**2**	**1,958**	**2**	**49,191**
Greater White-fronted Goose	High	1,472	3	2,969	5	1,732	3	1,386	3	2,005	4	16,623
Snow Goose	High	7	1	15	1	7	1	6	1	11	1	724
Brant	High	57	2	95	3	61	2	53	2	63	2	1,836
Cackling/ Canada Goose	High	179	11	283	18	208	13	191	12	242	15	972
Steller's Eider	High	2	1	6	2	3	1	2	1	3	1	61
Spectacled Eider	High	46	1	118	2	64	1	40	1	59	1	1,021
King Eider	High	360	3	1,184	10	625	5	370	3	624	5	4,787
Red-throated Loon	High	55	3	111	5	70	3	53	3	74	4	604
Pacific Loon	High	780	3	1,499	6	962	4	785	3	1,108	4	6,238

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Yellow-billed Loon	High	48	3	90	6	56	4	46	3	71	5	435
Subtotal	**High**	**3,007**	**3**	**6,369**	**6**	**3,788**	**4**	**2,931**	**3**	**4,261**	**4**	**33,303**
Total	**All**	**5,201**	**5**	**11,205**	**11**	**6,157**	**6**	**4,952**	**5**	**6,219**	**6**	**100,732**

Sources: Data from Amundson et al. 2019. Based on average densities from June aerial surveys of the Arctic Coastal Plain (Wilson et al. 2018) calculated for 6 x 6 kilometer grid cells, 1992–2016, and acreages within allocations under each alternative within three development scenarios.

[1]Allocated to areas closed to fluid mineral leasing and no surface occupancy under this Final Integrated Activity Plan/Environmental Impact Statement and within existing lease areas that may be developed under prior lease stipulations.

[2] Areas co-located within the Amundson et al. 2019 study area and the Bureau of Land Management controlled area in the low development potential area = 1,848,424 acres, medium development potential area = 4,663,252, high development potential area = 2,950,707 acres.

Table P-3
Number of Brant Colonies and Nests by Alternative in Areas Available to Fluid Mineral Leasing[1] under Three Development Potentials in the NPR-A

	Development Potential	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	
No. of Colonies	Low	1	1	0	0	1	1	1	1	1	1	4
Sum of Average Nests[2]	Low	2	0.3	0	0	2	0.3	2	0.3	2	0.3	6
Sum of Maximal Nests[3]	Low	2	0.2	0	0	2	0.2	2	0.2	2	0.2	8
No. of Colonies	Medium	4	4	2	2	2	2	29	27	28	26	41
Sum of Average Nests[3]	Medium	29	4	21	3	21	3	164	24	159	23	245
Sum of Maximal Nests[3]	Medium	47	4	35	3	35	3	367	28	359	27	587
No. of Colonies	High	9	8	0	0	12	11	30	28	26	24	65
Sum of Average Nests[3]	High	25	4	0	0	29	4	168	25	152	22	437
Sum of Maximal Nests[3]	High	50	4	0	0	58	4	259	20	223	17	734
Total Colonies	**All**	**14**	**13**	**2**	**2**	**15**	**14**	**60**	**56**	**55**	**51**	

Sources: Data from NSB DWM 2019, BLM GIS 2019, and USGS GIS 2019. Based on aerial surveys from 1 to 25 years (1994 to 2018) at each colony; Map 3-18 from the Final Integrated Activity Plan/Environmental Impact Statement.
[1]Allocated to fluid mineral leasing includes open to leasing with standard terms and conditions, open with timing limitations, and open with controlled surface use.
[2]In the NPR-A decision area, total colonies = 108, sum of average number of nests = 680, sum of maximal number of nests = 1,315.
[3]Sum of average nests is average annual number of nests in each colony and sum of maximal nests is the highest nest count in each colony, each of which summed across colonies within a combination of the alternatives and development potentials.

Table P-4
Acres Available to Fluid Mineral Leasing[1] of the Goose Molting Area Containing 85 Percent of Brant by Alternative in the High Development Potential Area in the NPR-A

Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]
0	0	0	0	754	<1	24,467	8	28,312	9

Sources: Source data (USGS, unpublished data) (Patil 2020).
[1]Allocated to fluid mineral leasing includes open to leasing with standard terms and conditions, open with timing limitations, and open with controlled surface use.
[2]Percentage of total acres in the Goose Molting area containing 85 percent of brant (Map 3-20 from the Final Integrated Activity Plan/Environmental Impact Statement; 302,049 acres under Bureau of Land Management control).

Table P-5
Acres Available to Fluid Mineral Leasing[1] of the Goose Molting Area Containing 85 Percent of Cackling/Canada Geese by Alternative in the High Development Potential Area in the NPR-A

Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]
0	0	0	0	754	<1	62,291	18	66,135	19

Sources: Source data (USGS, unpublished data) (Patil 2020).
[1]Allocated to fluid mineral leasing includes open to leasing with standard terms and conditions, open with timing limitations, and open with controlled surface use.
[2]Percentage of total acres in the Goose Molting area containing 85 percent of cackling/Canada geese (Map 3-20) from the Final Integrated Activity Plan/Environmental Impact Statement; 346,584 acres acres).

P.1 References

Amundson, C. L., P. L. Flint, R. A. Stehn, R. M. Platte, H. M. Wilson, W. W. Larned. and J. B. Fischer. 2019. "Spatio-temporal population change of Arctic-breeding waterbirds on the Arctic Coastal Plain of Alaska". *Avian Conservation and Ecology* 14(1):18.

BLM (Bureau of Land Management) GIS. 2019. GIS data used in the NPR-A IAP EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska

NSB DWM (North Slope Borough Department of Wildlife Management). 2019. GIS data used in the NPR-A IAP EIS alternatives, affected environment, and impact analysis.

Patil, V. 2020. Habitat selection scenarios for molting waterfowl in the Goose Molting Area of the Teshekpuk Lake Special Area, for NPR-A Integrated Activity Plan/Environmental Impact Statement (2020): U.S. Geological Survey data release, https://doi.org/10.5066/P9ZGNRTB.

USGS (U.S. Geological Survey). 2019. GIS data used in the NPR-A IAP EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Wilson, H. M., W. W. Larned, and M. A. Swaim. 2018. Waterfowl breeding populations on the Arctic Coastal Plain, Alaska, 1986–2017. Report by U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

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Appendix Q

Effects on Birds from Infrastructure and Habitat Modification

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ACRONYMS AND ABBREVIATIONS — Full Phrase

Acronyms and Abbreviations	Full Phrase
BLM	Bureau of Land Management
NPR-A	National Petroleum Reserve in Alaska

Appendix Q. Effects on Birds from Infrastructure and Habitat Modification

Table Q-1
Number of Birds by Alternative in Areas Available to Permanent Infrastructure[1] in Three Development Potential Areas in the National Petroleum Reserve in Alaska (NPR-A)

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Greater White-fronted Goose	Low	9,495	18	9,188	17	9,495	18	9,495	18	9,495	18	9,528
Snow Goose	Low	46	5	45	4	46	5	46	5	46	5	46
Brant	Low	141	4	141	4	141	4	141	4	141	4	141
Cackling/ Canada Goose	Low	72	5	72	5	72	5	72	5	72	5	72
Steller's Eider	Low	27	10	27	10	27	10	27	10	27	10	27
Spectacled Eider	Low	1,561	29	1,549	28	1,561	29	1,561	29	1,561	29	1,561
King Eider	Low	1,646	14	1,622	13	1,646	14	1,646	14	1,646	14	1,646
Red-throated Loon	Low	361	17	356	17	361	17	361	17	361	17	361
Pacific Loon	Low	4,565	18	4,471	18	4,565	18	4,565	18	4,565	18	4,572
Yellow-billed Loon	Low	104	7	99	7	104	7	104	7	104	7	104
Subtotal	**Low**	**18,019**	**17**	**17,569**	**17**	**18,019**	**17**	**18,019**	**17**	**18,019**	**17**	**18,058**
Greater White-fronted Goose	Medium	23,815	44	11,929	22	23,815	44	23,990	44	23,990	44	23,990
Snow Goose	Medium	171	17	49	5	171	17	171	17	171	17	171
Brant	Medium	957	29	224	7	957	29	960	30	960	30	960
Cackling/ Canada Goose	Medium	462	29	293	18	462	29	464	29	464	29	464
Steller's Eider	Medium	117	44	54	20	117	44	118	44	118	44	118
Spectacled Eider	Medium	2,136	39	1,143	21	2,136	39	2,144	39	2,144	39	2,144
King Eider	Medium	4,757	39	2,821	23	4,757	39	4,873	40	4,873	40	4,873

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Red-throated Loon	Medium	874	42	372	18	874	42	884	42	884	42	884
Pacific Loon	Medium	12,326	49	7,548	30	12,326	49	12,433	50	12,433	50	12,433
Yellow-billed Loon	Medium	855	59	402	28	855	59	866	59	866	59	866
Subtotal	**Medium**	**46,472**	**44**	**24,835**	**23**	**46,472**	**44**	**46,902**	**44**	**46,902**	**44**	**46,902**
Greater White-fronted Goose	High	9,915	18	4,882	9	10,398	19	14,620	27	15,139	28	16,585
Snow Goose	High	532	52	235	23	550	54	688	68	692	68	723
Brant	High	495	15	235	7	658	20	1,520	47	1,562	48	1,831
Cackling/ Canada Goose	High	642	40	501	31	684	43	924	58	932	59	970
Steller's Eider	High	33	12	15	6	37	14	52	20	55	21	61
Spectacled Eider	High	444	8	147	3	498	9	878	16	910	17	1,019
King Eider	High	2,786	23	1,192	10	2,979	24	4,106	34	4,392	36	4,784
Red-throated Loon	High	381	18	187	9	395	19	542	26	558	27	603
Pacific Loon	High	4,725	19	3,204	13	4,853	19	5,761	23	5,926	24	6,233
Yellow-billed Loon	High	375	26	245	17	374	26	414	28	424	29	435
Subtotal	**High**	**20,327**	**19**	**10,844**	**10**	**21,425**	**20**	**29,505**	**28**	**30,589**	**29**	**33,244**
Total	**All**	**84,818**	**80**	**53,248**	**50**	**85,915**	**81**	**94,426**	**89**	**95,510**	**90**	**98,205**

Sources: Data from Amundson et al. 2019. Based on average densities from June aerial surveys of the Arctic Coastal Plain (Wilson et al. 2018) calculated for 6 x 6 km grid cells, 1992–2016, and acreages within allocations under each alternative within the three development potential areas that also are within the Arctic Coastal Plain survey area.

[1]Allocated to potential infrastructure development includes available to infrastructure, available for corridors, and unavailable except for the following: essential pipelines, essential roads and pipelines, and essential coastal infrastructure.

[2]Areas co-located within the Amundson et al. 2019 study area and the BLM controlled area in the low development potential area = 1,848,424 acres, medium development potential area = 4,663,252, high development potential area = 2,950,707 acres.

Table Q-2
Number of Birds in Areas of Pre-existing Leases[1] and Co-located in Unavailable to Permanent Infrastructure[1] under Three Development Potentials in the NPR-A

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Greater White-fronted Goose	Medium	0	0	1,221	2	0	0	0	0	0	0	23,990
Snow Goose	Medium	0	0	3	0	0	0	0	0	0	0	171
Brant	Medium	0	0	15	0	0	0	0	0	0	0	960
Cackling/ Canada Goose	Medium	0	0	25	2	0	0	0	0	0	0	464
Steller's Eider	Medium	0	0	3	1	0	0	0	0	0	0	118
Spectacled Eider	Medium	0	0	114	2	0	0	0	0	0	0	2,144
King Eider	Medium	0	0	399	3	0	0	0	0	0	0	4,873
Red-throated Loon	Medium	0	0	52	3	0	0	0	0	0	0	884
Pacific Loon	Medium	0	0	726	3	0	0	0	0	0	0	12,433
Yellow-billed Loon	Medium	0	0	81	6	0	0	0	0	0	0	866
Subtotal	**Medium**	**0**	**0**	**2,639**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**46,902**
Greater White-fronted Goose	High	0	0	1,766	3	0	0	0	0	0	0	16,585
Snow Goose	High	<1	<1	11	1	<1	<1	0	0	0	0	723
Brant	High	<1	<1	65	2	<1	<1	0	0	0	0	1,831
Cackling/ Canada Goose	High	<1	<1	85	5	<1	<1	0	0	0	0	970
Steller's Eider	High	<1	<1	3	1	<1	<1	0	0	0	0	61
Spectacled Eider	High	<1	<1	92	2	<1	<1	0	0	0	0	1,019
King Eider	High	<1	<1	840	7	<1	<1	0	0	0	0	4,784
Red-throated Loon	High	<1	<1	77	4	<1	<1	0	0	0	0	603
Pacific Loon	High	<1	<1	749	3	<1	<1	0	0	0	0	6,233

Common Name	Development Potential[2]	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds	% of Total in NPR-A	Estimate of Birds
Yellow-billed Loon	High	<1	<1	46	3	<1	<1	0	0	0	0	435
Subtotal	**High**	**<1**	**<1**	**3,733**	**4**	**<1**	**<1**	**0**	**0**	**0**	**0**	**33,244**
Total	**All**	**<1**	**<1**	**6,371**	**6**	**<1**	**<1**	**0**	**0**	**0**	**0**	**98,205**

Sources: Data from Amundson et al. 2019. Based on average densities from June aerial surveys of the Arctic Coastal Plain (Wilson et al. 2018) calculated for 6 x 6 kilometer grid cells, 1992–2016, and acreages within allocations under each alternative within three development scenarios.

[1]Co-located in areas allocated to unavailable to infrastructure under this Final Integrated Activity Plan/Environmental Impact Statement and within existing lease areas that may be developed under prior lease stipulations.

[2]Areas co-located within the Amundson et al. 2019 study area and the Bureau of Land Management controlled area in the low development potential area = 1,848,424 acres, medium development potential area = 4,663,252, high development potential area = 2,950,707 acres.

Table Q-3
Number of Brant Colonies and Nests by Alternative in Areas Available to Permanent Infrastructure[1] under Three Development Potentials in the NPR-A

	Development Potential	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E		Total by Development Potential (All Allocations)
		Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	Total	% of Total in NPR-A[2]	
No. of Colonies	Low	4	4	4	4	4	4	4	4	4	4	4
Sum of Average Nests[2]	Low	6	1	6	1	6	1	6	1	6	1	6
Sum of Maximal Nests[3]	Low	8	1	8	1	8	1	8	1	8	1	8
No. of Colonies	Medium	39	36	4	4	39	36	39	36	39	36	39
Sum of Average Nests[3]	Medium	237	35	30	4	237	35	237	35	237	35	237
Sum of Maximal Nests[3]	Medium	573	44	67	5	573	44	573	44	573	44	573
No. of Colonies	High	21	19	6	6	27	25	51	47	53	49	65
Sum of Average Nests[3]	High	84	12	22	3	106	16	349	51	399	59	437
Sum of Maximal Nests[3]	High	161	12	30	2	191	15	557	42	666	51	734
Total Colonies	All	64	59	14	13	70	65	94	87	96	89	

Sources: Data from NSB DWM 2019, BLM GIS 2019, and USGS GIS 2019. Based on aerial surveys from 1 to 25 years (1994 to 2018) at each colony ; Map 3-18 in the Final Integrated Activity Plan/Environmental Impact Statement.

[1]Allocated to potential infrastructure development includes available to infrastructure, available for corridors, and unavailable except for the following: essential pipelines, essential roads and pipelines, and essential coastal infrastructure.

[2]In the NPR-A decision area, total colonies = 108, sum of average number of nests = 680, sum of maximal number of nests = 1,315.

[3]Sum of average nests is average annual number of nests in each colony and sum of maximal nests is the highest nest count in each colony, summed across colonies within a combination of the alternatives and development potentials.

Table Q-4
Acres Available to Permanent Infrastructure[1] of the Goose Molting Area Containing 85 Percent of Brant by Alternative in the High Development Potential Area in the NPR-A

Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]
40,727	13	34,708	11	73,111	24	212,895	70	217,120	72

Sources: Source data (USGS unpublished data) (Patil 2020).
[1]Allocated to potential infrastructure development includes available to infrastructure, available for corridors, and unavailable except for the following: essential pipelines, essential roads and pipelines, and essential coastal infrastructure.
[2]Percentage of total acres in the area containing 85 percent of brant (Map 3-20) in the Final Integrated Activity Plan/Environmental Impact Statement; 302,049 acres under BLM control).

Table Q-5
Acres Available to Permanent Infrastructure[1] of the Goose Molting Area Containing 85 Percent of Cackling/Canada Geese by Alternative in the High Development Potential Area in the NPR-A

Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]	Number of Acres	% of Total[2]
40,700	12	33,832	10	72,209	21	257,395	75	261,620	76

Sources: Source data from Patil 2020.USGS, unpublished data.
[1]Allocated to potential infrastructure development includes available to infrastructure, available for corridors, and unavailable except for the following: essential pipelines, essential roads and pipelines, and essential coastal infrastructure.
[2]Percentage of total acres in the area containing 85 percent of cackling/Canada geese (Map 3-20 in the Final Integrated Activity Plan/Environmental Impact Statement; 346,584 acres under BLM control).

Table Q-6
Direct Effects of Surface Disturbance (gravel cover), Indirect Effects of Habitat Modification (dust, gravel spray, and thermokarst), and Disturbance from Human Activity on Gravel Infrastructure by Alternative in the Reasonably Foreseeable Development Scenario

Alternative	Effect Type[1]	Low (acres)	Medium (acres)	High (acres)
A	Gravel coverage (acres)	183	749	1,269
B	Gravel coverage (acres)	199	816	1,382
C	Gravel coverage (acres)	267	1,097	1,858
D	Gravel coverage (acres)	356	1,461	2,475
E	Gravel coverage (acres)	356	1,461	2,475
A	Habitat modification (acres)	1,610	6,591	11,167
B	Habitat modification (acres)	1,751	7,181	12,162
C	Habitat modification (acres)	2,350	9,654	16,350
D	Habitat modification (acres)	3,133	12,857	21,780
E	Habitat modification (acres)	3,133	12,857	21,780
A	Disturbance zone (acres)	2,891	11,834	20,050
B	Disturbance zone (acres)	3,144	12,893	21,836
C	Disturbance zone (acres)	4,219	17,333	29,356
D	Disturbance zone (acres)	5,625	23,084	39,105
E	Disturbance zone (acres)	5,625	23,084	39,105

[1]Based on calculations for hypothetical gravel infrastructure in the Coastal Plain Oil and Gas Leasing Final Environmental Impact Statement, Section 3.3.3 (BLM 2019. Habitat modification area (328 feet) = area of gravel + 8.8 × area of gravel. Disturbance zone (656 feet) = area of gravel + 15.8 × area of gravel. Gravel area scenarios from Appendix B, Table B-2, in the Final Integrated Activity Plan/Environmental Impact Statement

Q.1 References

Amundson, C. L., P. L. Flint, R. A. Stehn, R. M. Platte, H. M. Wilson, W. W. Larned. and J. B. Fischer. 2019. “Spatio-temporal population change of Arctic-breeding waterbirds on the Arctic Coastal Plain of Alaska”. *Avian Conservation and Ecology* 14(1):18.

BLM (Bureau of Land Management). 2019. Coastal Plain oil and gas leasing program final environmental impact statement. U.S. Department of the Interior, Bureau of Land Management, Anchorage, Alaska.

BLM (Bureau of Land Management) GIS. 2019. GIS data used in the NPR-A IAP EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska

NSB DWM (North Slope Borough Department of Wildlife Mangement. 2019. GIS data used in the NPR-A IAP EIS alternatives, affected environment, and impact analysis.

Patil, V. 2020, Habitat selection scenarios for molting waterfowl in the Goose Molting Area of the Teshekpuk Lake Special Area, for NPR-A Integrated Activity Plan/Environmental Impact Statement (2020): U.S. Geological Survey data release, https://doi.org/10.5066/P9ZGNRTB.

USGS (U.S. Geological Survey). 2019. GIS data used in the NPR-A IAP EIS alternatives, affected environment, and impact analysis. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska

Wilson, H. M., W. W. Larned, and M. A. Swaim. 2018. Waterfowl breeding populations on the Arctic Coastal Plain, Alaska, 1986–2017. Report by U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Appendix R
Terrestrial Mammals

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ACRONYMS AND ABBREVIATIONS — Full Phrase

Acronym	Full Phrase
ADFG	Alaska Department of Fish and Game
EIS	environmental impact statement
IAP	Integrated Activity Plan
NPR-A	National Petroleum Reserve in Alaska
NSO	no surface occupancy
STC	standard terms and conditions

Appendix R. Terrestrial Mammals

Table R-1
Terrestrial Mammal Species Known or Expected to be in the NPR-A

Common Name	Scientific Name	Iñupiaq Name	Abundance
Arctic Fox	*Alopex lagopus*	Qusrhaaq/tibiganniaq/ qujhaaq	Common
Red Fox	*Vulpes vulpes*	Kavviaq/kayuqtuq	Uncommon
Gray Wolf	*Canis lupus*	Amabuq	Uncommon
Grizzly (Brown) Bear	*Ursus arctos*	Akjaq	Uncommon
Wolverine	*Gulo gulo*	Qavvik/qapvik	Uncommon
Caribou	*Rangifer tarandus*	Tuttu	Abundant
Dall Sheep	*Ovis dalli*	Imnaiq	Uncommon
Moose	*Alces americanus*	Tiniikaq/tuttuvak/titiniika	Uncommon
Muskox	*Ovibos moschatus*	Umifmak/imummak	Uncommon
Arctic Ground Squirrel	*Urocitellus parryii*	Siksrik	Abundant
Ermine (Short-tailed Weasel)	*Mustela erminea*	Itibiaq/tibiaq	Common
Least Weasel	*Mustela nivalis*	Naulayuq	Uncommon
Snowshoe Hare	*Lepus americanus*	Ukalliuraq/ukalliq	Rare or accidental
Brown Lemming	*Lemmus trimucronatus*	Aviffaq	Common
Collared Lemming	*Dicrostonyx groenlandicus*	Qixafmiutauraq	Common
Northern Red-backed Vole	*Myodes rutilus*	Avieeaq	Common
Root (Tundra) Vole	*Microtus oeconomus*	Avieeaq	Uncommon
Singing Vole	*Microtus miurus*	—	Common
Barren-ground Shrew	*Sorex ugyunak*	Ugrugnaq	Common
Tundra Shrew	*Sorex tundrensis*	Ugrufnaq	Uncommon
Alaska Marmot	*Marmota broweri*		Rare or accidental
American Beaver	*Castor canadensis*		Rare or accidental
American Marten	*Martes americana*	Qapvaitchiaq	Rare or accidental
American Mink	*Mustela vison*	Tibiaqpak	Rare or accidental
Canada Lynx	*Lynx canadensis*	Niutuuyiq/niutuiyiq/ nuutuuyiq	Rare or accidental
Cinereus Shrew	*Sorex cinereus*	—	Rare or accidental
Coyote	*Canis latrans*	Amabuuraq	Rare or accidental
Holarctic Least Shrew	*Sorex minutissimus*	—	Rare or accidental
Muskrat	*Ondatra zibethicus*	—	Rare or accidental
North American Porcupine	*Erethizon dorsatum*	Ixuqutaq/qifabluk	Rare or accidental
North American River Otter	*Lontra canadensis*	Pamiuqtuuq	Rare or accidental

Source: MacDonald and Cook 2009, BLM 2012, Tape et al. 2018.

Table R-2
Percent of Female Caribou of the Western Arctic Herd (1987–2018) Expected to be in Areas of Different Fluid Mineral Leasing Status

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Spring	Closed to Leasing	44.3	46.7	34.8	34.7	34.7
	No Surface Occupancy	1.2	1.5	2.6	2.3	5.7
	Controlled Surface Use	—	—	—	0	0
	Timing Limitations	—	—	10.2	10.4	6.9
	Standard Terms and Conditions	5.2	2.4	3.0	3.3	3.3
	Existing Leases (Assumed STC)	0.4	0.4	0.4	0.4	0.4
Calving	Closed to Leasing	82.4	86.1	78.2	78.1	78.1
	No Surface Occupancy	0.9	0.4	1.3	1.2	2.8
	Controlled Surface Use	—	—	—	0	0
	Timing Limitations	—	—	6.9	7.0	5.4
	Standard Terms and Conditions	4.2	1.0	1.1	1.2	1.2
	Existing Leases (Assumed STC)	0.1	0.1	0.1	0.1	0.1
Postcalving	Closed to Leasing	29.6	30.5	28.3	28.1	28.1
	No Surface Occupancy	0.2	0.1	0.4	0.4	1.3
	Controlled Surface Use	—	—	—	0	0
	Timing Limitations	—	—	1.9	2	1.2
	Standard Terms and Conditions	1.1	0.2	0.3	0.3	0.3
	Existing Leases (Assumed STC)	0.1	0.1	0.1	0.1	0.1
Summer	Closed to Leasing	33.0	32.0	5.9	5.8	5.8
	No Surface Occupancy	0.6	2.0	3.6	3.4	17.2
	Controlled Surface Use	—	—	—	0.0	0.0
	Timing Limitations	—	—	23.5	23.6	9.7
	Standard Terms and Conditions	3.3	2.9	3.9	4.0	4.2
	Existing Leases (Assumed STC)	0.0	0.0	0.0	0.0	0.0
Late Summer	Closed to Leasing	23.2	23.2	11.6	11.6	11.5
	No Surface Occupancy	2.3	4.6	4.3	3.9	7.3
	Controlled Surface Use	—	—	—	0.0	0.0
	Timing Limitations	—	—	10.1	10.2	6.4
	Standard Terms and Conditions	10.9	8.6	10.4	10.8	11.1
	Existing Leases (Assumed STC)	0.4	0.4	0.4	0.4	0.4
Fall	Closed to Leasing	6.3	6.7	3.0	2.9	2.9
	No Surface Occupancy	1.4	2.5	2.5	2.0	3.1
	Controlled Surface Use	—	—	—	0.0	0.0
	Timing Limitations	—	—	2.9	3.0	1.9
	Standard Terms and Conditions	6.2	4.7	5.6	6.0	6.1
	Existing Leases (Assumed STC)	1.0	1.0	1.0	1.0	1.0
Winter	Closed to Leasing	3.0	2.8	1.0	0.9	0.9
	No Surface Occupancy	0.7	1.4	1.3	1.0	1.7
	Controlled Surface Use	—	—	—	0.0	0.0
	Timing Limitations	—	—	1.4	1.5	0.9
	Standard Terms and Conditions	3.2	2.6	3.1	3.4	3.4
	Existing Leases (Assumed STC)	0.7	0.7	0.7	0.7	0.7

Note: Calculated from the Alaska Department of Fish and Games seasonal utilization distributions of collared female caribou 1987–2018 (Appendix A of the Final IAP/EIS, Map 3-21). Utilization distributions were calculated using kernel density estimation and the plugin bandwidth estimator (see Prichard et al. 2019 for a description of the methods).

Table R-3
Percent of Female Caribou of the Western Arctic Herd (1987–2018) Expected to be in Areas of With Different Infrastructure Allowed

Season	Land Status	Alternative				
		A	B	C	D	E
Spring	Closed to New Infrastructure	43.9	46.6	34.8	34.7	34.7
	Coastal Infrastructure Only	0.0	0.0	0.0	0.0	0.0
	Pipeline Crossings Only	0.0	0.0	0.0	0.0	0.0
	Roads/Pipelines Crossings Only	1.3	1.1	2.2	2.2	5.5
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	5.7	3.1	13.9	14	10.6
Calving	Closed to New Infrastructure	82.3	86.1	78.2	78.1	78.1
	Coastal Infrastructure Only	0.0	0.0	0.0	0.0	0.0
	Pipeline Crossings Only	0.0	0.0	0.0	0.0	0.0
	Roads/Pipelines Crossings Only	0.9	0.4	1.1	1.1	2.7
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	4.3	1.1	8.2	8.3	6.7
Postcalving	Closed to New Infrastructure	29.5	30.5	28.2	28.2	28.2
	Coastal Infrastructure Only	0.0	0.0	0.0	0.0	0.0
	Pipeline Crossings Only	0.0	0.0	0.0	0.0	0.0
	Roads/Pipelines Crossings Only	0.2	0.1	0.3	0.3	1.2
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	1.2	0.3	2.3	2.4	1.6
Summer	Closed to New Infrastructure	32.8	31.9	5.9	5.8	5.8
	Coastal Infrastructure Only	0.0	0.0	0.0	0.0	0.0
	Pipeline Crossings Only	0.0	0.0	0.0	0.0	0.0
	Roads/Pipelines Crossings Only	0.7	1.7	3.4	3.4	17.1
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	3.3	3.2	27.6	27.7	14
Late Summer	Closed to New Infrastructure	23	23.1	11.5	11.5	11.5
	Coastal Infrastructure Only	0.1	0.0	0.0	0.0	0.0
	Pipeline Crossings Only	0.1	0.1	0.1	0.0	0.0
	Roads/Pipelines Crossings Only	2.4	3.9	3.9	3.9	7.3
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	11.3	9.7	21.3	21.3	18
Fall	Closed to New Infrastructure	5.8	6.7	2.9	2.9	2.9
	Coastal Infrastructure Only	0.1	0.1	0.1	0.0	0.0
	Pipeline Crossings Only	0.1	0.1	0.1	0.0	0.0
	Roads/Pipelines Crossings Only	1.7	2.0	2.0	2.0	3.0
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	7.3	6.0	9.8	9.8	8.9
Winter	Closed to New Infrastructure	2.7	2.8	0.9	0.9	0.9
	Coastal Infrastructure Only	0.0	0.0	0.0	0.0	0.0
	Pipeline Crossings Only	0.1	0.1	0.1	0.0	0.0
	Roads/Pipelines Crossings Only	0.8	1.1	1.0	1.1	1.6
	Infrastructure Corridor	—	0.0	0.0	—	—
	Available for New Infrastructure	3.9	3.5	5.4	5.5	4.9

Source: ADFG. Calculated from the seasonal utilization distributions of collared female caribou 1987–2018 (Appendix A of the Final IAP/EIS, Map 3-21). Utilization distributions were calculated using kernel density estimation and the plug-in bandwidth estimator (see Prichard et al. 2019 for a description of the methods).

Table R-4
Percent of Female Caribou of the Teshekpuk Caribou Herd Expected to be in Areas with Different Fluid Mineral Leasing Status

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Spring	Closed to Leasing	37.1	37.3	13.9	2.9	2.8
	No Surface Occupancy	4.2	8.5	22.0	16.7	15.6
	Controlled Surface Use	—	—	—	1.2	1.3
	Timing Limitations	—	—	4.5	17.1	18.0
	Standard Terms and Conditions	17.0	12.4	17.9	20.4	20.6
	Existing Leases (Assumed STC)	18.2	18.2	18.2	18.2	18.2
	Closed/NSO under new IAP[2]	4.4	10.7	5.8	4.3	5.7
Calving[1]	Closed to Leasing	73.1	76.4	46.6	1.3	1.3
	No Surface Occupancy	2.3	4.3	25.8	33.8	29.0
	Controlled Surface Use	—	—	—	6.1	6.4
	Timing Limitations	—	—	5.0	34.7	39.1
	Standard Terms and Conditions	10.1	5.0	8.2	9.9	9.8
	Existing Leases (Assumed STC)	11.3	11.3	11.3	11.3	11.3
	Closed/NSO under new IAP[2]	2.3	9.3	3.9	1.7	2.8
Postcalving	Closed to Leasing	72.4	75.3	43.0	2.4	2.4
	No Surface Occupancy	2.4	4.1	27.6	33.2	29.9
	Controlled Surface Use	—	—	—	7.9	8.1
	Timing Limitations	—	—	5.4	30.6	33.6
	Standard Terms and Conditions	10.1	5.4	8.9	10.8	10.8
	Existing Leases (Assumed STC)	11.2	11.2	11.2	11.2	11.2
	Closed/NSO under new IAP[2]	2.6	9.0	4.0	1.8	3.0
Mosquito	Closed to Leasing	81.4	82.9	50.6	0.3	0.2
	No Surface Occupancy	1.1	2.0	27.7	43.7	42.8
	Controlled Surface Use	—	—	—	18.7	18.8
	Timing Limitations	—	—	3.0	16.4	17.6
	Standard Terms and Conditions	4.2	1.7	5.4	7.5	7.2
	Existing Leases (Assumed STC)	5.8	5.8	5.8	5.8	5.8
	Closed/NSO under new IAP[2]	1.8	5.2	2.2	0.8	1.5
Oestrid Fly	Closed to Leasing	54.5	54.9	22.9	0.7	0.5
	No Surface Occupancy	4.2	8.4	29.6	29.2	28.6
	Controlled Surface Use	—	—	—	7.1	7.2
	Timing Limitations	—	—	4.2	16.2	16.9
	Standard Terms and Conditions	15.9	11.4	18.0	21.5	21.4
	Existing Leases (Assumed STC)	18.9	18.9	18.9	18.9	18.9
	Closed/NSO under new IAP[2]	4.8	11.0	5.8	4.3	5.4
Late Summer	Closed to Leasing	39.3	38.5	11.1	0.9	0.9
	No Surface Occupancy	5.5	10.6	27.4	19.2	18.0
	Controlled Surface Use	—	—	—	1.6	1.6
	Timing Limitations	—	—	3.8	17.3	18.2
	Standard Terms and Conditions	21.5	17.2	24.1	27.4	27.6
	Existing Leases (Assumed STC)	29.9	29.9	29.9	29.9	29.9
	Closed/NSO under new IAP[2]	6.8	15.5	8.7	6.6	8.6

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Fall	Closed to Leasing	24.5	24.6	7.0	0.7	0.5
	No Surface Occupancy	5.0	10.2	19.6	13.8	13.4
	Controlled Surface Use	—	—	—	1.2	1.3
	Timing Limitations	—	—	2.5	10.6	11.1
	Standard Terms and Conditions	19.0	13.7	19.4	22.3	22.2
	Existing Leases (Assumed STC)	24.1	24.1	24.1	24.1	24.1
	Closed/NSO under new IAP[2]	6.2	12.6	7.6	6.1	8.1
Winter	Closed to Leasing	17.6	17.7	4.5	0.6	0.5
	No Surface Occupancy	4.8	9.6	15.2	11.1	11.7
	Controlled Surface Use	—	—	—	1.1	1.2
	Timing Limitations	—	—	2.9	7.1	6.8
	Standard Terms and Conditions	18.9	14.0	18.6	21.3	21.1
	Existing Leases (Assumed STC)	17.5	17.5	17.5	17.5	17.5
	Closed/NSO under new IAP[2]	4.4	8.6	5.3	4.5	5.6

Source: ADFG. Calculated from the seasonal utilization distributions of collared female caribou 1990–2018 (Appendix A of the Final IAP/EIS, Map 3-22). Utilization distributions were calculated using kernel density estimation and the plug-in bandwidth estimator (see Prichard et al. 2019 for a description of the methods).
[1]Parturient Caribou only 2002–2018.
[2]Areas that are currently leased but are in areas that would have been closed to leasing or no surface occupancy (NSO) in the Final IAP/EIS.

Table R-5
Percent of Female Caribou of the Teshekpuk Caribou Herd Expected to be in Areas with Different Infrastructure Allowed

Season	Land Status	Alternative				
		A	B	C	D	E
Spring	Closed to New Infrastructure	15.4	41.4	13.1	6.6	5.2
	Coastal Infrastructure Only	0.7	0.2	0.7	0.8	0.8
	Pipeline Crossings Only	0.4	0.2	0.4	0.9	0.9
	Roads/Pipelines Crossings Only	11.7	7.7	12.1	12.1	13.3
	Infrastructure Corridor	—	2.4	0.7	—	—
	Available for New Infrastructure	47.4	23.7	48.6	55.1	55.3
Calving[1]	Closed to New Infrastructure	46.0	77.4	43.4	17.7	12.8
	Coastal Infrastructure Only	1.1	0.1	1.1	1.6	1.5
	Pipeline Crossings Only	0.5	0.1	0.5	5.2	5.2
	Roads/Pipelines Crossings Only	9.3	3.0	9.3	9.5	10.4
	Infrastructure Corridor	—	6.4	3.0	—	—
	Available for New Infrastructure	39.3	9.2	38.8	62.1	66.1
Postcalving	Closed to New Infrastructure	42.3	76.4	39.9	14.6	11.2
	Coastal Infrastructure Only	1.4	0.1	1.5	2.2	2.1
	Pipeline Crossings Only	0.6	0.2	0.6	6.5	6.5
	Roads/Pipelines Crossings Only	11.0	3.1	11.0	11.2	12.2
	Infrastructure Corridor	—	5.9	2.8	—	—
	Available for New Infrastructure	40.2	9.7	39.7	61.0	63.4
Mosquito	Closed to New Infrastructure	48.7	79.1	45.3	11.7	10.2
	Coastal Infrastructure Only	3.1	0.1	3.4	5.1	5.0
	Pipeline Crossings Only	1.5	0.9	1.5	14.9	14.9
	Roads/Pipelines Crossings Only	9.3	1.0	9.2	9.7	10.5
	Infrastructure Corridor	—	6.8	4.1	—	—
	Available for New Infrastructure	28.7	3.4	27.9	50.0	50.9
Oestrid Fly	Closed to New Infrastructure	22.4	56.1	19.6	5.7	4.5
	Coastal Infrastructure Only	2.2	0.3	2.4	3.1	3.0
	Pipeline Crossings Only	1.1	0.7	1.1	6.7	6.7
	Roads/Pipelines Crossings Only	13.8	6.8	13.9	14.0	14.8
	Infrastructure Corridor	—	4.4	2.5	—	—
	Available for New Infrastructure	52.3	23.6	52.4	62.4	62.8
Late Summer	Closed to New Infrastructure	10.8	44.9	10.2	3.7	2.7
	Coastal Infrastructure Only	1.1	0.1	1.1	1.2	1.1
	Pipeline Crossings Only	0.5	0.2	0.5	1.2	1.2
	Roads/Pipelines Crossings Only	15.4	10.0	15.5	15.6	16.8
	Infrastructure Corridor	—	2.7	0.9	—	—
	Available for New Infrastructure	67.0	36.7	66.6	73.1	72.9
Fall	Closed to New Infrastructure	7.0	29.0	6.2	2.2	1.6
	Coastal Infrastructure Only	0.9	0.2	1.0	1.0	0.9
	Pipeline Crossings Only	0.6	0.4	0.6	0.9	0.9
	Roads/Pipelines Crossings Only	12.8	10.6	13.1	13.1	14.7
	Infrastructure Corridor	—	1.8	0.5	—	—
	Available for New Infrastructure	50.4	29.6	50.3	54.4	53.5

Season	Land Status	Alternative				
		A	B	C	D	E
Winter	Closed to New Infrastructure	5.8	20.0	3.8	1.6	1.2
	Coastal Infrastructure Only	0.7	0.2	0.7	0.8	0.7
	Pipeline Crossings Only	0.5	0.4	0.5	0.8	0.8
	Roads/Pipelines Crossings Only	9.9	8.7	10.3	10.3	11.6
	Infrastructure Corridor	—	1.0	0.3	—	—
	Available for New Infrastructure	40.8	27.3	42.0	44.2	43.3

Source: ADFG. Calculated from the seasonal utilization distributions of collared female caribou 1990–2018 (Appendix A of the Final IAP/EIS, Map 3-22). Utilization distributions were calculated using kernel density estimation and the plug-in bandwidth estimator (see Prichard et al. 2019 for a description of the methods).
[1]Parturient Caribou only 2002–2018.

Table R-6
Percent of Female Caribou of the Teshekpuk Caribou Herd Expected to be in Areas with Different Fluid Mineral Leasing Status, High Oil Potential Areas Only

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Spring	Closed to Leasing	23.4	21.5	10.9	—	—
	No Surface Occupancy	0.3	0.7	9.4	7.7	6.2
	Controlled Surface Use	—	—	—	0.7	0.7
	Timing Limitations	—	—	0.4	12.2	13.6
	Standard Terms and Conditions	0.9	2.4	3.8	3.9	4.1
	Existing Leases (Assumed STC)	11.4	11.4	11.4	11.4	11.4
	Closed/NSO under new IAP[2]	2.7	6.6	4.0	2.7	4.1
Calving[1]	Closed to Leasing	63.4	63.0	45.2	—	—
	No Surface Occupancy	0.1	0.2	16.3	27.1	22.3
	Controlled Surface Use	—	—	—	5.7	6.0
	Timing Limitations	—	—	0.9	29.5	33.9
	Standard Terms and Conditions	0.3	0.6	1.3	1.4	1.5
	Existing Leases (Assumed STC)	6.4	6.4	6.4	6.4	6.4
	Closed/NSO under new IAP[2]	1.2	5.3	3.1	1.0	2.1
Postcalving	Closed to Leasing	58.3	58.1	40.4	—	—
	No Surface Occupancy	0.0	0.1	15.7	24.9	21.6
	Controlled Surface Use	—	—	—	7.0	7.2
	Timing Limitations	—	—	1.1	25.1	28.2
	Standard Terms and Conditions	0.2	0.4	1.3	1.5	1.5
	Existing Leases (Assumed STC)	7.0	7.0	7.0	7.0	7.0
	Closed/NSO under new IAP[2]	1.5	5.7	3.1	1.1	2.3
Mosquito	Closed to Leasing	66.3	66.3	49.4	—	—
	No Surface Occupancy	0.0	0.0	13.8	35.1	33.7
	Controlled Surface Use	—	—	—	14.8	15.0
	Timing Limitations	—	—	1.5	14.3	15.6
	Standard Terms and Conditions	0.2	0.2	1.8	2.2	2.2
	Existing Leases (Assumed STC)	4.7	4.7	4.7	4.7	4.7
	Closed/NSO under new IAP[2]	1.3	4.3	1.9	0.6	1.3
Oestrid Fly	Closed to Leasing	37.4	35.6	21.7	—	—
	No Surface Occupancy	0.2	0.5	11.5	17.0	15.7
	Controlled Surface Use	—	—	—	4.9	5.1
	Timing Limitations	—	—	0.9	11.9	13.0
	Standard Terms and Conditions	0.8	2.3	4.3	4.6	4.7
	Existing Leases (Assumed STC)	9.2	9.2	9.2	9.2	9.2
	Closed/NSO under new IAP[2]	2.2	5.7	3.1	1.9	3.1
Late Summer	Closed to Leasing	26.7	23.3	10.0	—	—
	No Surface Occupancy	0.4	0.9	11.5	8.0	6.6
	Controlled Surface Use	—	—	—	0.7	0.8
	Timing Limitations	—	—	0.6	13.3	14.3
	Standard Terms and Conditions	1.4	4.3	6.4	6.6	6.8
	Existing Leases (Assumed STC)	18.0	18.0	18.0	18.0	18.0
	Closed/NSO under new IAP[2]	3.8	8.9	5.5	3.7	5.8

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Fall	Closed to Leasing	16.5	14.4	6.2	—	—
	No Surface Occupancy	1.1	1.6	7.9	5.9	5.1
	Controlled Surface Use	—	—	—	0.5	0.5
	Timing Limitations	—	—	0.4	8.1	8.7
	Standard Terms and Conditions	2.1	3.6	5.2	5.3	5.4
	Existing Leases (Assumed STC)	19.2	19.2	19.2	19.2	19.2
	Closed/NSO under new IAP[2]	4.9	9.6	6.3	5.0	7.0
Winter	Closed to Leasing	10.1	8.3	3.8	—	—
	No Surface Occupancy	0.6	1.0	4.4	3.7	3.3
	Controlled Surface Use	—	—	—	0.4	0.4
	Timing Limitations	—	—	0.2	4.1	4.5
	Standard Terms and Conditions	1.5	2.9	3.9	3.9	4.0
	Existing Leases (Assumed STC)	12.2	12.2	12.2	12.2	12.2
	Closed/NSO under new IAP[2]	3.1	5.6	3.8	3.1	4.3

Source: ADFG. Calculated from the seasonal utilization distributions of collared female caribou 1990–2018 (Appendix A of the Final IAP/EIS, Map 3-22). Utilization distributions were calculated using kernel density estimation and the plug-in bandwidth estimator (see Prichard et al. 2019 for a description of the methods).
[1]Parturient Caribou only 2002–2018.
[2]Areas that are currently leased but are in areas that would have been closed to leasing or NSO in the Final IAP/EIS .

Table R-7
Percent of Female Caribou of the Teshekpuk Caribou Herd Expected to be in Areas with Different Infrastructure Allowed, High Oil Potential Areas Only

Season	Land Status	Alternative				
		A	B	C	D	E
Spring	Closed to New Infrastructure	10.8	24.1	10.4	3.9	2.5
	Coastal Infrastructure Only	0.4	0.0	0.5	0.5	0.5
	Pipeline Crossings Only	0.1	—	0.1	0.8	0.8
	Roads/Pipelines Crossings Only	3.6	2.4	3.7	3.8	5.0
	Infrastructure Corridor	—	2.3	0.7	—	—
	Available for New Infrastructure	21.0	7.1	20.6	27.0	27.1
Calving[1]	Closed to New Infrastructure	44.9	61.2	42.2	16.5	11.6
	Coastal Infrastructure Only	0.9	0.0	1.0	1.5	1.4
	Pipeline Crossings Only	0.4	—	0.4	5.2	5.2
	Roads/Pipelines Crossings Only	3.5	0.8	3.5	3.7	4.8
	Infrastructure Corridor	—	6.4	3.0	—	—
	Available for New Infrastructure	20.3	1.6	19.9	43.2	47.1
Postcalving	Closed to New Infrastructure	39.9	57.0	37.5	12.2	8.8
	Coastal Infrastructure Only	1.1	0.0	1.2	1.9	1.8
	Pipeline Crossings Only	0.4	—	0.4	6.3	6.3
	Roads/Pipelines Crossings Only	4.0	0.9	4.0	4.3	5.5
	Infrastructure Corridor	—	5.9	2.8	—	—
	Available for New Infrastructure	19.9	1.6	19.4	40.6	42.9
Mosquito	Closed to New Infrastructure	48.5	63.4	45.1	11.6	10.0
	Coastal Infrastructure Only	1.9	0.0	2.2	3.8	3.7
	Pipeline Crossings Only	0.5	—	0.5	14.0	14.0
	Roads/Pipelines Crossings Only	4.5	0.2	4.3	4.8	5.6
	Infrastructure Corridor	—	6.8	4.1	—	—
	Available for New Infrastructure	15.4	0.5	14.6	36.7	37.6
Oestrid Fly	Closed to New Infrastructure	21.5	35.9	19.2	5.3	4.1
	Coastal Infrastructure Only	1.3	0.0	1.5	2.2	2.1
	Pipeline Crossings Only	0.4	—	0.4	6.1	6.1
	Roads/Pipelines Crossings Only	3.6	1.4	3.6	3.7	4.7
	Infrastructure Corridor	—	4.3	2.5	—	—
	Available for New Infrastructure	20.7	5.8	20.3	30.2	30.5
Late Summer	Closed to New Infrastructure	9.9	27.4	9.3	2.9	1.9
	Coastal Infrastructure Only	0.7	0.0	0.8	0.9	0.8
	Pipeline Crossings Only	0.2	—	0.2	1.0	1.0
	Roads/Pipelines Crossings Only	4.6	3.0	4.6	4.7	6.5
	Infrastructure Corridor	—	2.7	0.9	—	—
	Available for New Infrastructure	31.0	13.4	30.6	37.0	36.3
Fall	Closed to New Infrastructure	6.2	18.3	5.8	1.8	1.2
	Coastal Infrastructure Only	0.5	0.0	0.5	0.6	0.5
	Pipeline Crossings Only	0.1	—	0.1	0.6	0.6
	Roads/Pipelines Crossings Only	6.1	5.6	6.3	6.3	8.2
	Infrastructure Corridor	—	1.8	0.5	—	—
	Available for New Infrastructure	26.1	13.2	25.6	29.6	28.4

Season	Land Status	Alternative				
		A	B	C	D	E
Winter	Closed to New Infrastructure	3.7	10.6	3.5	1.2	0.9
	Coastal Infrastructure Only	0.3	0.0	0.3	0.4	0.3
	Pipeline Crossings Only	0.1	—	0.1	0.5	0.5
	Roads/Pipelines Crossings Only	3.6	3.4	3.7	3.7	4.8
	Infrastructure Corridor	—	1.0	0.3	—	—
	Available for New Infrastructure	16.7	9.4	16.4	18.6	17.9

Source: ADFG. Calculated from the seasonal utilization distributions of collared female caribou 1990–2018 (Appendix A of the Final IAP/EIS, Map 3-22). Utilization distributions were calculated using kernel density estimation and the plug-in bandwidth estimator (see Prichard et al. 2019 for a description of the methods).
[1]Parturient Caribou only 2002–2018.

Table R-8
Teshekpuk Caribou Herd Female Seasonal Distribution– Percent of High Quality Habitat by Fluid Mineral Lease Status

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Calving (Parturient) (1,380,570 acres)	Closed to Leasing	53.6	53.3	31.6	0.7	0.3
	No Surface Occupancy	1.3	2.5	18.0	18.2	15.9
	Controlled Surface Use	—	—	—	5.2	5.4
	Timing Limitations	—	—	1.2	25.6	28.1
	Standard Terms and Conditions	8.9	8.1	13.0	14.1	14.2
	Existing Leases (Assumed STC)	30.3	30.3	30.3	30.3	30.3
	Closed/NSO under new IAP[1]	5.0	17.9	8.9	5.0	9.3
Calving (Non-parturient) (3,105,187 acres)	Closed to Leasing	35.5	36.8	15.5	0.5	0.3
	No Surface Occupancy	6.3	14.7	24.0	18.5	17.3
	Controlled Surface Use	—	—	—	4.6	4.7
	Timing Limitations	—	—	2.7	13.9	15
	Standard Terms and Conditions	29.7	20.1	29.2	34.0	34.3
	Existing Leases (Assumed STC)	24.1	24.1	24.1	24.1	24.1
	Closed/NSO under new IAP[1]	4.2	11.9	5.6	4.3	5.9
Postcalving (1,273,720 acres)	Closed to Leasing	65.7	67.6	32.1	—	—
	No Surface Occupancy	0.6	0.5	28.5	21.2	20.7
	Controlled Surface Use	—	—	—	10.2	10.3
	Timing Limitations	—	—	2.3	28.2	30.7
	Standard Terms and Conditions	5.5	3.7	9.0	12.3	10.2
	Existing Leases (Assumed STC)	23.4	23.4	23.4	23.4	23.4
	Closed/NSO under new IAP[1]	2.3	14.7	5.9	2.3	5.2
Mosquito (Active) (647,475 acres)	Closed to Leasing	90.2	95.0	35.3	—	—
	No Surface Occupancy	0.8	0.0	51.9	52.6	55.7
	Controlled Surface Use	—	—	—	28.3	28.3
	Timing Limitations	—	—	1.4	2.3	2.7
	Standard Terms and Conditions	3.9	0.0	6.3	11.8	8.3
	Existing Leases (Assumed STC)	1.1	1.1	1.1	1.1	1.1
	Closed/NSO under new IAP[1]	1.1	1.1	0.2	0.1	0.1
Mosquito (Not Active) (662,847 acres)	Closed to Leasing	84.6	88.6	55.6	—	—
	No Surface Occupancy	0.7	0.0	27.6	44.6	42.5
	Controlled Surface Use	—	—	—	17.1	17.2
	Timing Limitations	—	—	2.4	22.0	25.3
	Standard Terms and Conditions	3.4	0.0	3.0	4.9	3.6
	Existing Leases (Assumed STC)	8.2	8.2	8.2	8.2	8.2
	Closed/NSO under new IAP[1]	1.1	8.2	3.8	0.9	2.1
Oestrid (Active) (1,462,550 acres)	Closed to Leasing	62.2	66.7	30.3	—	—
	No Surface Occupancy	2.6	2.2	35.0	35.4	35.7
	Controlled Surface Use	—	—	—	12.0	12.1
	Timing Limitations	—	—	1.3	16.7	18.4
	Standard Terms and Conditions	6.4	2.4	4.7	7.2	5.1
	Existing Leases (Assumed STC)	18.7	18.7	18.7	18.7	18.7
	Closed/NSO under new IAP[1]	6.1	14.3	8.3	6	9.4

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Oestrid (Not Active) (1,890,295 acres)	Closed to Leasing	43.8	48.9	24.3	—	—
	No Surface Occupancy	6.3	10.7	28	26	25.4
	Controlled Surface Use	—	—	—	5.1	5.2
	Timing Limitations	—	—	1.8	18.5	20.2
	Standard Terms and Conditions	14.1	4.6	10.1	14.5	13.4
	Existing Leases (Assumed STC)	30.0	30.0	30.0	30.0	30.0
	Closed/NSO under new IAP[1]	7.4	18.4	10.4	7.5	10.1
Late Summer (4,016,884 acres)	Closed to Leasing	26.1	23.9	10.2	0.0	0.0
	No Surface Occupancy	7.1	13.1	19.2	14.4	13.1
	Controlled Surface Use	—	—	—	2.4	2.4
	Timing Limitations	—	—	1.4	11.0	11.9
	Standard Terms and Conditions	28.9	25.1	31.3	34.3	34.6
	Existing Leases (Assumed STC)	35.0	35.0	35.0	35.0	35.0
	Closed/NSO under new IAP[1]	6.7	14.3	8.4	6.9	9.3

Source: Wilson et al. 2012. High quality habitat was defined as areas where the estimated relative probability of use ≥ 0.5.

[1]Areas that are currently leased but are in areas that would have been closed to leasing or NSO in the Final IAP/EIS.

Table R-9
Teshekpuk Caribou Herd Female Seasonal Distribution– Percent of High Quality Habitat by Infrastructure Allowed

Season	Land Status	Alternative				
		A	B	C	D	E
Calving (Parturient) (1,380,570 acres)	Closed to New Infrastructure	30.8	59.5	28.2	6.9	4.5
	Coastal Infrastructure Only	2.9	1.1	2.9	3.3	3.2
	Pipeline Crossings Only	0.0	0.0	0.0	6.5	6.5
	Roads/Pipelines Crossings Only	6.2	4.2	6.2	6.2	10.1
	Infrastructure Corridor	—	5.6	3.0	—	—
	Available for New Infrastructure	53.8	23.3	53.4	71.0	69.5
Calving (Non-parturient) (3,105,187 acres)	Closed to New Infrastructure	14.9	38.8	14.0	4.0	3.0
	Coastal Infrastructure Only	2.0	0.6	2.0	2.3	2.3
	Pipeline Crossings Only	0.0	0.0	0.0	3.3	3.3
	Roads/Pipelines Crossings Only	11.5	10.6	11.8	11.8	12.6
	Infrastructure Corridor	—	2.6	1.2	—	—
	Available for New Infrastructure	66.1	41.9	65.4	73.0	73.4
Postcalving (1,273,720 acres)	Closed to New Infrastructure	31.8	71.3	29.3	7.1	4.7
	Coastal Infrastructure Only	3.2	0.0	3.2	3.8	3.8
	Pipeline Crossings Only	0.0	0.0	0.0	6.6	6.6
	Roads/Pipelines Crossings Only	3.5	1.4	3.5	3.5	5.6
	Infrastructure Corridor	—	5.7	2.7	—	—
	Available for New Infrastructure	53.2	13.3	53.1	70.7	71.0
Mosquito (Active) (647,475 acres)	Closed to New Infrastructure	34.4	84.0	30.7	6.1	5.7
	Coastal Infrastructure Only	14.3	0.2	14.6	16.9	16.8
	Pipeline Crossings Only	0.2	0.1	0.2	16.4	16.4
	Roads/Pipelines Crossings Only	9.3	—	9.0	9.3	9.3
	Infrastructure Corridor	—	6.6	4.8	—	—
	Available for New Infrastructure	32.7	0.0	31.8	42.3	42.7
Mosquito (Not Active) (662,847 acres)	Closed to New Infrastructure	54.6	86.9	49.7	13.2	9.5
	Coastal Infrastructure Only	10.2	0.2	10.1	12.0	11.8
	Pipeline Crossings Only	0.1	0.0	0.1	15.5	15.5
	Roads/Pipelines Crossings Only	2.4	—	2.2	2.6	4.1
	Infrastructure Corridor	—	7.4	5.6	—	—
	Available for New Infrastructure	27.2	0.0	26.8	51.2	53.6
Oestrid (Active) (1,462,550 acres)	Closed to New Infrastructure	29.8	68.3	27.3	5.5	3.8
	Coastal Infrastructure Only	7.6	1.1	7.7	8.7	8.6
	Pipeline Crossings Only	0.1	0.1	0.1	8.0	8.0
	Roads/Pipelines Crossings Only	16.8	5	16.7	16.8	20.3
	Infrastructure Corridor	—	5.2	3.1	—	—
	Available for New Infrastructure	32.5	7.2	31.9	47.8	46.2
Oestrid (Not Active) (1,890,295 acres)	Closed to New Infrastructure	24.1	52.1	22.0	5.0	3.3
	Coastal Infrastructure Only	1.9	0.5	1.9	2.4	2.3
	Pipeline Crossings Only	0.0	0.0	0.0	5.6	5.6
	Roads/Pipelines Crossings Only	17.5	12	17.5	17.6	19.7
	Infrastructure Corridor	—	4.4	2.3	—	—
	Available for New Infrastructure	47.2	21.7	46.8	60.1	59.7

Season	Land Status	Alternative				
		A	B	C	D	E
Late Summer (4,016,884 acres)	Closed to New Infrastructure	10.2	27.1	9.2	2.3	1.4
	Coastal Infrastructure Only	0.4	0.1	0.4	0.6	0.6
	Pipeline Crossings Only	0.0	0.0	0.0	2.0	2.0
	Roads/Pipelines Crossings Only	15.3	14.3	15.6	15.6	16.7
	Infrastructure Corridor	—	2.4	1.0	—	—
	Available for New Infrastructure	70.1	52.2	69.8	75.7	75.3

Source: Wilson et al. 2012. High quality habitat was defined as areas where the estimated relative probability of use ≥ 0.5.

Table R-10
Wolverine Occupancy Estimates by Fluid Mineral Lease Status (Percent of Total Area)

Season	Fluid Mineral Leasing	Alternative				
		A	B	C	D	E
Low Occupancy[1] (0–0.249) (6,006,000 acres)	Closed to Leasing/NSO	45.4	66.1	50.6	35.7	35.9
	Controlled Surface Use	—	—	—	3.7	3.7
	Timing Limitations	—	—	6.4	10.1	10.7
	Standard Terms and Conditions	44.2	23.5	32.6	40.0	39.3
	Existing Lease (Assumed STC)	10.4	10.4	10.4	10.4	10.4
	Closed/NSO under new IAP	2.6	6.1	2.6	2.2	2.1
Mid-Low Occupancy[1] (0.25–0.499) (2,353,000 acres)	Closed to Leasing/NSO	55.5	68.8	54.8	47.1	46.4
	Controlled Surface Use	—	—	—	0.0	0.0
	Timing Limitations	—	—	11.9	19.1	19.4
	Standard Terms and Conditions	39.3	26.0	28.1	28.6	29.0
	Existing Lease (Assumed STC)	5.2	5.2	5.2	5.2	5.2
	Closed/NSO under new IAP	2.0	2.2	2.1	2.0	1.7
Mid-High Occupancy[1] (0.50–0.749) (2,114,000 acres)	Closed to Leasing/NSO	66.9	70.3	58.4	51.4	50.0
	Controlled Surface Use	—	—	—	0.1	0.2
	Timing Limitations	—	—	9.7	16.1	16.3
	Standard Terms and Conditions	26.9	23.5	25.7	26.1	27.2
	Existing Lease (Assumed STC)	6.2	6.2	6.2	6.2	6.2
	Closed/NSO under new IAP	2.5	3.4	3.0	2.5	2.8
High Occupancy[1] (0.75–1.00) (7,986,000 acres)	Closed to Leasing/NSO	48.7	49.5	32.4	31.0	30.0
	Controlled Surface Use	—	—	—	—	—
	Timing Limitations	—	—	9.7	11.0	10.5
	Standard Terms and Conditions	35.3	34.5	41.9	42	43.5
	Existing Lease (Assumed STC)	16.0	16.0	16.0	16.0	16.0
	Closed/NSO under new IAP	3.8	6.4	4.6	3.9	5.0

Source: Poley et al. 2018. Occupancy estimates reflect probability that wolverine tracks were present in an area during winter surveys after correcting for detectability.

R.1 REFERENCES

Bureau of Land Management (BLM). 2012. National Petroleum Reserve-Alaska (NPR-A) Final Integrated Activity Plan/Environmental Impact Statement. In cooperation with the North Slope Borough, US Bureau of Ocean Energy Management, and US Fish and Wildlife Service. Anchorage, Alaska: US Department of Interior, Bureau of Land Management. Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=14702.

MacDonald, S. O., and J. A. Cook. 2009. Recent Mammals of Alaska. University of Alaska Press, Fairbanks. 387 pp.

Poley, L.G., A. J. Magoun, M. D. Robards, and R.L. Klimstra. 2018. Distribution and occupancy of wolverines on tundra, northwestern Alaska. Journal of Wildlife Management 82: 991–1002.

Prichard, A. K., M. J. Macander, J. H. Welch, and B. E. Lawhead. 2019. Caribou monitoring study for the Bear Tooth Unit Program, Arctic Coastal Plain, Alaska, 2018. Annual report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc.—Environmental Research & Services, Fairbanks. 65 pp.

Tape, K. D., B. M. Jones, C. D. Arp, I. Nitze, and G. Grosse. 2018. Tundra be dammed: Beaver colonization of the Arctic. Global Change Biology 2018: 1–11. http://doi.org/10.1111/gcb.14332.

Wilson, R. R., A. K. Prichard, L. S. Parrett, B. T. Person, G. M. Carroll, M. A. Smith, C. L. Rea, and D. A. Yokel. 2012. Summer resource selection and identification of important habitat prior to industrial development for the Teshekpuk Caribou Herd in northern Alaska. PloS one, 7(11), e48697. https://doi.org/10.1371/journal.pone.0048697.

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Appendix S
Marine Mammals

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Appendix S. Marine Mammals

English Name	Scientific Name	Iñupiaq Name	Population Estimate	Temporal Occurrence	MMPA Status	ESA Status	BLM Status	Analysis Area(s)
Polar bear	*Ursus maritimus*	nanuq	SBS7: 907 (95% CI = 548-1,270); CS [8]: 2,937 (1,552-5,944)	Year-round	Protected	Threatened	Sensitive species	NPR-A
Northern Fur Seal	*Callorhinus ursinus*	–	539,638 [1]	Year-round	Protected	Not listed	Not listed	Transit
Steller's Sea Lion	*Eumetopias jubatus*	ugiġñaq	53,303 [1]	Year-round	Depleted (Western distinct population segment)	Endangered	Not listed	Transit
Pacific Walrus	*Odobenus rosmarus*	aiviq	129,000 (95% CI = 55,000−507,000) [4]	Seasonal	Protected	Not listed	Sensitive species	NPR-A, transit
Bearded Seal	*Erignathus barbatus nauticus*	ugruk	299,174 (95% CI: 245,476–360,544) [2]	Year-round	Protected	Threatened (Beringia and Okhotsk distinct population segment)	Not listed	NPR-A, transit
Ribbon Seal	*Histriphoca fasciata*	qaiġulik	184,000 (95% CI = 145,752–230,134) [2]	Seasonal	Protected	Not listed	Not listed	transit
Spotted Seal	*Phoca largha*	qasigiaq	461,625 (95% CI = 388,732–560,348) [2]	Seasonal	Protected	Not listed (in analysis area)	Not listed	NPR-A, transit
Ringed Seal	*Phoca hispida*	natchiq; qayaġulik	Reliable estimate unavailable [1] (partial surveys indicated 170,000) [2]	Year-round	Depleted (Arctic subspecies)	Threatened (Arctic subspecies)	Not listed	NPR-A, transit
Northern Sea Otter	*Enhydra lutris*	–	54,771 [1]	Year-round	Protected	Threatened (Southwestern distinct population segment)	Sensitive species	Transit
Bowhead Whale	*Balaena mysticetus*	aġviq	16,820 [1]	Seasonal	Depleted	Endangered	Not listed	NPR-A, transit

English Name	Scientific Name	Iñupiaq Name	Population Estimate	Temporal Occurrence	MMPA Status	ESA Status	BLM Status	Analysis Area(s)
Northern Pacific Right Whale	*Eubalaena japonica*	aġviq	31 [1]	Seasonal	Depleted	Endangered	Not listed	Transit
Minke Whale	*Balaenoptera acutorostrata*	–	Reliable estimate unavailable [1]	Seasonal	Protected	Not listed	Not listed	NPR-A, transit
Fin Whale	*Balaenoptera physalus*	–	Reliable estimate unavailable [1]	Extralimital & seasonal	Depleted	Endangered	Not listed	Transit
Humpback Whale	*Megaptera novaeangliae*	–	6,000–14,000 (Bering Sea and Aleutians in summer) [1]	Extralimital & seasonal	Depleted	Endangered	Not listed	Transit
Gray Whale	*Eshrichtius robustus*	aġviġluaq	ENP: 20,990 (CV = 0.05); WNP: 140 (CV = 0.04) [5]	Seasonal	Protected	Not listed	Not listed	NPR-A, transit
Killer Whale	*Orcinus orca*	aaġlu	Reliable estimate unavailable [1]	Extralimital & seasonal	Protected	Not listed	Not listed	NPR-A, transit
Beluga Whale	*Delphinapterus leucas*	sisuaq; qiḷalugaq	Beaufort: 39,258 (1992) [1] Chukchi: 20,752 (2017) [3]	Seasonal	Protected	Not listed	Not listed	NPR-A, transit
Narwhal	*Monodon monoceros*	qiḷalugaq tuugaalik	Reliable estimate unavailable [1]	Extralimital & seasonal	Protected	Not listed	Not listed	NPR-A
Harbor Porpoise	*Phocoena phocoena*	aġviqsuaq	Bering Sea: 482,151 (1999) [1]	Seasonal	Protected	Not listed	Not listed	Transit
Dall's Porpoise	*Phocoenoides dalli*	–	11,143 (CV = 0.32) eastern Bering Sea [1]	Year-round	Protected	Not listed	Not listed	Transit
Sperm Whale	*Physeter macrocephalus*	–	Reliable estimate unavailable [1]	Extralimital & seasonal	Depleted	Endangered	Not listed	Transit

[1]Muto et al. 2018
[2]Conn et al. 2014
[3]Lowry et al. 2017
[4]Speckman et al. 2011
[5]NMFS 2014
[6]BLM 2019
[7]Bromaghin et al. 2015
[8]Regehr et al. 2018

S.1 References

BLM (Bureau of Land Management). 2019. "BLM Alaska Special Status Species List."

Bromaghin, J. F., T. L. McDonald, I. Stirling, A. E. Derocher, E. S. Richardson, E. V. Regehr, D. C. Douglas, G. M. Durner, T. Atwood, and S. C. Amstrup. 2015. Polar bear population dynamics in the southern Beaufort Sea during a period of sea ice decline. Ecological Applications 25:634–651.

Conn, P. B., J. M. Ver Hoef, B. T. Mcclintock, E. E. Moreland, J. M. London, M. F. Cameron, S. P. Dahle, and P. L. Boveng. 2014. Estimating multispecies asbundance using automated detection systems: ice-associated seals in the Bering Sea. Methods in Ecology and Evolution 5(12): 1280–1293. https://doi.org/10.1111/2041-210X.12127.

Lowry, L. F., M. C. S. Kingsley, D. D. W. Hauser, J. Clarke, and R. Suydam. 2017. Aerial Survey Estimates of Abundance of the Eastern Chukchi Sea Stock of Beluga Whales (Delphinapterus leucas) in 2012. Arctic 70 (3):273–286. doi: 10.14430/arctic4667.

Muto, M. M., V. T. Helker, R. P. Angliss, B. A. Allen, P. L. Boveng, J. M. Breiwick, M. F. Cameron, et al. 2018. Alaska Marine Mammal Stock Assessments, 2017. NOAA Technical Memorandum NMFS-AFSC-378. Seattle, WA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. https://doi.org/10.7289/V5/TM-AFSC-378.

NMFS (National Marine Fisheries Service). 2014. Gray whale (Eschrichtius robustus); Eastern North Pacific Stock. National Marine Fisheries Service, Seattle, WA. Available from: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock Accessed: 8 October 2019

Regehr, E.V., N. J. Hostetter, R. R. Wilson, K. D. Rode, M. St. Martin, and S. J. Converse. 2018. Integrated population modeling provides the first empirical estimates of vital rates and abundance for polar bears in the Chukchi Sea. Scientific Reports 8:16780, doi:10.1038/s41598-018-34824-7.

Speckman, S. G., V. I. Chernook, D. M. Burn, M. S. Udevitz, A. A. Kochnev, A. Vasilev, C. V. Jay, A. Lisovsky, A. S. Fischbach, and R. B. Benter. 2011. Results and evaluation of a survey to estimate Pacific walrus population size, 2006. Marine Mammal Science 27(3): 514–553. https://doi.org/10.1111/j.1748-7692.2010.00419.x.

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Appendix T
Subsistence Use and Resources

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Appendix T. Subsistence Use and Resources

T.1 TABLES

Table T-1
NPR-A IAP Subsistence Study Communities

Study Community No.	Study Community	Study Community Type[1]
1	Anaktuvuk Pass	Primary
2	Atqasuk	Primary
3	Nuiqsut	Primary
4	Point Lay	Primary
5	Utqiagvik	Primary
6	Wainwright	Primary
7	Ambler	Peripheral
8	Kiana	Peripheral
9	Kobuk	Peripheral
10	Noatak	Peripheral
11	Noorvik	Peripheral
12	Selawik	Peripheral
13	Shungnak	Peripheral
14	Allakaket	Caribou
15	Bettles	Caribou
16	Brevig Mission	Caribou
17	Buckland	Caribou
18	Deering	Caribou
19	Elim	Caribou
20	Fairbanks	Caribou
21	Galena	Caribou
22	Golovin	Caribou
23	Hughes	Caribou
24	Huslia	Caribou
25	Kaltag	Caribou
26	Kivalina	Caribou
27	Kotlik	Caribou
28	Kotzebue	Caribou
29	Koyuk	Caribou
30	Koyukuk	Caribou
31	Nome	Caribou
32	Nulato	Caribou
33	Point Hope	Caribou
34	Shaktoolik	Caribou
35	Shishmaref	Caribou
36	St. Michael	Caribou
37	Stebbins	Caribou
38	Teller	Caribou
39	Unalakleet	Caribou
40	Wales	Caribou

Study Community No.	Study Community	Study Community Type[1]
41	White Mountain	Caribou
42	Wiseman	Caribou

[1] Primary and peripheral study communities are also caribou study communities.

Table T-2
Subsistence Data Sources

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Anaktuvuk Pass	(Adams, Stephenson, Dale, Ahgook, and Demma 2008)	Wolves	1986–91	–	–	–	–
	(Bacon, Hepa, Brower, Pederson, Olemaun, George, and Corrigan 2009)	ALL	1996–97, 1998–99, 1999–00, 2000–01, 2001–02, 2002–03	ALL	1996–97, 1998–99, 1999–00, 2000–01, 2001–02, 2002–03	–	–
	(Brower and Opie 1996)	ALL	1994–95	ALL	1994–95	–	–
	(Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
	(Fuller and George 1999)	ALL	1992	ALL	1992	–	–
	(Holen, Hazell, and Koster 2012)	ALL	2011	LLM	2011	ALL	2011
	(Pedersen 1979)	–	–	–	–	ALL	Lifetime pre-1979
	(Pedersen and Hugo 2005)	Fish	2001–02, 2002–03	Fish	2001–02, 2002–03	Fish	2001–02, 2002–03
	(Pedersen and Nageak 2009)	Caribou	2006–07	Caribou	2006–07	Caribou	2006–07
	(Pedersen and Opie 1991)	Caribou	1990–91	–	–	–	–
	(Pedersen and Opie 1992)	Caribou	1991–92	–	–	–	–
	(Pedersen and Opie 1994)	Caribou	1993–94	–	–	–	–
	(Spearman, Pedersen, and Brown 1979)	–	–	ALL	General	–	–
	(SRB&A 2013c)	–	–	ALL	2001–10	ALL	2001–10

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Atqasuk	Alaska Consultants Inc. 1984 (Alaska Consultants Inc., Courtnage, and Associates 1984)	–	–	–	–	Marine	1979–83
	(Bacon, Hepa, Brower, Pederson, Olemaun, George, and Corrigan 2011)	ALL	1996–97, 1997–98	ALL	1996–97, 1997–98	–	–
	(Braem, Kaleak, Koster, Leavitt, Neakok, Patkotak, Pedersen, and Simon 2011)	Caribou	2002–07	Caribou	2002–03, 2003–04, 2004–05, 2005–06, 2006–07	–	–
	(Hepa, Brower, and Bates 1997)	ALL	1994–95	ALL	1994–95	–	–
	(Pedersen 1979, Pedersen, Libbey, Schneider, and Dementieff 1979)	–	–	–	–	ALL	Lifetime pre-1979
Nuiqsut	(ADF&G 2019)	ALL	1985	–	–	–	–
	(Bacon et al. 2011)	ALL	1995–96, 2000–01	ALL	1995–96, 2000–01	–	–
	(BLM 2004)	–	–	–	–	ALL	1994–03
	(Braem et al. 2011)	Caribou	2002–07	Caribou	2002–07	–	–
	(Brower and Hepa 1998)	ALL	1994–95	ALL	1994–95	–	–
	(Brown 1979)	–	–	ALL	Pre-1975	ALL	Pre-1979
	(Brown et al. 2016)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
	(EDAW Inc., Consulting, Research, Callaway, Associates, and Economics 2008)	–	–	ALL	2004	–	–
	(Fuller and George 1999)	ALL	1992	ALL	1992	–	–
	(Galginaitis 2017)	–	–	–	–	Bowhead	2001–16
	(Hoffman, Libbey, and Spearman 1988)	–	–	ALL	Lifetime pre-1979	–	–
	(Pedersen 1979)	–	–	–	–	ALL	Lifetime pre-1979
	(Pedersen 1986)	–	–	–	–	ALL	1973–86
	(Pedersen 1995)	ALL	1993	–	–	–	–
	(SRB&A 2003)	–	–	–	–	ALL	1994–03

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Nuiqsut *(cont.)*	(SRB&A 2010a)	Caribou	–	ALL	1995–06	ALL	1995–06
	(SRB&A 2010b)	–	–	Caribou	2008	Caribou	2008
	(SRB&A 2011)	–	–	Caribou	2009	Caribou	2009
	(SRB&A 2012)	Caribou	2010	Caribou	2010	Caribou	2010
	(SRB&A 2013b)	Caribou	2011	Caribou	2011	Caribou	2011
	(SRB&A 2014a)	Caribou	2012	Caribou	2012	Caribou	2012
	(SRB&A 2015)	Caribou	2013	Caribou	2013	Caribou	2013
	(SRB&A 2016)	Caribou	2014	Caribou	2014	Caribou	2014
	(SRB&A 2017b)	Caribou	2015	Caribou	2015	Caribou	2015
Point Lay	(Alaska Consultants Inc. et al. 1984)	–	–	–	–	Marine	1979–83
	(Bacon et al. 2011)	ALL	1994—94, 2002–03	ALL	1994–95, 2002–03	–	–
	(Braem, Mikow, Brenner, Godduhn, Retherford, and Kostick 2017)	ALL	2012	Narrative Only	Lifetime–2012	ALL	2012
	(Impact Assessment Inc. 1989)	ALL	1987	Marine Mammals	1987	ALL	Lifetime to 1987
	(Mikow, Retherford, Kostick, and Godduhn 2016)	Fish	2012–14	–	–	–	–
	(Pedersen 1979)	–	–	–	–	ALL	Lifetime to 1979
	(Schneider and Bennett 1979)	–	–	ALL	1979	–	–
	(SRB&A 2013a)	–	–	Marine	2010–12	Marine	2012–12
	(SRB&A 2014b)	–	–	ALL	1997–06	ALL	1997–06
	(SRB&A 2017a)	Caribou	2015	–	–	–	–
Utkiagvik	(Bacon et al. 2011)	ALL	1995–97, 2000, 2001, 2003	ALL	1995–97, 2000, 2001, 2003	–	–
	(Brown et al. 2016)	ALL	2014	Migratory Birds	2014	ALL	2014
	(Fuller and George 1999)	ALL	1992	ALL	1992	–	–
	(Naves 2010)	Migratory Birds	2005, 2007, 2008	–	–	–	–
	(SRB&A 2017a)	Caribou	2015	–	–	–	–
	(SRB&A and ISER 1993)	ALL	1987–89	–	–	–	–

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Wainwright	(Alaska Consultants Inc. et al. 1984)	–	–	Marine	General	Marine	1979–83
	(Fuller and George 1999)	ALL	1992	Selected	1992	–	–
	(Ivie and Schneider 1988)	–	–	ALL	1979	–	–
	(Kassam and Wainwright Traditional Council 2001)	–	–	ALL	Pre-2001	ALL	Pre-2001
	(Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016)	ALL	2009	Key Resources	Not Defined	–	–
	(Mikow et al. 2016)	Fish	2012–14	–	–	–	–
	(Pedersen 1979)	–	–	–	–	ALL	Lifetime to 1979
	(SRB&A 2013a)	–	–	Marine	2010–12	Marine	2010–12
	(SRB&A 2017a)	Caribou	2015	–	–	–	–
	(SRB&A and Research) 1993)	ALL	1988–90	ALL	1988–90	ALL	1988–90
	(SRB&A Unpublished)	–	–	–	–	ALL	1987–89
	(Wainwright Traditional Council and The Nature Conservancy 2008)	–	–	–	–	ALL	1998–07
Ambler	(Andersen, Brown, Walker, and Elkin 2004)	NSF	2002	NSF	2002	–	–
	(Marcotte and Haynes 1985)	ALL	1982	ALL	1982	ALL	1981–82; 1981–83
	(Watson 2018)	–	–	–	–	ALL	Lifetime to 2016
	(Webb 1999)	Migratory Birds	1998	–	–	–	–
	(Webb and Koyukuk/Nowitna Refuge Complex (U.S.) 2000)	Migratory Birds	1998–99	–	–	–	–
	(Wilson and Kostick 2016)	ALL	2014	LLM, SLM, Birds	2014	ALL	2014
	(YRDFA 2008)	–	–	ALL	Historic	–	–

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Kiana	(ADF&G 2019)	LLM, SLM	1999	–	–	–	–
	(Anderson, Anderson, Bane, Nelson, and Towarak 1998)	–	–	ALL	1974–75	–	–
	(Braem 2012a)	LLM, SLM	2009–10	Moose, Caribou	2009–10	–	–
	(Braem, Godduhn, Mikow, Brenner, Trainor, Wilson, and Kostick 2018)	Salmon, NSF	2012–14	–	–	–	–
	(Georgette 2000)	Birds	1996	–	–	–	–
	(Magdanz, Koster, Naves, and Fox 2011b)	ALL	2006	–	–	–	–
	(Magdanz, Smith, Braem, and Koster 2011a)	Fish	1994–04	–	–	–	–
	(Schroeder, Anderson, and Hildreth 1987)	–	–	–	–	ALL	Lifetime (ca. 1925–86)
	(Wolfe and Paige 1995)	Birds	1993	–	–	–	–
Kobuk	(ADF&G 2019)	LLM, SLM	2004	–	–	–	–
	(Anderson et al. 1998)	–	–	ALL	1974–75	–	–
	(Braem 2012a)	LLM, SLM	2009–10	Moose, Caribou	2009–10	–	–
	(Braem, Mikow, Wilson, and Kostick 2015)	ALL	2012	ALL	ca. 2012	ALL	2012
	(Braem et al. 2018)	Salmon, NSF	2012–14	–	–	–	–
	(Georgette 2000)	Birds	1996–97	–	–	–	–
	(Magdanz et al. 2011a)	Fish	1994–04	–	–	–	–
	(Schroeder et al. 1987)	–	–	–	–	ALL	Lifetime (ca. 1925–85)
	(Watson 2018)	–	–	–	–	ALL	Lifetime to 2016

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Noatak	(ADF&G 2019)	ALL	1994	–	–	–	–
	(ADF&G 2019)	LLM, SLM	1999	–	–	–	–
	(ADF&G 2019)	LLM, SLM	2002	–	–	–	–
	(Braem and Kostick 2014)	LLM, SLM	2010–11	Caribou	2010–11	–	–
	(Braem et al. 2018)	Salmon, NSF	2012–14	–	–	–	–
	(Georgette 2000)	Birds	1997	–	–	–	–
	(Magdanz, Braem, Robbins, and Koster 2010)	ALL	2007	–	–	ALL	2007
	(Mikow, Braem, and Kostick 2014)	LLM, SLM	2011–12	Caribou	2011–12	–	–
	(Satterthwaite–Phillips, Christopher Krenz, Glenn Gray, and Dodd 2016)	–	–	–	–	ALL*	Lifetime to 2014
	(SRB&A 2009)	–	–	ALL	1998–07	ALL	1998–07
	(Schroeder et al. 1987)	–	–	–	–	ALL	Lifetime (ca. 1925–85)
Noorvik	(ADF&G 2019)	LLM, SLM	2002	–	–	–	–
	(Anderson et al. 1998)			ALL	1974–75	–	–
	(Braem 2012b)	LLM, SLM	2008–09	LLM, SLM	2008–09	–	–
	(Braem et al. 2017)	ALL	2012	LLM, SLM, Birds	2012	ALL	2012
	(Braem et al. 2018)	Salmon, NSF	2013–14	–	–	–	–
	(Georgette 2000)	Birds	1996	–	–	–	–
	(Satterthwaite–Phillips et al. 2016)	–	–	–	–	ALL*	Lifetime to 2014
	(Schroeder et al. 1987)	–	–	–	–	ALL	Lifetime (ca. 1925–85)

Community	Source	Harvest Data		Timing of Subsistence		Use Areas	
		Resource	Time Period	Resource	Time Period	Resource	Time Period
Selawik	(ADF&G 2019)	LLM, SLM, NSF	2006	–	–	–	–
	(ADF&G 2019)	LLM, SLM	1998	–	–	–	–
	(Braem, Fox, Magdanz, and Koster 2013)	ALL	2010–11	LLM, SLM, Birds	2010–11	ALL	2010–11
	(Braem et al. 2018)	Salmon, NSF	2013–14	–	–	–	–
	(Georgette 2000)	Birds	1997–98	–	–	–	–
	(Satterthwaite–Phillips et al. 2016)	–	–	–	–	ALL*	Lifetime to 2014
	(Schroeder et al. 1987)	–	–	–	–	ALL	Lifetime (ca. 1925–85)
	(Wolfe and Paige 2002)	Birds	1993	–	–	–	–
Shungnak	(Andersen and Jennings 2001)	Birds	2000	Birds	2000	–	–
	(Braem 2012b)	LLM, SLM	2008–09	Caribou	2008–09	–	–
	(Braem et al. 2015)	ALL	2012	ALL	ca. 2012	ALL	2012
	(Braem et al. 2018)	Salmon, NSF	2013–14	–	–	–	–
	(Magdanz, Walker, and Paciorek 2004)	ALL	2002	–	–	–	–
	(Schroeder et al. 1987)	–	–	–	–	ALL	Lifetime (ca. 1925–85)
	(Watson 2018)	–	–	ALL	pre–1958	ALL	Lifetime to 2016
	(Wolfe and Paige 1995)	Birds	1993	–	–	–	–

*SRB&A requested these use area data, but the data were either unavailable or had not been provided to SRB&A.

– = no data; ALL = all resources/comprehensive; NSF= non-salmon fish; SLM = small land mammals; LLM = large land mammals

Table T-3
Harvest Characteristics of Anaktuvuk Pass

Resources[1]	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
All Resources	**98**	**91**	**89**	**76**	**95**	**–**	**73,715**	**839**	**246**	**100.0**
Large Land Mammals (High Resource Importance)	**92**	**55**	**46**	**52**	**80**	**696**	**67,604**	**770**	**226**	**91.9**
Caribou	92	61	49	49	68	514	65,678	784	222	86.2
Moose	29	10	6	9	24	4	2,230	25	7	3.2
Dall sheep	48	24	16	19	36	22	2,249	26	8	2.9
Brown bear	7	6	5	4	2	5	526	6	2	0.6
Non-Salmon Fish (High Resource Importance)	**88**	**75**	**74**	**57**	**64**	**3,989**	**4,563**	**52**	**15**	**6.1**
Grayling	70	68	50	43	29	1,715	1,471	17	5	2.0
Lake trout	59	51	38	32	29	407	1,479	16	5	1.9
Unknown char	–	–	–	–	–	319	1,052	12	4	1.8
Arctic char	65	56	40	34	31	644	1,718	19	6	1.8
Unknown trout	6	6	6	3	2	149	208	2	1	0.3
Dolly Varden	14	11	6	5	6	63	78	1	<1	0.1
Halibut	16	3	3	3	13	5	5	<1	<1	<0.1
Rainbow smelt	25	0	0	4	25	0	0	0	0	0.0
Sheefish	8	1	0	2	8	0	0	0	0	0.0
Smelt	8	–	–	5	8	–	–	–	–	0.0
Vegetation (High Resource Importance)	**81**	**74**	**74**	**34**	**33**	**731**	**1,074**	**12**	**4**	**1.4**
Berries	84	76	76	42	44	728	1,978	22	6	2.0
Cloudberry	61	55	55	29	24	162	600	7	2	0.6
Blueberry	76	69	68	28	22	100	353	4	1	0.5
Salmonberry	42	36	34	17	9	58	231	3	1	0.3
Crowberry	37	32	32	15	8	93	243	3	1	0.3
Plants/greens/mushrooms	19	18	18	11	6	227	227	2	1	0.2
Eskimo potato	17	15	15	11	6	60	213	2	1	0.2
Low bush cranberry	44	38	37	18	14	34	130	1	<1	0.2
Wood	18	18	18	5	3	28	–	–	–	0.0

Resources[1]	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
Marine Mammals (High Resource Importance)	**61**	**2**	**0**	**26**	**61**	**0**	**0**	**0**	**0**	**0.0**
Belukha	23	0	0	13	23	0	0	0	0	0.0
Bearded seal	13	1	0	5	13	0	0	0	0	0.0
Bowhead whale	60	2	2	25	60	0	0	0	0	0.0
Whale	52	2	–	26	52	–	–	–	–	0.0
Ringed seal	6	1	0	4	6	0	0	0	0	0.0
Salmon (Moderate Resource Importance)	**43**	**8**	**6**	**9**	**40**	**145**	**278**	**3**	**1**	**0.4**
Chinook salmon	17	3	2	1	15	19	175	2	1	0.2
Coho salmon	13	3	2	3	11	17	88	1	<1	0.1
Sockeye salmon	16	2	2	3	15	56	226	2	1	0.1
Unknown salmon	9	2	1	3	9	2	10	<1	<1	<0.1
Migratory Birds (Low Resource Importance)	**35**	**16**	**14**	**14**	**24**	**197**	**256**	**3**	**1**	**0.3**
Lesser Canada geese (taverner/parvipes)	15	10	10	6	6	75	90	1	<1	0.1
White-fronted geese	9	7	7	4	3	26	77	1	<1	0.1
Unknown geese	7	2	0	2	7	14	37	<1	<1	0.1
Snow geese	8	5	5	9	9	18	58	1	<1	<0.1
Mallard	7	6	6	4	5	10	20	<1	<1	<0.1
Upland Game Birds (Low Resource Importance)	**31**	**23**	**20**	**15**	**15**	**164**	**134**	**2**	**<1**	**0.2**
Unknown ptarmigan	34	28	25	17	11	146	108	1	<1	0.2
Ptarmigan	27	18	16	13	18	126	126	1	<1	0.1
Small Land Mammals (Low Resource Importance)	**21**	**19**	**18**	**11**	**9**	**66**	**28**	**<1**	**<1**	**<0.1**
Parka squirrel (ground squirrel)	10	10	10	4	0	136	9	<1	<1	<0.1
Wolf	16	14	12	6	5	35	0	0	0	0.0
Wolverine	12	10	9	4	3	10	0	0	0	0.0

Resources[1]	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
Bird Eggs (Low Resource Importance)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.0**
Marine Invertebrates (Low Resource Importance)	**4**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0.0**

Sources: (Pedersen and Opie 1991); (Pedersen and Opie 1992); (Fuller and George 1999); (Pedersen and Opie 1994); (Brower and Opie 1996); (Bacon et al. 2011); (Pedersen and Hugo 2005); (Pedersen and Nageak 2009); (ADF&G 2019); (Holen et al. 2012)

– = no data

Resource Category (e.g., large land mammal) averages do not equal the sum of averages for individual species due to different available data sets for each species and resource category.

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-4
Harvest Characteristics of Atqasuk

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**–**	**–**	**–**	**–**	**–**	**66,967**	**66,967**	**1,124**	**291**	**100.0**
Large Land Mammals (High Resource Importance)	**–**	**–**	**–**	**–**	**–**	**43,419**	**43,419**	**728**	**189**	**64.9**
Caribou	96	70	65	71	65	260	42,903	719	187	64.0
Moose	–	–	–	–	–	2	1,076	18	5	1.9
Non-Salmon Fish (High Resource Importance)	**–**	**–**	**–**	**–**	**–**	**20,852**	**20,852**	**350**	**91**	**30.8**
Broad whitefish	–	–	–	–	–	2,670	8,545	143	37	12.4
Grayling	–	–	–	–	–	6,483	5,834	99	25	9.1
Unknown whitefish	–	–	–	–	–	1,085	1,757	31	8	2.9
Humpback whitefish	–	–	–	–	–	880	1,848	31	8	2.9
Burbot	–	–	–	–	–	253	1,063	18	5	1.6
Rainbow smelt	–	–	–	–	–	1,067	6,403	102	28	7.7
Marine Mammals (Moderate Resource Importance)	**–**	**–**	**–**	**–**	**–**	**1,458**	**1,458**	**26**	**6**	**2.4**
Bearded seal	–	–	–	–	–	5	1,287	23	6	2.2
Migratory Birds (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**1,139**	**1,139**	**19**	**5**	**1.7**
White-fronted geese	–	–	–	–	–	258	821	14	4	1.2
Unknown geese	–	–	–	–	–	235	629	11	3	1.0
Vegetation (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**407**	**407**	**7**	**2**	**0.6**
Salmon (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**105**	**105**	**2**	**0**	**0.2**
Upland Game Birds (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**72**	**55**	**1**	**0**	**0.1**
Small Land Mammals (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**17**	**17**	**0**	**0**	**0.0**

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Bird Eggs (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**1**	**1**	**0**	**0**	**0.0**
Marine Invertebrates (Low Resource Importance)	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**

Sources: (Hepa et al. 1997); (Bacon et al. 2011); (Braem et al. 2011)

– = no data

Resource Category (e.g., large land mammal) averages do not equal the sum of averages for individual species due to different available data sets for each species and resource category.

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-5
Harvest Characteristics of Nuiqsut

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**100**	**95**	**93**	**95**	**97**	**–**	**171,752**	**1,773**	**428**	**100.0**
Large Land Mammals (High Resource Importance)	**96**	**77**	**76**	**78**	**76**	**509**	**66,313**	**736**	**175**	**45.7**
Caribou	96	72	67	71	74	507	64,796	688	157	45.4
Moose	51	40	11	19	41	8	4,300	39	9	3.2
Brown bear	23	14	7	9	18	7	615	7	2	0.4
Muskox	8	0	0	3	8	1	295	2	1	0.3
Dall sheep	9	0	0	4	9	0	0	0	0	0.0
Non-Salmon Fish (High Resource Importance)	**97**	**83**	**81**	**80**	**79**	**44,644**	**57,150**	**620**	**147**	**30.4**
Cisco	98	75	73	65	60	46,478	29,354	386	73	18.3
Broad whitefish	86	69	67	62	49	6,693	21,366	241	57	14.2
Arctic cisco	86	61	58	70	57	24,500	18,270	174	44	11.8
Humpback whitefish	29	26	23	16	9	1,287	1,962	16	4	1.5
Burbot	64	51	47	38	35	506	2,105	23	5	1.4
Grayling	60	50	47	33	24	2,241	1,973	21	5	1.3
Least cisco	48	40	37	27	17	3,954	2,581	29	7	1.3
Arctic char	49	38	36	23	22	691	1,960	16	4	1.2
Unknown Dolly Varden	12	10	10	0	3	408	1,346	13	3	0.4
Rainbow smelt	29	13	13	15	22	228	478	4	1	0.1
Smelt	30	15	15	8	23	3,173	159	2	0	0.1
Northern pike	9	7	3	0	7	22	73	1	0	0.1
Round whitefish	5	5	4	3	1	133	131	0	0	0.1
Lake trout	10	3	3	1	7	18	73	1	0	0.0
Arctic cod	13	7	7	5	7	72	12	0	0	0.0
Saffron cod	7	7	7	3	0	132	28	0	0	0.0
Sheefish	6	0	0	3	6	0	0	0	0	0.0
Marine Mammals (High Resource Importance)	**97**	**54**	**33**	**68**	**89**	**3,029**	**48,392**	**478**	**120**	**20.4**
Bowhead	97	30	10	47	96	3	46,862	463	118	20.8
Ringed seal	56	36	28	34	43	68	3,967	47	11	3.2
Bearded seal	57	32	15	29	50	11	4,239	46	11	2.3

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Walrus	43	7	1	17	43	1	367	6	1	0.2
Polar bear	29	7	1	8	29	1	187	2	0	0.2
Spotted seal	7	13	3	3	5	6	401	4	1	0.1
Beluga	24	2	0	13	24	0	0	0	0	0.0
Unknown seal	5	0	0	1	5	0	0	0	0	0.0
Migratory Birds (High Resource Importance)	**85**	**78**	**74**	**54**	**57**	**2,388**	**3,638**	**39**	**9**	**2.4**
White-fronted geese	71	62	59	42	36	692	2,485	30	7	1.6
Eider	61	40	36	40	44	662	1,059	12	3	0.7
Canada geese	66	58	53	40	36	346	782	5	1	0.5
Ducks	45	30	25	18	30	388	581	8	1	0.4
Unknown Canada geese	29	26	24	17	12	242	799	7	2	0.2
Common eider	9	7	7	7	3	152	246	1	0	0.1
Brant	22	17	17	13	9	130	171	2	0	0.1
King eider	36	24	22	17	19	76	119	1	0	0.1
Snow geese	21	19	15	9	7	44	154	2	1	0.0
Long-tailed duck (oldsquaw)	10	4	4	5	6	39	31	0	0	0.0
Salmon (Moderate Resource Importance)	**65**	**43**	**38**	**32**	**33**	**168**	**946**	**11**	**3**	**0.4**
Chum salmon	26	23	19	17	11	326	1,971	19	5	0.6
Pink salmon	38	28	24	15	17	179	502	6	1	0.3
Unknown salmon	13	5	4	7	9	17	71	1	0	0.1
Coho salmon	8	3	3	1	5	9	53	1	0	0.0
Chinook salmon	9	2	1	4	9	4	41	0	0	0.0
Sockeye salmon	8	3	3	5	6	5	19	0	0	0.0
Upland Game Birds (Moderate Resource Importance)	**54**	**48**	**48**	**35**	**16**	**568**	**353**	**5**	**1**	**0.2**
Ptarmigan	74	66	66	50	19	1,465	1,026	13	3	0.6
Unknown ptarmigan	16	12	12	9	5	53	39	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Vegetation (Moderate Resource Importance)	**61**	**59**	**47**	**25**	**27**	**116**	**165**	**2**	**0**	**0.1**
Berries	35	43	15	8	20	165	166	2	0	0.1
Cloud berry	62	55	53	16	29	80	320	3	1	0.1
Plants/greens/mushrooms	13	12	9	2	6	10	32	0	0	0.0
Blueberry	40	29	29	9	16	7	28	0	0	0.0
Low bush cranberry	12	9	9	3	5	3	12	0	0	0.0
Crowberry	9	7	7	2	2	1	6	0	0	0.0
Sourdock	10	5	5	2	7	–	3	0	0	0.0
Wood	50	50	50	3	3	61	0	0	0	0.0
Small Land Mammals (Moderate Resource Importance)	**45**	**41**	**37**	**19**	**11**	**238**	**71**	**1**	**0**	**0.0**
Parka squirrel (ground)	31	31	29	13	5	313	110	2	0	0.1
Arctic fox	12	14	10	3	1	42	12	0	0	0.0
Red fox	15	20	15	3	0	21	2	0	0	0.0
Wolverine	17	22	13	4	5	19	0	0	0	0.0
Wolf	12	18	7	3	6	13	0	0	0	0.0
Bird Eggs (Low Resource Importance)	**24**	**16**	**15**	**8**	**12**	**211**	**46**	**1**	**0**	**0.0**
Geese eggs	37	18	16	13	23	251	75	1	0	0.0
Marine Invertebrates (Low Resource Importance)	–	–	–	–	–	–	–	–	–	–

Sources: (ADF&G 2019); (Fuller and George 1999); (Pedersen 1995); (Bacon et al. 2011); (Braem et al. 2011); (SRB&A 2012); (SRB&A 2013b); (SRB&A 2014a); (SRB&A 2015); (SRB&A 2016); (Brown et al. 2016)

– = no data

Resource Category (e.g., large land mammal) averages do not equal the sum of averages for individual species due to different available data sets for each species and resource category.

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-6
Harvest Characteristics of Point Lay

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**96**	**84**	**82**	**87**	**96**	**77,737**	**113,314**	**2,129**	**604**	**100.0**
Marine Mammals (High Resource Importance)	**94**	**73**	**64**	**80**	**92**	**45,565**	**66,172**	**1,339**	**368**	**58.7**
Beluga	92	63	52	70	63	16,252	35,535	717	225	33.9
Bowhead	87	30	12	40	84	1	22,149	515	85	14.3
Bearded seal	69	52	31	42	54	33	9,065	179	42	7.8
Walrus	38	25	13	16	28	9	6,941	120	37	6.6
Ringed seal	39	33	23	23	25	33	1,729	31	9	1.5
Spotted seal	23	24	17	18	9	22	1,373	26	9	1.3
Polar bear	35	4	2	3	34	1	605	12	4	0.6
Unknown seal	17	7	0	7	17	0	0	0	0	0.0
Large Land Mammals (High Resource Importance)	**94**	**68**	**66**	**72**	**79**	**13,302**	**30,594**	**517**	**156**	**26.5**
Caribou	94	66	66	67	75	223	29,501	494	149	25.5
Moose	22	10	8	8	14	2	1,001	22	8	1.0
Reindeer, feral	10	7	5	7	10	3	434	6	2	0.3
Brown bear	20	7	5	3	17	3	260	5	2	0.3
Non-Salmon Fish (High Resource Importance)	**82**	**52**	**45**	**42**	**69**	**8,062**	**6,624**	**105**	**29**	**8.2**
Rainbow smelt	–	–	–	–	–	1,831	10,985	171	47	11.6
Grayling	65	39	37	31	44	1,502	1,352	24	7	1.2
Dolly Varden	15	11	8	5	8	268	883	13	3	1.1
Arctic char	13	6	5	3	9	46	151	3	1	0.3
Arctic cisco	8	4	2	2	7	142	99	1	0	0.1
Smelt	49	25	20	15	37	109	345	5	1	0.1
Sheefish	34	2	2	10	34	15	81	1	0	0.1
Herring	8	3	3	2	5	27	85	1	0	0.1
Broad whitefish	18	5	3	2	17	10	33	1	0	0.0
Humpback whitefish	8	4	2	3	5	7	15	0	0	0.0
Lake trout	10	3	1	3	8	1	3	0	0	0.0
Pacific tom cod	7	0	0	2	7	0	0	0	0	0.0
Northern pike	5	0	0	2	5	0	0	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Pacific herring	8	4	2	0	5	9	56	1	0	–
Arctic grayling	56	37	30	25	39	2,897	2,635	41	10	–
Saffron cod	8	1	1	1	7	4	1	0	0	–
Migratory Birds (High Resource Importance)	**76**	**68**	**64**	**54**	**44**	**1,812**	**3,688**	**67**	**21**	**3.1**
White-fronted geese	57	50	45	38	29	522	1,908	30	8	1.6
Eider	77	68	65	46	27	702	1,054	25	9	1.0
Canada geese	64	53	53	43	35	225	934	22	8	0.9
Brant	43	37	35	20	22	190	656	14	5	0.6
Common eider	24	29	17	10	12	95	369	6	2	0.3
King eider	31	29	24	21	17	148	388	6	2	0.3
Unknown Canada geese	21	19	19	12	10	96	327	5	1	0.2
Long-tailed duck (oldsquaw)	11	11	11	5	3	113	169	4	1	0.2
Snow geese	31	26	19	17	17	45	168	2	1	0.1
Spectacled eider	5	5	5	2	5	48	116	2	0	0.1
Vegetation (High Resource Importance)	**75**	**64**	**64**	**39**	**46**	**159**	**455**	**7**	**2**	**0.3**
Salmonberry	83	71	69	45	43	94	377	6	1	0.3
Berries	68	53	53	27	41	45	179	4	1	0.2
Blueberry	31	24	24	19	14	50	200	3	1	0.1
Crowberry	19	14	14	14	10	23	91	1	0	0.1
Plants/greens/mushrooms	26	22	22	0	3	11	44	1	0	0.0
Low bush cranberry	26	21	21	10	10	7	30	0	0	0.0
Wood	19	19	19	2	0	22	0	0	0	0.0
Salmon (Moderate Resource Importance)	**56**	**35**	**25**	**25**	**47**	**1,444**	**4,049**	**62**	**16**	**2.4**
Coho salmon	18	17	13	11	11	195	1,028	16	4	1.0
Pink salmon	28	24	15	13	20	630	1,674	26	7	1.0
Chum salmon	27	20	15	14	21	254	1,469	22	6	0.7
Sockeye salmon	12	5	4	2	10	34	168	3	1	0.2
Unknown salmon	8	2	0	2	8	17	75	1	0	0.2
Chinook salmon	22	15	8	7	18	11	105	2	0	0.1

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Bird Eggs (Moderate Resource Importance)	**59**	**49**	**47**	**34**	**23**	**769**	**171**	**3**	**1**	**0.1**
Unknown geese eggs	38	33	31	19	17	691	186	3	1	0.1
Unknown gull eggs	31	26	24	14	14	290	87	1	0	0.1
Tundra swan eggs	10	7	7	5	5	105	66	1	0	0.0
Unknown duck eggs	24	19	17	12	12	182	27	0	0	0.0
Unknown loon eggs	7	5	5	2	5	54	10	0	0	0.0
Tern eggs	14	12	12	5	5	139	7	0	0	0.0
Ptarmigan eggs	7	2	2	0	5	11	1	0	0	0.0
Upland Game Birds (Low Resource Importance)	**47**	**44**	**42**	**28**	**16**	**641**	**594**	**9**	**3**	**0.4**
Unknown ptarmigan	43	36	33	17	17	698	681	10	3	0.5
Ptarmigan	52	52	52	39	16	473	331	8	3	0.3
Small Land Mammals (Low Resource Importance)	**27**	**35**	**21**	**11**	**11**	**91**	**43**	**1**	**0**	**<0.1**
Parka squirrel (ground)	11	13	11	9	5	143	59	1	0	0.1
Arctic fox	2	13	2	0	0	3	0	0	0	0.0
Red fox	5	13	4	0	0	1	0	0	0	0.0
Wolverine	9	22	4	3	6	5	0	0	0	0.0
Wolf	2	17	1	0	1	1	0	0	0	0.0
Marine Invertebrates (Low Resource Importance)	**5**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**<0.1**
King crab	5	0	0	0	5	0	0	0	0	0.0

Sources: (Impact Assessment Inc. 1989); (Bacon et al. 2011); (Mikow et al. 2016); (SRB&A 2017a)
– = no data

Resource Category (e.g., large land mammal) averages do not equal the sum of averages for individual species due to different available data sets for each species and resource category.

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-7
Harvest Characteristics of Utqiagvik

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**89**	**57**	**54**	**63**	**87**	**838,887**	**897,204**	**742**	**217**	**100.0**
Marine Mammals (High Resource Importance)	**71**	**30**	**34**	**45**	**70**	**266,755**	**470,250**	**331**	**98**	**49.3**
Bowhead whale	70	24	31	43	67	18	209,678	125	38	18.1
Bearded seal	44	22	12	27	32	475	126,708	102	29	14.6
Walrus	31	6	8	17	27	134	103,287	79	23	12.9
Ringed seal	19	10	10	11	11	362	18,915	17	5	2.5
Polar bear	7	2	2	3	6	17	6,235	6	2	0.8
Beluga	15	4	0	9	14	6	6,236	5	1	0.5
Unknown seal	6	0	0	1	6	0	0	0	0	0.0
Large Land Mammals (High Resource Importance)	**72**	**39**	**33**	**39**	**57**	**227,007**	**301,095**	**252**	**72**	**36.9**
Caribou	70	28	33	38	52	2,232	298,449	244	70	35.9
Moose	14	2	4	2	13	35	17,519	18	6	2.0
Non-Salmon Fish (High Resource Importance)	**69**	**29**	**18**	**37**	**60**	**70,974**	**80,948**	**66**	**19**	**8.8**
Broad whitefish	54	22	15	29	40	16,995	49,807	40	12	5.1
Least cisco	11	6	3	6	7	8,715	6,643	6	2	0.9
Grayling	27	13	11	14	17	7,089	6,103	5	2	0.7
Rainbow smelt	19	2	1	7	18	594	2,322	2	1	0.4
Humpback whitefish	11	7	7	5	5	1,097	2,561	2	1	0.3
Arctic cisco	36	5	5	17	33	4,728	3,388	3	1	0.3
Burbot	11	7	7	6	5	341	1,408	1	0	0.2
Halibut	10	3	3	4	8	2,436	2,591	2	0	0.2
Sheefish	6	0	0	2	6	0	0	0	0	0.0
Salmon (High Resource Importance)	**69**	**26**	**12**	**26**	**55**	**11,294**	**13,254**	**10**	**3**	**1.1**
Sockeye salmon	29	9	9	11	23	4,630	18,667	12	4	1.0
Chum salmon	24	13	9	10	15	976	5,771	4	1	0.5
Coho salmon	24	9	5	10	20	508	2,957	2	1	0.3
Pink salmon	17	9	6	7	12	572	1,821	1	0	0.2

Resource	Percentage of Households: Use	Percentage of Households: Try to Harvest	Percentage of Households: Harvest	Percentage of Households: Give	Percentage of Households: Receive	Estimated Harvest: Numbers[1]	Estimated Harvest: Total Pounds[2]	Estimated Harvest: Average HH Pounds	Estimated Harvest: Per Capita Pounds	Percent of Total Harvest
Chinook salmon	15	5	3	7	12	107	1,337	1	0	0.1
Unknown salmon	9	1	1	2	8	117	612	1	0	0.1
Migratory Birds (Moderate Resource Importance)	**53**	**16**	**33**	**29**	**35**	**23,348**	**28,122**	**24**	**7**	**3.5**
White-fronted geese	39	23	17	20	22	3,795	13,208	12	4	1.7
Unknown eider	0	0	19	0	0	4,481	8,754	8	2	1.3
Common eider	16	9	4	8	9	1,144	2,711	2	1	0.3
King eider	26	16	9	15	14	1,146	1,818	1	0	0.1
Snow geese	7	5	2	3	2	62	228	0	0	0.0
Vegetation (Moderate Resource Importance)	**43**	**18**	**7**	**15**	**35**	**556**	**643**	**0**	**0**	**0.1**
Salmonberry	37	12	10	11	30	94	374	0	0	0.0
Blueberry	17	4	4	6	14	55	221	0	0	0.0
Marine Invertebrates (Low Resource Importance)	**7**	**2**	**2**	**2**	**5**	**2,469**	**2,293**	**2**	**1**	**0.3**
Upland Game Birds (Low Resource Importance)	**9**	**9**	**9**	**4**	**1**	**902**	**671**	**1**	**0**	**0.1**
Unknown ptarmigan	9	9	8	4	1	631	476	0	0	0.1
Bird Eggs (Low Resource Importance)	**13**	**7**	**7**	**3**	**7**	**405**	**229**	**0**	**0**	**0.0**
Unknown geese eggs	3	1	2	1	2	238	935	1	0	0.1
Small Land Mammals (Low Resource Importance)	**8**	**6**	**3**	**2**	**4**	**152**	**103**	**0**	**0**	**0.0**

Sources: (SRB&A and ISER 1993); (Fuller and George 1999); (Bacon et al. 2011); (Brown et al. 2016)

Resource Category (e.g., large land mammal) averages do not equal the sum of averages for individual species due to different available data sets for each species and resource category.

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-8
Harvest Characteristics of Wainwright

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**99**	**97**	**97**	**84**	**99**	**346,343**	**389,846**	**2,955**	**775**	**100.0**
Marine Mammals (High Resource Importance)	**96**	**93**	**85**	**64**	**96**	**138,001**	**180,795**	**1,393**	**359**	**51.6**
Bowhead	96	93	81	49	96	3	66,889	632	161	20.4
Bearded seal	69	38	34	25	55	105	23,816	150	39	6.5
Beluga	84	82	28	38	82	15	16,844	74	20	4.3
Walrus	97	67	61	62	84	852	104,447	764	200	28.4
Ringed seal	7	6	18	4	2	79	3,596	19	5	1.1
Spotted seal	6	5	5	4	4	11	798	6	2	0.2
Large Land Mammals (High Resource Importance)	**97**	**64**	**61**	**62**	**84**	**30,681**	**109,457**	**775**	**203**	**28.9**
Caribou	97	67	61	62	84	852	104,447	764	200	28.4
Brown bear	3	6	3	2	0	2	190	1	0	0.1
Non-Salmon Fish (High Resource Importance)	**90**	**59**	**55**	**56**	**80**	**151,288**	**70,570**	**485**	**133**	**15.0**
Rainbow smelt	77	44	50	47	55	69,755	95,083	652	178	16.2
Smelt	86	52	49	49	61	24,536	12,174	83	24	3.4
Whitefish	–	–	22	–	–	5,037	5,037	41	10	2.0
Cisco	–	–	19	–	–	4,633	4,633	37	9	1.8
Arctic grayling	49	26	22	23	37	3,811	3,437	23	6	1.1
Least cisco	20	8	11	9	16	1,972	1,980	17	4	0.9
Broad whitefish	48	7	4	16	47	1,079	3,188	17	5	0.5
Burbot	14	9	8	7	9	116	487	3	1	0.1
Bering cisco	18	8	5	8	14	787	652	5	1	0.1
Arctic cisco	11	6	5	7	9	481	375	2	1	0.1
Humpback whitefish	13	5	3	6	11	282	599	4	1	0.0
Sheefish	8	2	1	3	7	12	65	0	0	0.0
Migratory Birds (High Resource Importance)	**82**	**52**	**45**	**46**	**68**	**4,087**	**7,981**	**58**	**15**	**2.1**
Black brant	–	–	–	–	–	1,632	4,897	–	–	1.5
Unknown geese	77	45	17	40	58	849	2,805	18	5	0.7

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Unknown ducks	59	34	11	31	46	407	755	5	1	0.2
Tundra swan (whistling)	5	5	4	2	1	5	53	0	0	0.0
Vegetation (High Resource Importance)	**74**	**64**	**62**	**30**	**30**	**180**	**763**	**6**	**2**	**0.2**
Cloud berry	73	63	61	28	30	244	1,589	10	3	0.4
Blueberry	16	16	12	3	3	7	33	0	0	0.0
Low bush cranberry	12	11	9	3	2	4	24	0	0	0.0
Salmon (Moderate Resource Importance)	**41**	**18**	**13**	**13**	**34**	**518**	**1,667**	**12**	**3**	**0.5**
Coho salmon	12	7	5	5	8	138	729	5	1	0.1
Chum salmon	16	8	5	6	12	71	428	3	1	0.1
Chinook salmon	14	7	4	4	11	26	273	2	1	0.1
Pink salmon	18	8	6	5	13	89	253	2	0	0.0
Sockeye salmon	9	4	4	2	6	60	258	3	0	0.0
Sockeye salmon	9	4	4	2	6	60	258	3	0	0.0
Upland Game Birds (Low Resource Importance)	**7**	**7**	**12**	**5**	**1**	**132**	**97**	**1**	**0**	**0.0**
Ptarmigan	7	7	12	5	1	129	96	1	0	0.0
Small Land Mammals (Low Resource Importance)	**13**	**15**	**9**	**5**	**3**	**75**	**9**	**0**	**0**	**0.0**
Wolverine	7	10	5	2	1	13	0	0	0	0.0
Wolf	6	8	4	1	2	11	0	0	0	0.0
Bird Eggs (Low Resource Importance)	–	–	–	–	–	–	**6**	–	–	**0.0**
Marine Invertebrates (Low Resource Importance)	–	–	–	–	–	–	**20**	–	–	**0.0**

Sources: (SRB&A and Research 1993); (Fuller and George 1999); (Bacon et al. 2011); (Kofinas et al. 2016); (Mikow et al. 2016): (SRB&A 2017a)

– = no data

Resource Category (e.g., large land mammal) averages do not equal the sum of averages for individual species due to different available data sets for each species and resource category.

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-9
Synthesis of Subsistence Timing of Primary Study Communities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon	4	4	4	3	3	4	6	6	5	6	5	5
Marine non-salmon	1	2	3	1	1	3	4	3	4	5	3	3
Salmon	–	–	–	–	1	3	5	5	4	4	1	1
Caribou	6	6	6	6	6	6	6	6	6	6	6	6
Moose	–	1	1	1	2	2	4	6	4	1	–	–
Bear	1	1	1	2	3	3	3	4	3	2	1	1
Muskox	–	–	1	–	–	–	1	2	2	1	–	–
Dall sheep	1	1	2	1	1	1	1	1	2	1	1	1
Furbearers	6	5	6	4	3	1	1	2	4	4	5	5
Small land mammals	1	2	1	2	4	3	3	4	3	–	1	1
Marine mammals	2	2	3	4	4	5	4	4	4	4	1	2
Polar bear	3	3	2	1	2	1	1	2	1	1	3	2
Upland birds	4	4	5	5	5	4	2	2	5	5	4	4
Waterfowl	–	–	2	5	6	6	6	4	5	3	1	–
Plants and berries	–	–	–	–	3	4	5	6	6	–	–	–

Sources: (Bacon et al. 2011); (Braem et al. 2011); (Brower, Olemaun, and Hepa 2000); (Brower and Hepa 1998); (EDAW Inc. et al. 2008); (Fuller and George 1999); (Galginaitis and Funk 2004); (Galginaitis 2006); (Galginaitis 2008a); (Galginaitis 2008b); (Galginaitis 2009); (Galginaitis and Funk 2005); (Holen et al. 2012); (Kassam and Wainwright Traditional Council 2001); (Libbey, Spearman, and Hoffman 1979); (Pedersen and Opie 1991); (Pedersen and Hugo 2005); (Pedersen and Linn 2005); (Schneider, Pedersen, and Libbey 1980); (SRB&A 2010a); (SRB&A 2013a); (SRB&A 2014b)

(Utqiagvik) Caribou includes reindeer hunting; bear includes polar bear hunting.

Numbers in cells indicate the number of communities for which subsistence activities are documented in each month.

– = no data

Table T-10
Subsistence Timing of Anaktuvuk Pass

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Most Recent Decade for Subsistence Activity/Harvest Data
Freshwater non-salmon	–	X	X	X	X	X	X	X	X	X	X	X	2000s
Salmon	–	–	–	–	–	–	X	X	X	X	–	–	1990s
Caribou	X	X	X	X	X	X	X	X	X	X	X	X	2010s
Moose	–	–	–	-	-	-	X	X	X	X	–	–	2010s
Bear	–	–	–	X	X	X	X	X	X	X	–	–	2010s
Dall sheep	X	X	X	X	X	X	X	X	X	X	X	X	2010s
Goat	–	–	–	–	–	–	–	X	X	–	–	–	2010s
Furbearers	X	X	X	X	X	–	–	X	X	–	X	X	2010s/2000s
Small land mammals	X	X	X	X	X	–	X	X	X	–	X	X	2010s/2000s
Upland birds	X	X	X	X	X	X	X	X	X	X	X	X	2010s/2000s
Waterfowl	–	–	X	X	X	X	X	-	-	–	–	–	2010s/2000s
Plants and berries	–	–	–	–	–	X	X	X	X	–	–	–	2010s/2000s

Sources: (Bacon et al. 2011); (Pedersen and Hugo 2005); (Holen et al. 2012); (SRB&A 2013c)

– = no data

Table T-11
Subsistence Timing of Atqasuk

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Most Recent Decade for Subsistence Activity/Harvest Data
Freshwater non-salmon	X	X	X	–	–	X	X	X	X	X	X	X	1980s/1990s
Marine non-salmon	–	–	–	–	–	X	X	X	X	X	X	X	1990s
Caribou	X	X	X	X	X	X	X	X	X	X	X	X	1980s/2000s
Moose	–	–	–	–	X	X	X	X	X	–	–	–	1980s
Bear	–	–	–	–	X	X	X	X	X	–	–	–	1980s/1990s
Furbearers	X	X	X	X	X	–	–	–	X	X	X	X	1980s
Small land mammals	–	–	–	–	X	X	X	X	X	–	–	–	1980s
Marine mammals	–	–	–	–	–	X	–	–	–	–	–	–	1990s
Seal	–	–	–	–	–	X	–	–	–	–	–	–	1990s
Waterfowl	–	–	–	–	X	X	X	–	X	–	–	–	1990s
Plants and berries	–	–	–	–	X	X	X	X	X	–	–	–	1980s/1990s

Sources: (Bacon et al. 2011); (Schneider et al. 1980); (Braem et al. 2011)

– = no data

Table T-12
Subsistence Timing of Nuiqsut

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Most Recent Decade for Subsistence Activity/Harvest Data
Freshwater non-salmon	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Marine non-salmon	–	–	–	–	–	–	–	–	X	X	–	–	1990s
Salmon	–	–	–	–	–	–	X	X	–	–	–	–	2000s
Caribou	X	X	X	X	X	X	X	X	X	X	X	X	2000s/2010s
Moose	–	–	–	–	–	–	–	X	X	–	–	–	2000s
Polar bear	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Muskox	–	–	–	–	–	–	–	X	X	X	–	–	2000s
Furbearers	X	X	X	X	–	–	X	X	X	X	X	X	2000s
Small land mammals	–	–	–	–	X	X	X	X	X	–	–	–	1970s
Marine mammals	–	–	–	X	X	X	X	X	X	–	–	–	2000s
Upland birds	–	–	X	X	X	X	–	–	X	–	–	–	1990s/2000s
Waterfowl	–	–	–	X	X	X	X	X	X	–	–	–	2000s
Eggs	–	–	–	–	–	X	–	–	–	–	–	–	1990s
Plants and berries	–	–	–	–	–	–	–	X	X	–	–	–	1990s

Sources: (Bacon et al. 2011); (Brower and Hepa 1998); (EDAW Inc. et al. 2008); (Fuller and George 1999); (Galginaitis and Funk 2004); (Galginaitis and Funk 2005); (Galginaitis 2006); (Galginaitis 2008a); (Galginaitis 2008b); (Galginaitis 2009); (Libbey et al. 1979); (SRB&A 2010a); (SRB&A 2013b)

– = no data

Table T-13
Subsistence Timing of Point Lay

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Most Recent Decade for Subsistence Activity/Harvest Data
Freshwater non-salmon	–	–	–	–	–	–	X	X	–	X	–	–	2000s
Marine non-salmon	–	–	X	X	–	–	X	–	–	X	–	–	2000s
Salmon	–	–	–	–	X	X	X	X	X	X	–	–	1990s–2000s/2000s
Caribou	X	X	X	X	X	X	X	X	X	X	X	X	1990s–2000s/2000s
Moose	–	–	–	–	–	–	–	X	–	–	–	–	2000s
Muskox	–	–	–	–	–	–	X	X	–	–	–	–	2000s
Furbearers	–	–	X	–	–	–	–	–	–	X	–	–	2000s
Small land mammals	–	–	–	–	–	X	–	–	–	–	–	–	2000s
Marine mammals	–	X	X	X	X	X	X	X	X	X	–	–	1990s–2000s/2000s
Seal	–	–	X	X	X	X	X	X	X	X	–	–	1990s–2000s/2000s
Walrus	–	–	–	–	–	X	X	–	–	–	–	–	1990s–2000s/2000s
Beluga whale	–	–	–	–	–	X	X	–	–	–	–	–	1990s–2000s/2000s
Polar bear	X	X	–	–	–	–	–	–	–	–	X	X	1990s-2000s
Upland birds	X	X	X	X	X	–	–	X	X	X	X	X	1990s–2000s/2000s
Waterfowl	–	–	X	X	X	X	X	X	X	–	–	–	1990s–2000s/2000s
Plants and berries	–	–	–	–	X	X	X	X	X	–	–	–	1990s–2000s/2000s

Sources: (Bacon et al. 2011); (SRB&A 2014b)

– = no data

Table T-14
Subsistence Timing of Utqiagvik

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Most Recent Decade for Subsistence Activity/Harvest Data
Freshwater non-salmon	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Marine non-salmon	–	X	X	–	X	X	X	X	X	X	X	X	2000s
Salmon	–	–	–	–	–	X	X	X	X	X	–	–	1990s/2000s
Caribou	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Moose	–	X	X	X	X	X	X	X	X	–	–	–	1980s/2000s
Bear	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Dall sheep	–	–	X	–	–	–	–	–	X	–	–	–	1990s/2000s
Muskox	–	–	X	–	–	–	–	–	X	–	–	–	2000s
Furbearers	X	X	X	X	X	X	–	–	X	X	X	X	2000s
Small land mammals	–	X	–	X	X	–	–	–	–	–	–	–	1990s/2000s
Marine mammals	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Upland birds	X	X	X	X	X	X	X	–	X	X	X	X	1990s/2000s
Waterfowl	–	–	–	–	X	X	X	X	X	X	X	–	2000s
Marine invertebrates	–	–	–	–	–	X	X	X	X	X	–	–	1990s/2000s
Plants and berries	–	–	–	–	X	X	X	X	X	–	–	–	1990s/2000s

Sources: (Bacon et al. 2011); (Fuller and George 1999); (SRB&A 2010a)

Note: Caribou includes reindeer hunting; bear includes polar bear hunting.

– = no data

Table T-15
Subsistence Timing Characteristics of Wainwright

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Most Recent Decade for Subsistence Activity/Harvest Data
Freshwater non-salmon	X	–	–	–	–	–	X	X	X	X	X	X	2000s
Marine non-salmon	X	X	X	–	–	X	X	X	X	X	X	X	2000s
Salmon	–	–	–	–	–	X	X	X	X	X	X	X	2000s
Caribou	X	X	X	X	X	X	X	X	X	X	X	X	2000s
Moose	–	–	–	–	–	–	X	X	–	–	–	–	2000s
Bear	–	–	–	–	–	–	–	X	–	–	–	–	2000s
Furbearers	X	X	X	–	–	–	–	–	–	–	X	X	2000s
Small land mammals	–	–	–	–	–	–	–	X	–	–	–	–	2000s
Marine mammals	X	X	X	X	X	X	X	X	X	X	–	X	2000s
Seal	X	X	X	X	X	X	X	X	X	X	–	X	2000s
Walrus	–	–	–	X	X	X	X	X	–	–	–	–	2000s
Bowhead whale	–	–	–	–	–	–	–	–	–	–	–	–	2000s
Beluga whale	–	–	–	–	–	–	–	–	–	–	–	–	2000s
Polar bear	X	X	X	–	X	–	–	X	–	–	X	–	2000s
Upland birds	X	X	X	X	X	X	–	–	X	X	X	X	2000s
Waterfowl	–	–	–	X	X	X	X	X	X	X	–	–	2000s
Plants and berries	–	–	–	–	–	–	X	X	X	–	–	–	2000s

Sources: (Kassam and Wainwright Traditional Council 2001); (Bacon et al. 2011)

– = no data

Table T-16
Harvest Characteristics of Ambler

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**98**	**96**	**96**	**87**	**92**	**170,468**	**170,468**	**2,243**	**603**	**100.0**
Large Land Mammals (High Resource Importance)	**89**	**75**	**70**	**58**	**62**	**34,309**	**72,520**	**1,022**	**278**	**59.9**
Caribou	88	74	69	56	51	489	66,473	937	255	54.6
Moose	36	21	13	14	26	10	5,231	74	20	4.5
Black bear	19	12	8	8	11	6	529	7	2	0.4
Brown bear	5	6	4	3	1	2	188	3	1	0.0
Non-salmon Fish (High Resource Importance)	**93**	**82**	**77**	**58**	**72**	**49,411**	**53,231**	**729**	**205**	**28.9**
Broad whitefish	62	38	37	25	48	9,321	23,473	317	88	17.1
Sheefish	87	72	69	47	56	1,481	20,966	291	84	7.5
Humpback whitefish	27	20	18	11	19	2,448	4,990	69	19	1.9
Northern pike	32	27	24	13	14	463	1,729	24	7	1.0
Grayling	57	38	38	21	30	948	853	11	3	0.5
Arctic grayling	47	41	37	18	20	908	674	9	3	-
Dolly Varden	36	24	20	8	23	76	345	5	1	0.1
Burbot	32	19	15	8	19	282	836	11	3	0.3
Herring	6	2	2	0	6	0	1	0	0	0.0
Salmon (High Resource Importance)	**79**	**55**	**54**	**35**	**62**	**10,096**	**22,063**	**306**	**87**	**5.9**
Chum salmon	76	53	52	34	57	2,902	20,262	281	80	5.4
Coho salmon	11	7	7	4	6	190	945	13	4	0.0
Pink salmon	6	4	4	1	3	173	489	7	2	0.0
Sockeye salmon	8	3	3	2	4	83	320	4	1	0.4
Chinook salmon	7	4	4	0	4	3	46	1	0	0.0
Vegetation (High Resource Importance)	**98**	**85**	**77**	**51**	**51**	**2,772**	**2,772**	**36**	**10**	**1.6**
Blueberry	89	77	75	36	32	283	1,132	15	4	0.6
Low bush cranberry	58	55	53	26	17	190	759	10	3	0.4
Salmonberry	45	38	34	13	15	71	286	4	1	0.1
Other wood	57	38	38	21	26	0	0	0	0	0.0
Crowberry	28	26	25	4	4	11	43	1	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Other wild berry	9	11	9	4	0	4	15	0	0	0.0
High bush cranberry	8	8	8	0	0	4	15	0	0	0.0
Raspberry	9	8	8	2	2	34	135	2	0	0.0
Eskimo potato	6	8	6	0	2	3	10	0	0	0.0
Sourdock	8	8	6	4	2	12	12	0	0	0.0
Stinkweed	6	8	6	4	2	6	6	0	0	0.0
Wild rhubarb	4	6	4	0	0	49	195	3	1	0.1
Hudson Bay tea	6	6	6	0	0	116	116	2	0	0.0
Small Land Mammals (Low Resource Importance)	**21**	**19**	**18**	**11**	**9**	**900**	**855**	**11**	**3**	**1.5**
Beaver	21	18	18	13	9	95	1,133	15	4	1.3
Snowshoe hare	15	11	9	9	8	53	133	2	0	0.0
Wolf	10	8	7	2	3	17	0	0	0	0.0
Muskrat	9	9	9	4	0	36	65	1	0	0.0
Wolverine	9	7	7	2	2	16	0	0	0	0.0
Marten	7	6	6	2	1	28	0	0	0	0.0
Porcupine	9	8	8	6	2	13	103	1	0	0.0
Red fox	6	5	5	2	3	13	0	0	0	0.0
Migratory Birds (Moderate Resource Importance)	**58**	**40**	**56**	**23**	**30**	**2,032**	**3,315**	**43**	**11**	**1.3**
Canada geese	98	96	96	87	92	170,468	170,468	2,243	603	100.0
White-fronted geese	36	28	21	19	13	190	806	11	3	0.3
Mallard	26	17	36	11	11	245	479	6	2	0.1
Northern pintail	23	15	23	11	11	153	239	3	1	0.0
Long-tailed duck (oldsquaw)	8	9	17	6	0	122	177	2	1	0.0
Black scoter	13	9	11	8	6	58	103	1	0	0.0
Widgeon	13	9	10	8	6	58	76	1	0	0.0
Snow geese	9	9	5	2	2	12	48	1	0	0.0
Surf scoter	6	6	9	4	0	56	89	1	0	0.0
Unknown ducks	8	2	5	0	6	31	51	1	0	0.0
Upland Game Birds (Moderate Resource Importance)	**55**	**40**	**42**	**28**	**26**	**530**	**523**	**7**	**2**	**0.2**
Ptarmigan	55	40	38	28	26	433	433	6	2	0.2
Grouse	17	13	14	9	4	56	39	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Marine Mammals (High Resource Importance)	**62**	**2**	**2**	**26**	**60**	**602**	**602**	**8**	**2**	**0.3**
Bowhead	42	0	0	13	42	0	0	0	0	0.0
Unknown seal	36	0	0	13	36	0	0	0	0	0.0
Bearded seal	25	2	2	11	23	1	602	8	2	0.3
Beluga	23	0	0	8	23	0	0	0	0	0.0

Sources: (Georgette 2000); (ADF&G 2019); (Braem et al. 2015); (Braem et al. 2018)

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-17
Harvest Characteristics of Kiana

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**99**	**92**	**92**	**–**	**–**	**24,266**	**133,211**	**1,402**	**347**	**100.0**
Large Land Mammals (High Resource Importance)	**91**	**71**	**69**	**59**	**68**	**419**	**62,120**	**634**	**163**	**37.7**
Caribou	89	70	66	53	65	403	54,755	559	144	31.2
Moose	29	16	13	9	14	13	7,054	72	19	6.5
Black bear	7	8	3	6	4	3	268	3	1	0.0
Non-Salmon Fish (High Resource Importance)	**83**	**66**	**64**	**40**	**68**	**15,962**	**39,350**	**405**	**97**	**28.7**
Whitefish	60	44	42	–	–	10,834	22,189	234	58	16.7
Sheefish	76	59	57	32	58	1,485	15,018	154	37	5.4
Burbot	36	27	26	14	21	499	2,096	22	5	2.9
Pike	25	21	20	–	–	1,043	3,444	36	9	2.6
Dolly Varden	30	20	16	6	21	267	880	9	2	1.0
Broad whitefish	52	35	31	18	34	3,513	11,240	114	27	–
humpback whitefish	41	30	26	15	25	3,375	7,087	73	17	–
Northern pike	19	18	14	8	6	313	1,033	11	3	–
Grayling	12	9	12	–	–	113	102	1	0	0.1
Smelt	14	7	5	–	–	871	121	1	0	0.1
Salmon (High Resource Importance)	**90**	**64**	**61**	**37**	**82**	**5,546**	**21,511**	**223**	**54**	**24.4**
Chum salmon	86	62	58	37	79	3,298	19,199	199	48	20.7
Coho salmon	26	18	16	11	20	247	1,238	13	3	2.0
Sockeye salmon	13	7	5	5	13	112	452	5	1	1.0
Pink salmon	16	11	9	8	11	163	405	4	1	0.1
Chinook salmon	12	4	4	2	8	14	160	2	0	0.4
Vegetation (High Resource Importance)	**86**	**73**	**75**	**–**	**–**	**842**	**5,027**	**53**	**13**	**3.8**
Blueberry	83	70	71	–	–	442	2,874	30	8	2.2
Salmonberry	49	36	36	–	–	206	1,342	14	4	1.0
Low bush cranberry	33	29	27	–	–	64	420	4	1	0.3
Crowberry	18	14	14	–	–	38	250	3	1	0.2

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Wild rhubarb	12	9	9	–	–	50	50	1	0	0.0
Eskimo potato	9	8	8	–	–	16	65	1	0	0.0
Marine Mammals (Low Resource Importance)	**70**	**10**	**5**	**–**	**–**	**6**	**2,590**	**27**	**7**	**1.9**
Bearded seal	16	7	5	–	–	6	2,590	27	7	1.9
Unknown seal oil	14	7	5	–	–	871	121	1	0	0.1
Migratory Birds (Moderate Resource Importance)	**47**	**38**	**38**	**–**	**–**	**795**	**2,006**	**20**	**5**	**1.2**
Canada geese	39	34	31	–	–	195	666	7	2	0.5
Ducks	27	25	23	–	–	303	571	6	2	0.4
White-fronted geese	22	20	11	–	–	66	279	3	1	0.3
Small Land Mammals (Low Resource Importance)	**15**	**16**	**18**	**7**	**2**	**120**	**502**	**5**	**1**	**1.1**
Beaver	19	18	18	12	4	72	888	9	2	1.3
Muskrat	9	14	9	–	–	81	0	0	0	0.0
Snowshoe hare	7	8	5	–	–	25	64	1	0	0.0
Land otter	4	5	3	–	–	2	0	0	0	0.0
Marten	4	5	1	–	–	37	0	0	0	0.0
Marine Invertebrates (Low Resource Importance)	**9**	**4**	**4**	**–**	**–**	**671**	**1,346**	**14**	**4**	**1.0**
Clams	4	1	1	–	–	629	1,258	13	3	0.9
Upland Game Birds (Low Resource Importance)	**7**	**8**	**9**	**–**	**–**	**161**	**151**	**1**	**0**	**0.0**
Ptarmigan	5	8	4	–	–	37	37	0	0	0.0

Sources: (Wolfe and Paige 1995); (Georgette 2000); (ADF&G 2019); (Magdanz et al. 2011a); (Braem 2012b); (Braem et al. 2018)

– = no data

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-18
Harvest Characteristics of Kobuk

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**100**	**100**	**100**	**90**	**100**	**50,743**	**50,743**	**1,410**	**309**	**100.0**
Large Land Mammals (High Resource Importance)	**93**	**84**	**71**	**62**	**79**	**6,233**	**24,617**	**772**	**173**	**36.1**
Caribou	89	78	66	57	63	154	20,976	655	147	31.8
Moose	48	45	16	16	43	6	2,958	95	21	3.8
Black bear	25	29	12	12	16	4	397	13	3	0.4
Brown bear	17	27	11	10	10	3	286	9	2	0.0
Salmon (High Resource Importance)	**84**	**63**	**60**	**40**	**57**	**15,142**	**12,915**	**387**	**84**	**29.8**
Chum salmon	83	63	60	38	54	2,174	12,841	384	84	29.5
Pink salmon	5	5	5	4	1	4	11	0	0	0.0
Non-Salmon Fish (High Resource Importance)	**96**	**87**	**86**	**57**	**65**	**13,850**	**26,015**	**809**	**176**	**27.2**
Sheefish	94	81	79	42	43	903	10,199	306	67	23.3
Broad whitefish	27	19	19	9	14	543	1,738	55	12	1.8
Northern pike	37	33	33	8	11	70	232	7	2	0.6
Humpback whitefish	46	36	36	22	31	1,263	2,653	82	18	0.6
Arctic grayling	54	44	44	13	17	186	167	5	1	–
Dolly Varden	24	23	18	3	9	24	79	2	0	0.2
Grayling	33	30	30	17	13	256	231	6	1	0.4
Burbot	9	6	5	1	7	21	90	3	1	0.1
Least cisco	7	3	0	3	7	0	0	0	0	0.0
Migratory Birds (Moderate Resource Importance)	**73**	**40**	**48**	**40**	**57**	**1,167**	**1,781**	**61**	**14**	**3.2**
White-fronted geese	33	30	35	23	20	130	549	19	4	0.9
Canada geese	63	37	37	30	50	112	383	11	2	0.7
Mallard	50	33	39	27	20	100	195	7	2	0.2
Long-tailed duck (oldsquaw)	27	20	18	17	7	40	57	2	0	0.1
Scaup	17	13	13	13	3	27	46	1	0	0.0
Northern pintail	30	10	27	13	23	89	139	5	1	0.1
Wigeon	17	10	10	10	10	31	41	1	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Unknown ducks	7	7	3	7	0	33	50	1	0	0.1
Northern shoveler	13	7	5	7	7	12	13	0	0	0.0
Brant	7	7	3	7	0	2	6	0	0	0.0
Snow geese	10	7	0	3	3	0	0	0	0	0.0
Sandhill crane	7	7	5	0	0	3	22	1	0	0.0
Black scoter	10	3	12	3	7	22	39	1	0	0.0
Green-winged teal	7	0	0	0	7	0	0	0	0	0.0
Vegetation (High Resource Importance)	**100**	**87**	**67**	**67**	**80**	**986**	**986**	**27**	**6**	**1.9**
Blueberry	87	67	67	50	37	96	385	11	2	0.7
Low bush cranberry	67	60	60	33	17	89	355	10	2	0.7
Other wood	80	50	50	20	53	0	0	0	0	0.0
Salmonberry	40	23	23	13	23	32	127	4	1	0.2
Crowberry	10	10	10	3	3	5	19	1	0	0.0
Eskimo potato	10	10	10	7	3	6	25	1	0	0.0
Stinkweed	7	7	7	3	0	2	2	0	0	0.0
Small Land Mammals (Low Resource Importance)	**29**	**26**	**25**	**15**	**14**	**237**	**221**	**6**	**1**	**1.3**
Beaver	20	16	15	9	9	28	208	6	1	1.2
Wolf	11	11	10	3	2	8	0	0	0	0.0
Red fox	15	14	10	5	9	11	0	0	0	0.0
Marten	8	9	5	2	2	8	0	0	0	0.0
Muskrat	13	10	10	13	7	8	15	0	0	0.0
Snowshoe hare	7	7	7	7	3	10	24	1	0	0.0
Upland Game Birds (Moderate Resource Importance)	**63**	**50**	**35**	**37**	**33**	**119**	**119**	**4**	**1**	**0.3**
Ptarmigan	60	47	47	33	30	120	120	3	1	0.2
Grouse	30	30	15	23	17	25	18	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Marine Mammals (High Resource Importance)	**63**	**0**	**0**	**23**	**63**	**0**	**0**	**0**	**0**	**0.0**
Unknown seal	60	0	0	17	60	0	0	0	0	0.0
Bowhead	33	0	0	13	33	0	0	0	0	0.0
Belukha	17	0	0	7	17	0	0	0	0	0.0
Bearded seal	10	0	0	0	10	0	0	0	0	0.0

Sources: (Georgette 2000); (ADF&G 2019); (Braem 2012); (Braem et al. 2015); (Braem et al. 2018)

– = no data

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-19
Harvest Characteristics of Noatak

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**96**	**95**	**95**	**91**	**92**	**101,354**	**96,797**	**88,230**	**412**	**100.0**
Large Land Mammals (High Resource Importance)	**92**	**70**	**61**	**60**	**75**	**429**	**49,145**	**12,597**	**132**	**41.9**
Caribou	88	66	60	54	67	416	44,761	12,355	124	39.6
Moose	25	12	7	10	23	7	3,843	222	8	1.9
Dall sheep	7	4	3	2	5	5	568	5	1	0.3
Salmon (High Resource Importance)	**87**	**77**	**77**	**59**	**62**	**6,122**	**33,145**	**9,379**	**83**	**20.0**
Chum salmon	85	75	74	57	58	6,282	28,800	8,869	74	18.8
Coho salmon	19	15	14	11	11	827	3,905	224	8	0.6
Chinook salmon	5	4	3	2	3	12	105	13	0	0.1
Non-Salmon Fish (High Resource Importance)	**92**	**79**	**72**	**68**	**80**	**20,674**	**27,156**	**4,721**	**61**	**19.5**
Trout	91	83	78	72	78	10,234	32,180	270	61	16.8
Dolly Varden	90	76	67	61	65	5,798	15,361	3,941	37	8.7
Whitefish	61	39	38	37	54	6,778	14,234	120	27	7.4
Humpback whitefish	12	11	12	9	8	1,098	1,432	896	5	2.0
Burbot	14	9	10	8	11	79	68	268	1	0.4
Sheefish	31	6	11	10	35	110	612	112	1	0.4
Grayling	26	24	25	15	8	813	552	186	2	0.4
Broad whitefish	26	19	16	15	16	1,163	3,703	48	7	0.0
Least cisco	8	7	7	5	5	456	305	38	1	0.1
Northern pike	10	6	5	4	6	68	225	2	0	0.2
Unknown whitefish	12	9	10	7	3	357	9	732	2	0.4
Lake trout	8	6	4	1	3	52	313	3	1	0.2
Saffron cod	32	4	22	23	47	370	21	58	0	0.0
Marine Mammals (High Resource Importance)	**59**	**20**	**39**	**53**	**72**	**60**	**17,784**	**9,188**	**57**	**14.4**
Bearded seal	52	19	32	40	56	48	12,579	7,176	42	10.6
Belukha	44	7	11	37	48	6	3,834	1,525	11	2.8
Walrus	12	2	4	8	14	2	931	483	3	0.8

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Ringed seal	8	3	3	6	6	4	245	2	0	0.1
Bowhead	5	0	23	10	23	0	0	0	0	0.0
Vegetation (High Resource Importance)	**89**	**85**	**85**	**60**	**64**	**1,669**	**4,428**	**956**	**11**	**2.8**
Blueberry	59	29	28	30	46	167	1,085	9	2	0.6
Salmonberry	92	69	68	69	71	410	2,666	22	5	1.4
Berries	59	59	66	28	37	256	20	1,666	4	1.0
Blackberry	59	29	28	30	46	167	1,085	9	2	0.6
Wood	50	50	52	12	9	231	0	0	0	0.0
Low bush cranberry	47	32	30	20	31	77	498	4	1	0.3
Plants/greens/mushrooms	15	15	22	7	13	149	2	172	0	0.1
Stinkweed	16	14	14	9	8	44	44	0	0	0.0
Hudson Bay tea	16	14	14	12	8	17	17	0	0	0.0
Eskimo potato	19	12	11	10	11	11	44	0	0	0.0
Willow leaves	20	12	11	12	18	30	30	0	0	0.0
Raspberry	12	11	11	8	7	16	101	1	0	0.1
Sourdock	20	9	9	10	18	50	50	0	0	0.0
Other wild greens	7	6	6	4	2	14	14	0	0	0.0
Migratory Birds (Moderate Resource Importance)	**50**	**46**	**43**	**29**	**29**	**753**	**1,566**	**504**	**5**	**1.2**
Canada geese	52	44	32	34	34	273	975	9	2	0.6
Unknown Canada geese	40	38	43	18	9	262	11	896	2	0.5
Northern pintail	20	20	16	12	8	162	187	43	0	0.1
White-fronted geese	17	17	15	11	11	116	386	108	1	0.3
Mallard	7	12	7	2	0	68	97	36	0	0.0
Snow geese	4	5	4	3	0	13	38	13	0	0.0
Bird Eggs (Low Resource Importance)	**21**	**20**	**28**	**11**	**9**	**530**	**130**	**8**	**0**	**0.1**
Gull eggs	32	27	26	19	16	632	158	1	0	0.1
Lesser Canada geese eggs	–	21	–	–	–	240	60	1	0	–
Mew gull eggs	–	13	–	–	–	133	40	0	0	–
Unknown gull eggs	7	8	-	0	0	121	20	9	0	0.0
Canada geese eggs	7	7	7	7	3	99	27	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Upland Game Birds (Low Resource Importance)	**24**	**20**	**19**	**12**	**17**	**270**	**196**	**72**	**1**	**0.1**
Ptarmigan	30	22	16	13	21	205	198	2	0	0.1
Willow ptarmigan	–	18	–	–	–	329	329	3	1	–
Unknown ptarmigan	18	18	22	10	13	210	3	210	1	0.1
Spruce grouse	6	6	6	4	2	16	11	0	0	0.0
Small Land Mammals (Low Resource Importance)	**10**	**11**	**10**	**5**	**4**	**38**	**72**	**1**	**0**	**0.1**
Beaver	6	7	4	3	1	12	126	1	0	0.1
Wolf	7	8	5	2	3	7	0	0	0	0.0
Wolverine	3	6	4	–	1	8	0	0	0	0.0
Lynx	5	9	3	2	2	8	0	0	0	–
Red fox	3	5	3	1	2	12	0	0	0	0.0

Sources: (ADF&G 2019); (Georgette 2000); (ADF&G 2019); (ADF&G 2019); (Magdanz et al. 2010); (Braem and Kostick 2014); (Mikow et al. 2014); (Braem et al. 2018); (Gonzalez et al. 2018) (Gonzalez, Mikow, and Kostick 2018)

– = no data

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-20
Harvest Characteristics of Noorvik

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**100**	**94**	**93**	**75**	**96**	**353,142**	**353,142**	**2,616**	**603**	**100.0**
Non-Salmon Fish (High Resource Importance)	**95**	**70**	**68**	**56**	**81**	**135,861**	**135,661**	**1,040**	**238**	**38.5**
Sheefish	82	56	54	36	54	4,054	45,697	348	80	19.0
Broad whitefish	78	45	42	33	53	12,063	38,603	297	68	9.1
Northern pike	59	43	41	25	27	6,347	20,945	161	37	4.8
Humpback whitefish	46	30	29	23	23	11,337	23,807	184	42	3.8
Burbot	63	41	38	20	40	637	2,677	20	5	1.0
Dolly Varden	36	18	16	8	24	188	622	5	1	0.1
Least cisco	21	15	14	10	10	3,572	2,645	21	5	0.4
Bering cisco	7	5	5	1	2	170	237	2	0	0.1
Rainbow smelt	5	5	4	2	1	15	93	1	0	0.0
Saffron cod	20	1	0	0	20	0	0	0	0	0.0
Large Land Mammals (High Resource Importance)	**96**	**69**	**69**	**50**	**75**	**43,959**	**138,021**	**954**	**214**	**36.8**
Caribou	95	67	67	48	60	869	118,140	818	184	32.8
Moose	57	28	20	18	43	35	18,902	129	28	3.7
Black bear	14	11	3	3	12	7	641	4	1	0.2
Brown bear	9	9	3	3	6	4	338	2	1	0.1
Salmon (High Resource Importance)	**90**	**47**	**46**	**43**	**69**	**60,326**	**98,281**	**759**	**174**	**17.1**
Chum salmon	89	47	45	42	66	15,408	93,115	719	165	16.3
Coho salmon	15	10	10	6	8	721	3,507	27	6	0.5
Pink salmon	20	15	14	11	9	456	1,087	9	2	0.2
Chinook salmon	8	5	4	2	4	25	236	2	0	0.0
Marine Mammals (High Resource Importance)	**71**	**11**	**10**	**20**	**67**	**9,336**	**9,336**	**69**	**16**	**2.6**
Bearded seal	36	7	7	11	30	18	7,514	56	13	2.1
Unknown seal	43	1	0	7	43	0	0	0	0	0.0
Bowhead	40	1	0	8	40	0	0	0	0	0.0
Belukha	20	1	0	2	20	0	0	0	0	0.0
Ringed seal	10	2	2	5	7	10	547	4	1	0.2

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Migratory Birds (Moderate Resource Importance)	**83**	**54**	**65**	**35**	**53**	**5,615**	**8,178**	**64**	**14**	**2.0**
Unknown Canada geese	64	41	21	23	34	207	707	5	1	0.4
Mallard	47	33	45	13	19	607	1,183	9	2	0.2
Northern pintail	46	31	36	17	18	458	714	6	1	0.2
White-fronted geese	31	25	42	13	10	304	1,290	10	2	0.3
Brant	33	23	25	7	17	177	404	3	1	0.1
American wigeon	31	23	22	16	8	318	418	3	1	0.1
Snow geese	19	14	8	7	8	110	442	3	1	0.2
Scaup	19	13	13	7	6	149	249	2	0	0.1
Black scoter	18	10	19	4	10	260	457	4	1	0.1
Northern shoveler	10	7	10	2	4	74	80	1	0	0.0
Tundra swan (whistling)	10	6	11	0	4	25	284	2	0	0.1
Green-winged teal	10	6	4	1	4	48	25	0	0	0.0
Unknown geese	6	5	2	1	2	41	137	1	0	0.1
Unknown ducks	7	5	1	1	5	41	62	0	0	0.0
Long-tailed duck (oldsquaw)	8	5	18	1	4	254	374	3	1	0.0
Vegetation (High Resource Importance)	**90**	**86**	**86**	**40**	**54**	**5,837**	**5,837**	**43**	**10**	**1.7**
Salmonberry	78	64	64	17	36	576	2,303	17	4	0.7
Blueberry	86	73	73	25	31	407	1,628	12	3	0.5
Low bush cranberry	55	41	41	14	28	238	952	7	2	0.3
Other wood	36	33	33	11	12	136	0	0	0	0.0
Sourdock	28	23	22	4	8	189	189	1	0	0.1
Stinkweed	18	17	17	4	2	77	77	1	0	0.0
Hudson Bay tea	19	17	17	5	5	30	30	0	0	0.0
Wild rhubarb	20	16	16	6	5	214	214	2	0	0.1
Crowberry	17	12	12	0	7	32	129	1	0	0.0
Eskimo potato	12	8	8	1	4	63	254	2	0	0.1
Willow leaves	8	6	6	2	2	10	10	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Small Land Mammals (Low Resource Importance)	**24**	**20**	**16**	**9**	**10**	**1,409**	**1,244**	**9**	**2**	**1.1**
Beaver	21	16	13	6	8	80	992	7	2	0.6
Snowshoe hare	37	27	27	16	14	450	1,008	7	2	0.3
Muskrat	12	11	10	7	2	187	246	2	0	0.1
Land otter	8	8	8	4	0	33	20	0	0	0.0
Wolf	5	7	3	0	1	56	0	0	0	0.0
Upland Game Birds (Moderate Resource Importance)	**37**	**29**	**26**	**13**	**12**	**784**	**781**	**6**	**1**	**0.1**
Unknown ptarmigan	33	27	25	13	10	435	435	3	1	0.1
unknown grouse	12	6	6	2	6	28	19	0	0	0.0
Bird Eggs (Low Resource Importance)	**20**	**20**	**11**	**6**	**5**	**391**	**252**	**2**	**0**	**0.1**
Unknown duck eggs	11	11	8	4	4	189	28	0	0	0.0
Unknown gull eggs	6	7	3	4	1	280	84	1	0	0.0
Unknown geese eggs	7	7	3	2	2	31	8	0	0	0.0
Marine Invertebrates (Low Resource Importance)	**7**	**1**	**1**	**0**	**7**	**10**	**10**	**0**	**0**	**0.0**
King crab	5	0	0	0	5	0	0	0	0	0.0

Sources: (Georgette 2000); (ADF&G 2019); (Braem 2012b); (Braem et al. 2017); (Braem et al. 2018)

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-21
Harvest Characteristics of Selawik

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**99**	**91**	**91**	**89**	**97**	**456,493**	**456,493**	**2,701**	**533**	**100.0**
Non-Salmon Fish (High Resource Importance)	**79**	**64**	**62**	**53**	**57**	**176,422**	**182,318**	**1,063**	**227**	**67.9**
Broad whitefish	71	53	48	40	51	10,495	87,306	510	111	20.4
Sheefish	72	56	53	39	42	6,011	43,712	256	55	15.1
Northern pike	63	51	46	34	31	11,779	38,872	225	48	11.5
Humpback whitefish	31	21	19	16	20	8,515	16,930	98	21	5.2
Burbot	35	29	24	17	16	712	2,992	17	4	1.0
Least cisco	17	14	13	11	9	4,629	3,117	18	4	0.9
Grayling	18	12	12	9	5	815	734	4	1	0.2
Dolly Varden	18	9	4	7	14	19	62	0	0	0.0
Round whitefish	7	6	5	6	4	1,887	1,682	10	2	0.4
Saffron cod	19	0	0	4	19	0	0	0	0	0.0
Smelt	9	1	1	7	8	150	561	3	1	0.1
Herring	7	0	0	1	7	0	0	0	0	0.0
Large Land Mammals (High Resource Importance)	**97**	**68**	**62**	**69**	**87**	**38,968**	**158,979**	**977**	**210**	**25.1**
Caribou	97	68	59	59	80	809	110,033	653	137	20.4
Moose	65	36	25	36	53	50	26,775	164	35	4.7
Black bear	9	9	2	3	6	4	339	2	0	0.1
Migratory Birds (Moderate Resource Importance)	**62**	**44**	**51**	**41**	**41**	**5,559**	**7,250**	**46**	**10**	**2.7**
Lesser Canada geese (taverner/parvipes)	52	34	20	23	34	509	2,024	13	3	0.7
White-fronted geese	34	25	15	20	17	372	1,577	10	2	0.7
Mallard	41	34	29	21	20	358	698	4	1	0.2
Black scoter	31	30	23	23	7	303	520	3	1	0.2
Northern pintail	29	22	20	18	13	270	422	3	1	0.1
Wigeon	17	15	11	7	12	423	554	3	1	0.1
Snow geese	10	8	2	6	4	30	117	1	0	0.1
Teal	5	8	4	2	3	311	162	1	0	0.0
Northern shoveler	7	8	13	6	2	184	200	1	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
White-winged scoter	6	7	1	3	2	105	240	1	0	0.2
Brant	8	6	5	6	3	107	244	2	0	0.1
Long-tailed duck (oldsquaw)	3	5	2	3	0	90	121	1	0	0.1
Cacklers	8	5	10	8	4	129	302	2	0	0.1
Surf scoter	3	5	5	3	0	81	129	1	0	0.1
Salmon (Moderate Resource Importance)	**47**	**12**	**10**	**17**	**45**	**6,478**	**5,475**	**31**	**7**	**1.4**
Chum salmon	37	10	8	14	35	797	4,858	28	6	1.2
Sockeye salmon	5	1	1	2	4	59	292	2	0	0.2
Unknown salmon	5	1	1	2	5	19	111	1	0	0.1
Pink salmon	3	1	1	0	3	46	113	1	0	0.0
Chinook salmon	3	1	1	0	3	8	69	0	0	0.0
Vegetation (High Resource Importance)	**95**	**80**	**80**	**58**	**53**	**6,397**	**6,397**	**38**	**7**	**1.4**
Salmonberry	71	60	55	31	25	512	1,910	11	2	0.4
Blueberry	74	59	57	31	34	484	1,899	11	2	0.4
Low bush cranberry	43	35	35	22	18	325	1,289	8	2	0.3
Wood	32	30	29	12	14	232	0	0	0	0.0
Stinkweed	26	19	19	10	10	591	591	3	1	0.1
Wild rhubarb	15	12	12	9	4	91	331	2	0	0.1
Hudson Bay tea	13	11	9	3	2	23	23	0	0	0.0
Blackberry	17	10	8	3	10	36	142	1	0	0.0
Sourdock	10	8	8	3	3	88	88	1	0	0.0
Wild celery	9	8	6	2	1	25	25	0	0	0.0
Eskimo potato	6	7	4	4	0	7	30	0	0	0.0
Marine Mammals (High Resource Importance)	**75**	**10**	**3**	**30**	**75**	**3,510**	**3,510**	**21**	**4**	**0.8**
Bearded seal	26	4	2	11	24	7	3,143	19	4	0.7
Unknown seal	73	2	0	25	73	0	0	0	0	0.0
Bowhead	46	0	0	13	46	0	0	0	0	0.0
Belukha	29	0	0	10	29	0	0	0	0	0.0
Walrus	7	0	0	2	7	0	0	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Small Land Mammals (Low Resource Importance)	**26**	**19**	**18**	**14**	**9**	**496**	**1,202**	**7**	**1**	**0.3**
Beaver	26	20	9	9	9	116	1,548	9	2	0.2
Snowshoe hare	14	13	13	12	4	205	304	2	0	0.1
Muskrat	13	11	11	8	3	203	207	1	0	0.0
Land otter	10	10	8	4	2	22	0	0	0	0.0
Wolf	16	7	2	3	10	18	0	0	0	0.0
Wolverine	7	3	6	1	6	3	0	0	0	0.0
Upland Game Birds (Moderate Resource Importance)	**36**	**30**	**28**	**24**	**17**	**917**	**917**	**6**	**1**	**0.3**
Ptarmigan	36	30	27	24	17	1,424	1,424	8	2	0.3
Bird Eggs (Low Resource Importance)	**7**	**6**	**5**	**3**	**3**	**46**	**28**	**0**	**0**	**0.0**
Duck eggs	10	9	9	4	1	237	36	0	0	0.0
Marine Invertebrates (Low Resource Importance)	**7**	**2**	**2**	**0**	**7**	**3**	**3**	**0**	**0**	**0.0**

Sources: (Wolfe and Paige 2002); (ADF&G 2019); (Braem et al. 2013); (Braem et al. 2018)

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-22
Harvest Characteristics of Shungnak

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
All Resources	**100**	**100**	**100**	**83**	**98**	**66,139**	**126,376**	**2,137**	**489**	**100.0**
Large Land Mammals (High Resource Importance)	**97**	**68**	**65**	**50**	**71**	**14,478**	**66,672**	**1,174**	**263**	**48.0**
Caribou	97	66	64	48	60	441	60,044	1,055	237	44.7
Moose	57	27	19	16	41	12	6,302	113	25	3.1
Black bear	18	10	5	2	14	3	243	4	1	0.2
Brown Bear	9	7	3	2	7	1	83	2	0	0.0
Non-Salmon Fish (High Resource Importance)	**87**	**69**	**69**	**48**	**72**	**24,515**	**52,685**	**865**	**200**	**32.0**
Humpback whitefish	37	29	28	19	22	7,367	15,470	270	60	14.0
Sheefish	86	66	66	30	54	2,901	29,096	468	109	7.3
Broad whitefish	44	28	25	14	32	2,747	8,789	144	34	3.2
Least cisco	7	7	4	4	2	1,125	1,125	16	4	1.1
Dolly Varden	29	27	25	7	10	114	375	6	1	0.3
Arctic grayling	28	26	26	7	11	613	552	9	2	–
Burbot	24	16	14	7	13	55	232	4	1	0.3
Grayling	29	24	24	11	12	421	378	6	1	0.3
Northern pike	15	12	12	1	4	65	213	3	1	0.1
Sucker	10	10	8	2	4	86	60	1	0	0.0
Round whitefish	8	6	3	3	6	69	49	1	0	0.0
Unknown whitefish	3	4	1	1	1	3	6	0	0	0.0
Salmon (High Resource Importance)	**81**	**54**	**51**	**32**	**62**	**9,632**	**28,340**	**456**	**106**	**15.2**
Chum salmon	78	52	50	30	58	4,691	28,070	452	105	14.8
Sockeye salmon	6	2	1	3	5	23	136	2	0	0.3
Chinook salmon	4	1	0	1	4	0	0	0	0	0.0
Migratory Birds (High Resource Importance)	**70**	**47**	**47**	**31**	**51**	**1,698**	**2,877**	**50**	**11**	**1.9**
White-fronted geese	38	28	31	20	25	184	782	13	3	0.6
Canada geese	54	39	36	24	35	192	658	11	3	0.5
Northern pintail	37	26	26	16	20	172	269	5	1	0.1
Long-tailed duck (oldsquaw)	30	22	21		17	136	182	3	1	0.1

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Mallard	39	25	26	16	23	104	202	3	1	0.2
Scoter	25	24	20	12	14	58	98	2	0	0.1
American wigeon	18	18	14	8	4	90	119	2	0	0.0
Scaup	9	9	9	9	0	113	189	3	1	0.1
Black scoter	11	9	16	7	4	105	185	3	1	0.1
Unknown ducks	10	6	4	5	5	22	39	1	0	0.0
Snow geese	6	5	4	2	2	8	31	1	0	0.0
Unknown geese	5	4	2	4	2	10	0	0	0	0.0
Northern shoveler	4	3	3	1	1	14	15	0	0	0.0
Vegetation (High Resource Importance)	**96**	**94**	**85**	**46**	**42**	**987**	**1,983**	**34**	**8**	**1.5**
Berries	94	84	84	33	31	365	2,374	44	10	1.6
Blueberry	87	76	76	37	26	187	747	11	3	0.7
Low bush cranberry	52	41	41	26	22	97	388	6	1	0.3
Other wood	37	37	37	9	4	0	0	0	0	0.0
Salmonberry	30	26	26	15	11	31	123	2	0	0.1
Roots	33	20	18	8	18	25	102	2	0	0.1
Plants/greens/mushrooms	25	18	16	6	12	53	53	1	0	0.0
Stinkweed	17	13	13	9	7	11	11	0	0	0.0
Wild rhubarb	11	9	9	7	4	33	114	2	0	0.1
Eskimo potato	7	7	7	2	2	2	7	0	0	0.0
Small Land Mammals (Moderate Resource Importance)	**47**	**35**	**29**	**20**	**22**	**353**	**592**	**10**	**2**	**0.9**
Beaver	39	30	28	18	15	53	688	11	3	0.9
Porcupine	17	13	10	4	8	7	55	1	0	0.0
Wolf	13	12	9	3	5	14	0	0	0	0.0
Wolverine	4	5	2	0	2	1	0	0	0	0.0
Muskrat	14	8	6	5	6	23	23	0	0	0.0
Snowshoe hare	10	6	6	3	6	24	74	1	0	0.0
Land otter	2	4	1	0	1	1	0	0	0	0.0

Resource	Percentage of Households					Estimated Harvest				Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Numbers[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
Upland Game Birds (Low Resource Importance)	**43**	**29**	**30**	**17**	**24**	**284**	**279**	**5**	**1**	**0.1**
Willow ptarmigan	47	39	34	16	27	343	343	6	1	0.2
Ptarmigan	35	20	17	17	20	141	141	2	1	0.1
Spruce grouse	12	10	10	2	8	14	0	0	0	0.0
Grouse	9	7	3	2	2	8	6	0	0	0.0
Marine Mammals (High Resource Importance)	**71**	**2**	**1**	**15**	**71**	**1**	**187**	**3**	**1**	**0.1**
Unknown seal	67	0	0	4	67	0	0	0	0	0.0
Bearded seal	41	1	1	10	40	1	187	3	1	0.1
Bowhead	45	1	0	6	45	0	0	0	0	0.0
Belukha	11	0	0	3	10	0	0	0	0	0.0
Ringed seal	5	0	0	1	4	0	0	0	0	0.0

Sources: (Wolfe and Paige 1995); (ADF&G 2019); (Magdanz et al. 2004); (Braem et al. 2015); (Braem et al. 2018)

– = no data

[1]Estimated numbers typically represent individuals except in some cases, such as vegetation, where numbers may represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources that community residents do not typically eat, such as furbearers.

Table T-23
Harvest Characteristics of Additional Caribou Study Communities

Community	Percentage of Households					Estimated Harvest				
	Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	Percent of Total Harvest
Allakaket	72	38	15	21	52	32	4,129	80	22	4.2
Ambler	88	74	69	56	51	489	66,473	937	255	54.6
Anaktuvuk Pass	92	61	49	49	68	514	65,678	784	222	86.2
Atqasuk	96	70	65	71	65	260	42,903	719	187	64.0
Bettles	62	29	18	32	32	11	1,387	106	38	14.1
Brevig Mission (pending data compilation)	47	17	11	16	40	46	6,261	93	24	0.0
Buckland	84	71	68	57	58	622	84,558	915	186	38.3
Deering	88	52	46	51	68	243	32,989	738	241	42.1
Elim	92	63	51	56	77	153	20,844	276	70	–
Fairbanks (no harvest data)	–	–	–	–	–	–	–	–	–	–
Galena	13	5	4	4	10	18	2,801	15	5	1.1
Golovin	79	30	21	22	67	57	7,707	161	32	10.3
Hughes	31	27	6	4	18	10	1,360	40	15	4.2
Huslia	75	40	33	23	38	107	13,880	182	60	3.3
Kaltag	14	6	5	5	10	6	795	13	3	-
Kiana	89	70	66	53	65	403	54,755	559	144	31.
Kivalina	90	69	56	57	70	412	57,326	1,550	251	25.7
Kobuk	89	78	66	57	63	154	20,976	655	147	31.8
Kotlik	-	-	7	-	-	8	1,600	29	4	-
Kotzebue	86	49	42	47	64	2,094	284,711	353	90	25.7
Koyuk	94	66	56	52	64	292	39,742	474	118	40.0
Koyukuk (no harvest data)	–	–	–	–	–	–	–	–	–	–
Noatak	88	66	60	54	67	416	44,761	12,355	124	39.6
Nome	–	–	–	–	–	–	–	–	–	–
Noorvik	95	67	67	48	60	869	118,140	818	184	32.8
Nuiqsut	96	72	67	71	74	507	64,796	688	157	45.4
Nulato	5	3	3	2	3	4	552	7	2	0.0
Point Hope	91	53	30	51	80	185	25,156	143	34	7.6
Point Lay	94	66	66	67	75	223	29,501	494	149	25.5
Selawik	97	65	59	67	82	969	131,801	810	174	20.4
Shaktoolik	84	54	51	43	67	156	21,196	361	93	–

Community	Percentage of Households					Estimated Harvest				
	Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	Percent of Total Harvest
Shishmaref	75	38	35	44	59	333	45,237	335	80	13.7
Shungnak	97	66	64	48	60	441	60,044	1,055	237	44.7
St. Michael	68	29	18	16	57	33	4,413	47	10	–
Stebbins	7	5	1	2	5	9	1,161	9	2	0.9
Teller	34	4	3	3	32	11	2,823	20	6	–
Unalakleet	83	42	37	32	64	481	65,468	317	93	–
Utqiagvik	70	28	33	38	52	2,232	298,449	244	70	35.9
Wainwright	97	67	61	62	84	852	104,447	764	200	28.4
Wales	19	3	1	5	19	1	162	3	1	0.4
White Mountain	75	41	33	32	56	81	10,985	168	54	55.8
Wiseman	80	80	60	60	20	7	890	104	40	20.9
All Communities	72	46	38	39	53	352	47,201	703	98	26.5

Sources: See **Table T-2** and ADF&G 2019

– = no data

[1]Caribou uses of primary and peripheral study communities are addressed in **Table T-3** through **Table T-22**.

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T.2 MAPS

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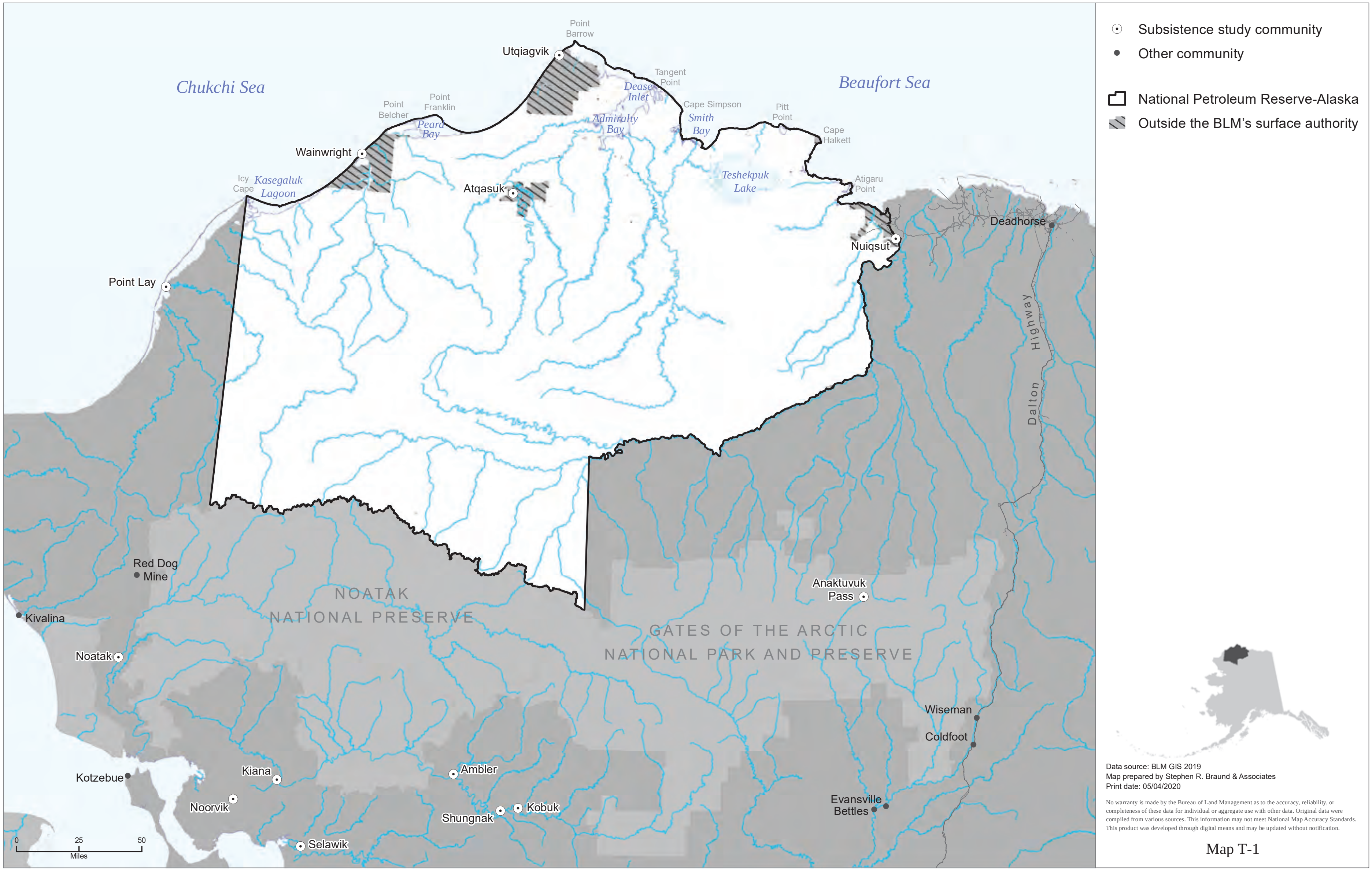
National Petroleum Reserve-Alaska EIS Subsistence Study Communities

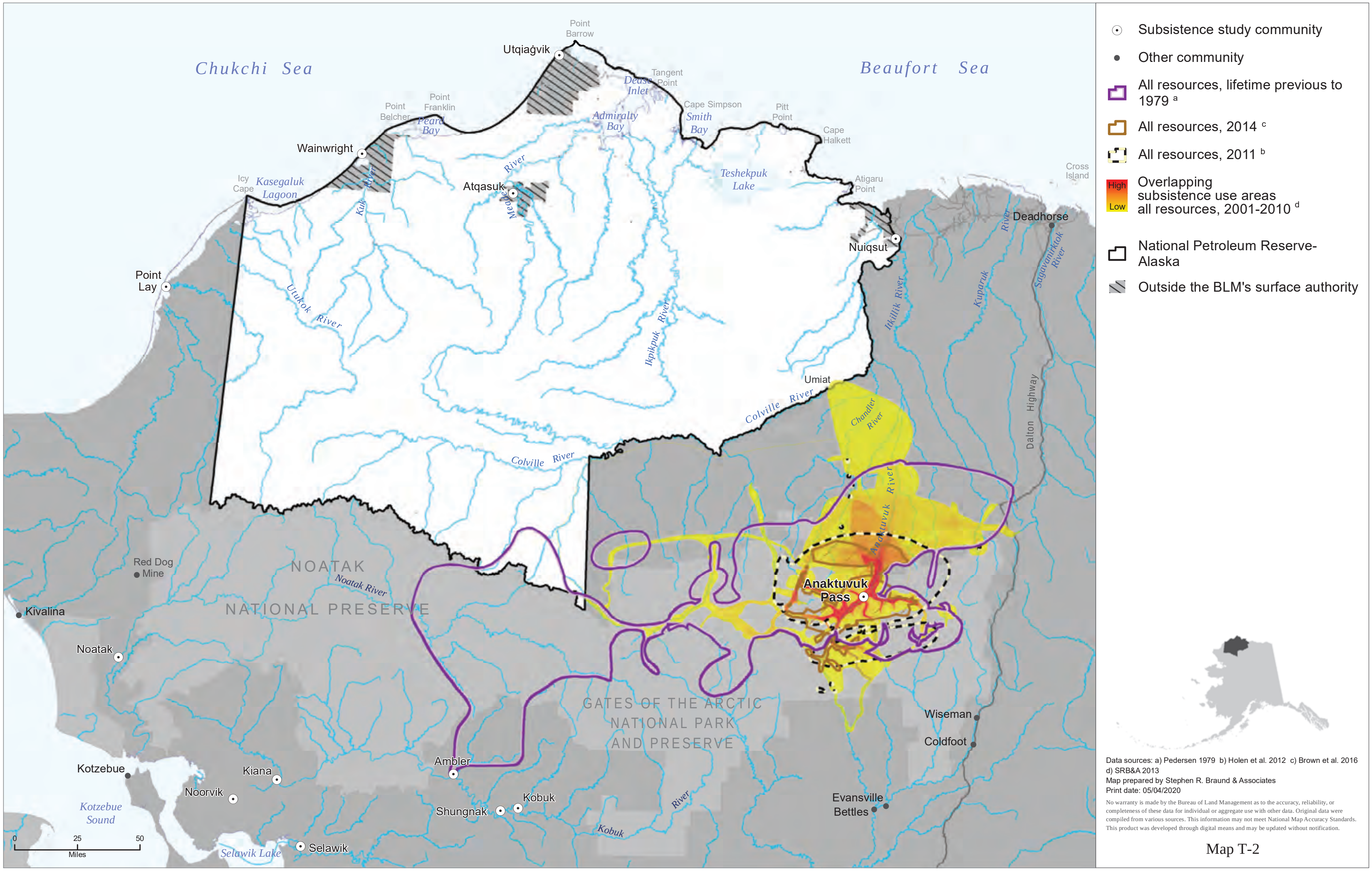


Data source: BLM GIS 2019
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

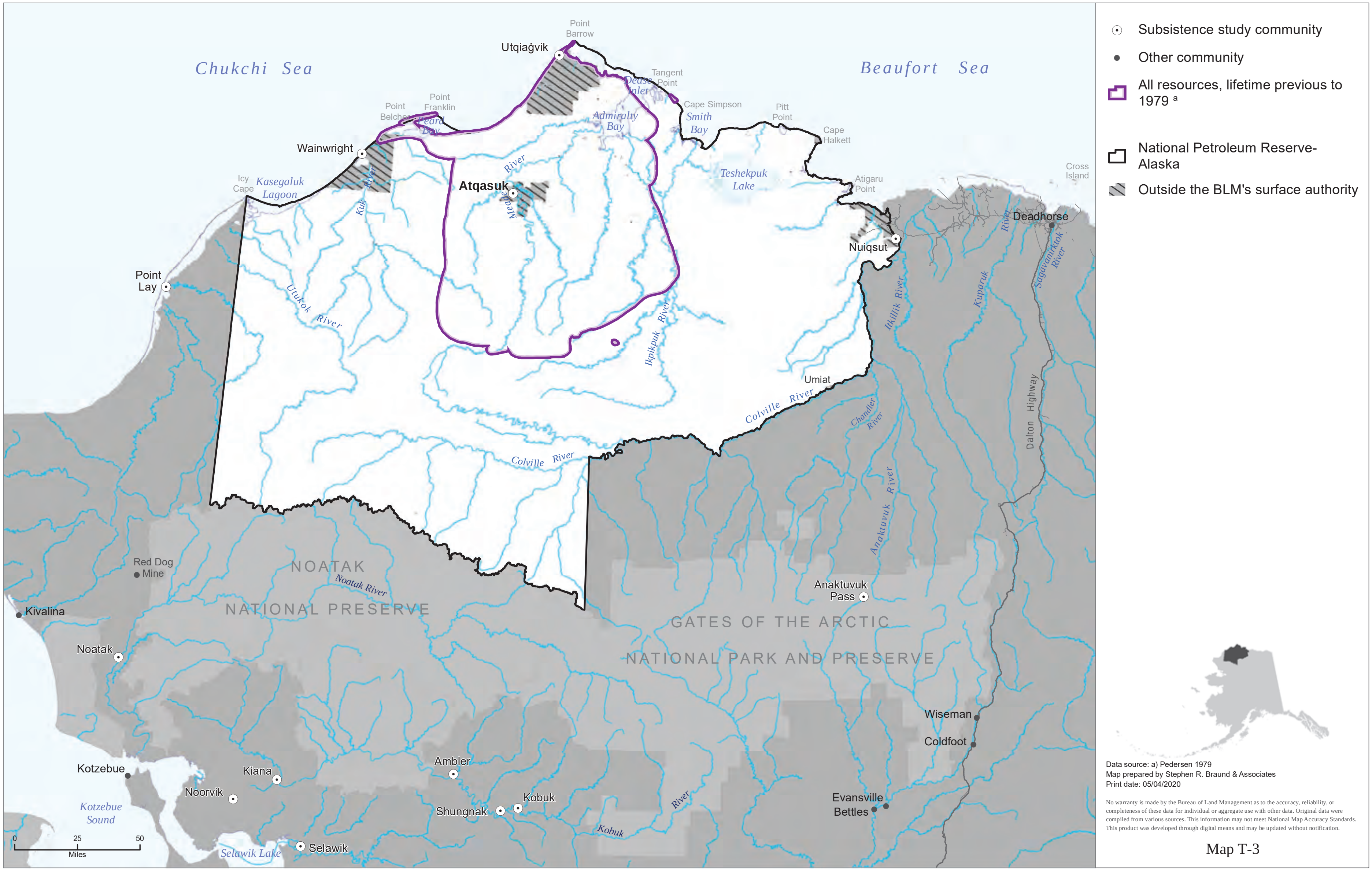
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map T-1

Anaktuvuk Pass Subsistence Use Areas, All Studies



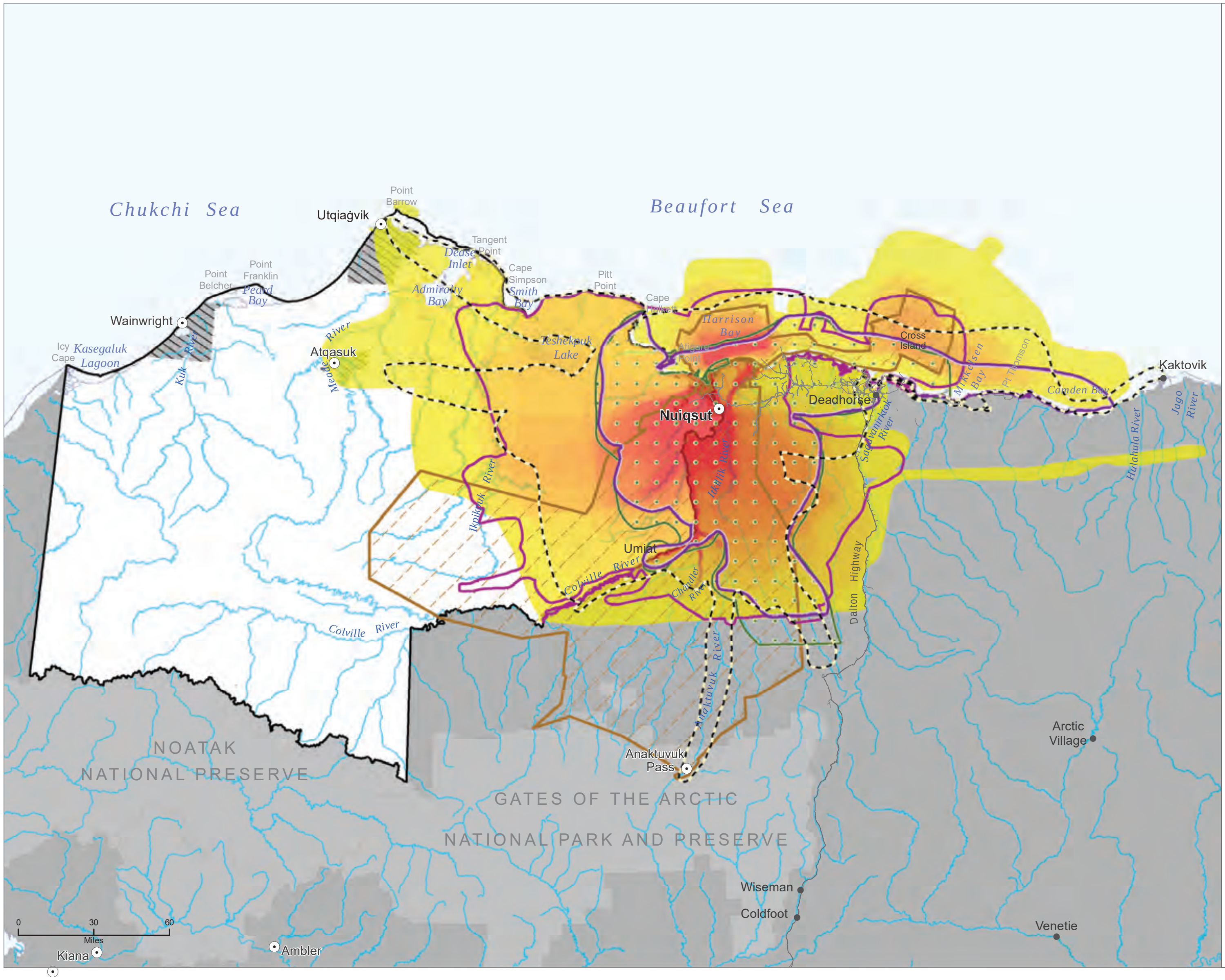
Map T-2



Data source: a) Pedersen 1979
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

Map T-3

Nuiqsut Subsistence Use Areas, All Studies



Subsistence study community

Other community

All resources, early 1970s [a]

All resources, lifetime previous to 1979 [b]

All resources, 1973-1986 [c]

All resources, 1994-2003 [d]

All resources, 2014 [e]

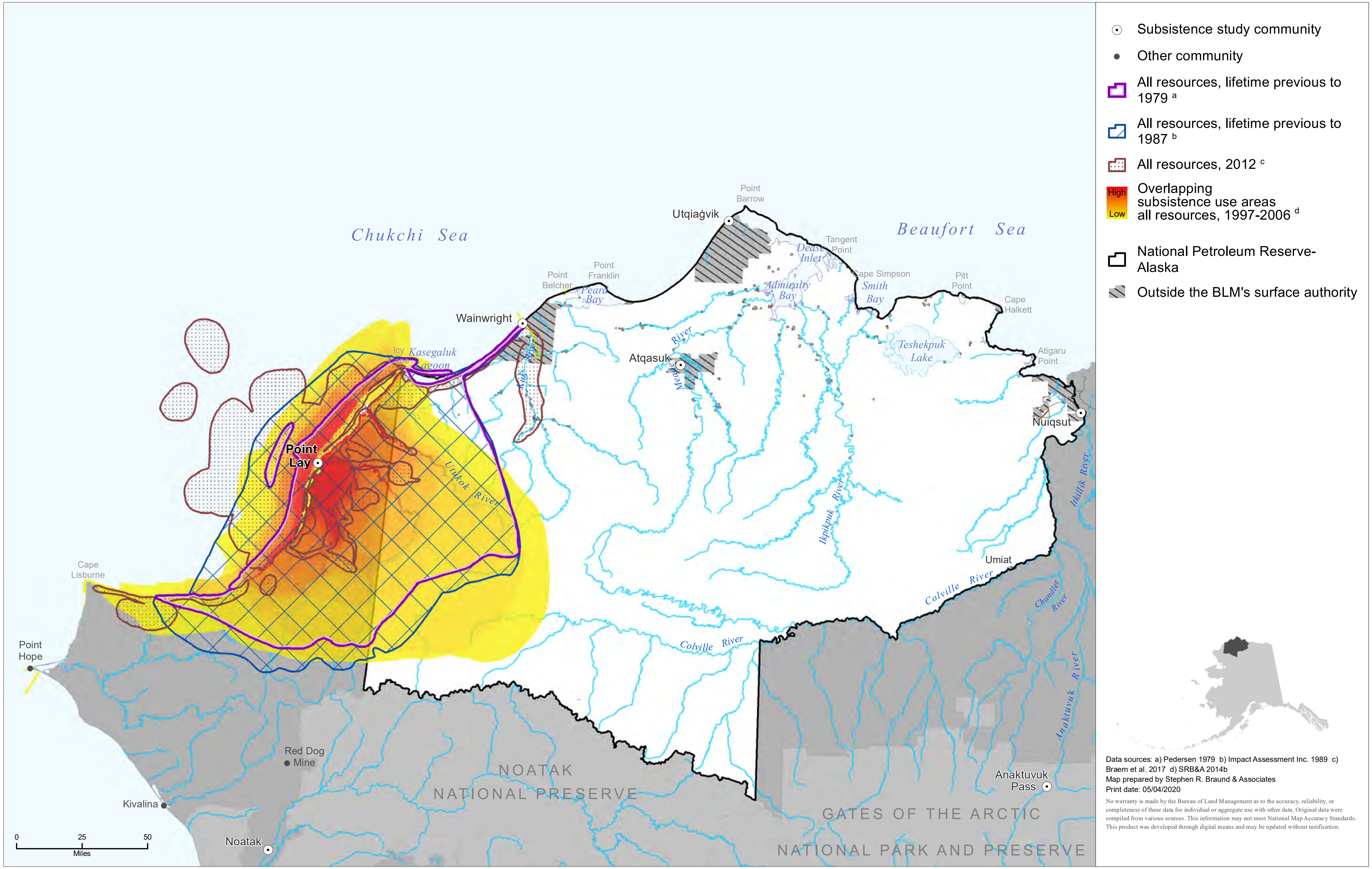
High / Low Overlapping subsistence use areas all resources, 1995-2006 [f]

National Petroleum Reserve-Alaska

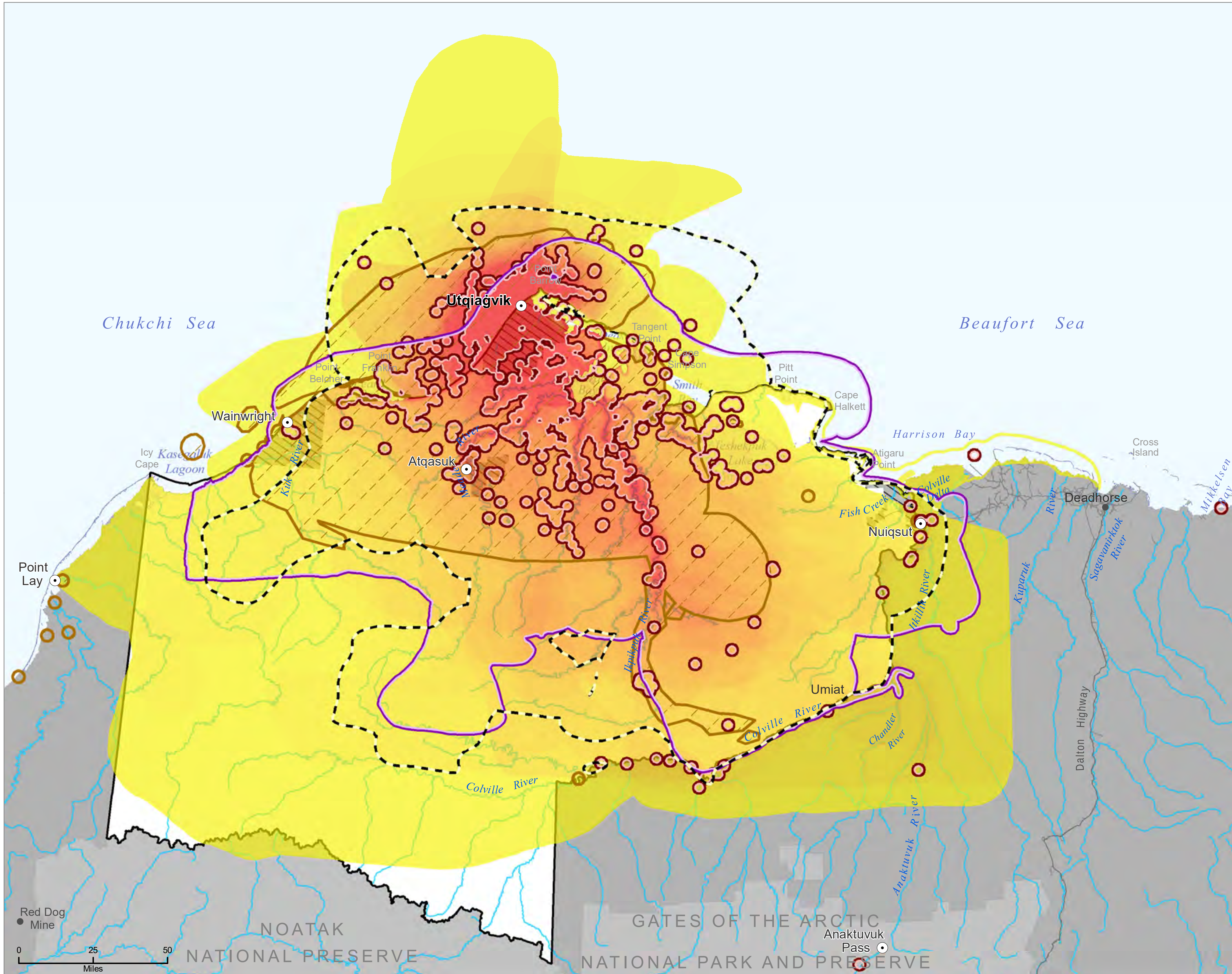
Outside the BLM's surface authority

Data sources: a) Brown 1979 b) Pedersen 1979 c) Pedersen 1986 d) BLM 2004 e) Brown et al. 2016 f) SRB&A 2010a
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

Map T-4

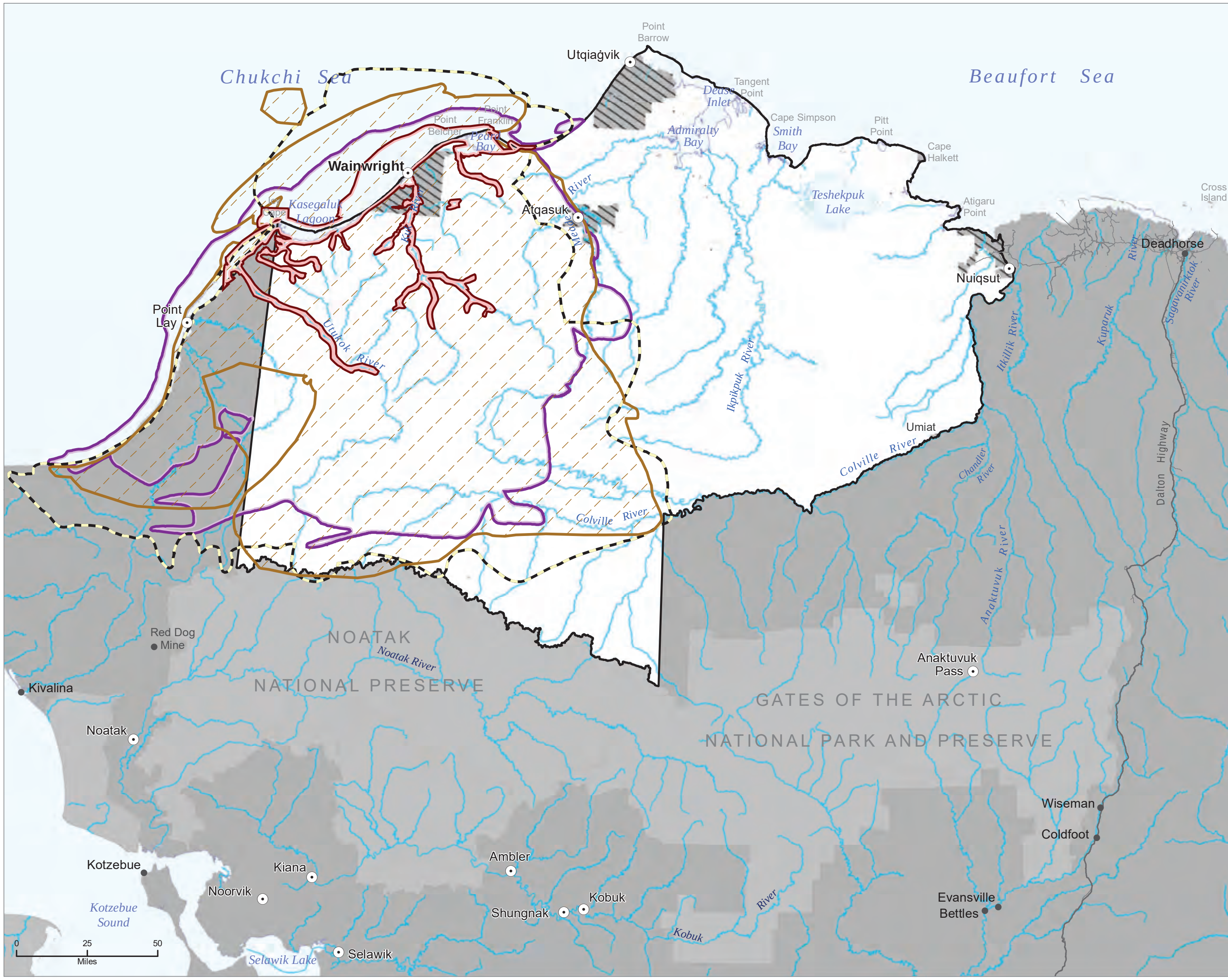


Data sources: a) Pedersen 1979 b) Impact Assessment Inc. 1989 c) Braem et al. 2017 d) SRB&A 2014b
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020



Subsistence study community
Other Community
All resources, lifetime Previous to 1979 [a]
All resource harvest sites buffered, 1987-1989 [b]
All resources, 1987-1989 [c]
All resources, 2014 [d]
High
Low
Overlapping subsistence use areas all resources, 1997-2006 [e]
National Petroleum Reserve-Alaska
Outside the BLM's surface authority

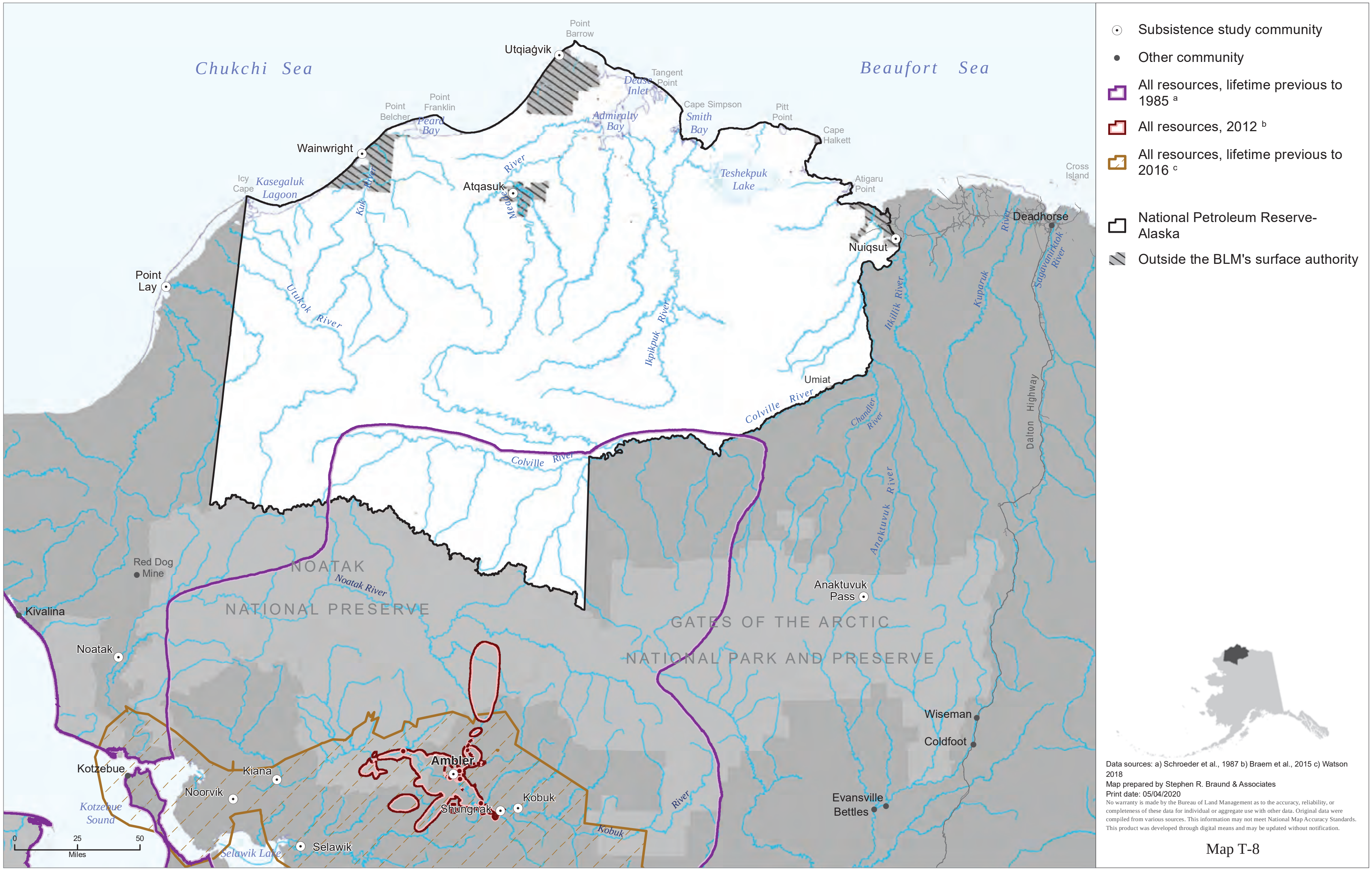
Data sources: a) Pedersen 1979 b) SRB&A and ISER 1989 c) SRB&A Unpublished d) Brown et al. 2016 e) SRB&A 2010a
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020



- Subsistence study community
- Other community
- All resources, lifetime previous to 1979 [a]
- All resources, 1987-1989 [b]
- All resources, lifetime previous to 1982 [c]
- All resources, 1998-2007 [d]
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Pedersen 1979 b) SRB&A Unpublished
c) Nelson 1981 d) Wainwright Traditional Council and The Nature Conservancy 2008
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

Map T-7


Chukchi Sea
Beaufort Sea
Point Barrow
Utqiaġvik
Tangent Point
Dease Inlet
Admiralty Bay
Cape Simpson
Smith Bay
Pitt Point
Cape Halkett
Point Franklin
Point Belcher
Peard Bay
Wainwright
Icy Cape
Kasegaluk Lagoon
Atqasuk
Teshekpuk Lake
Atigaru Point
Cross Island
Deadhorse
Nuiqsut
Point Lay
Utukok River
Ikpikpuk River
Umiat
Colville River
Chandler River
Anaktuvuk River
Itkillik River
Kuparuk River
Sagavanirktok River
Dalton Highway
Red Dog Mine
Kivalina
Noatak
NOATAK NATIONAL PRESERVE
Noatak River
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
Anaktuvuk Pass
Wiseman
Coldfoot
Evansville
Bettles
Kotzebue
Kotzebue Sound
Noorvik
Kiana
Ambler
Shungnak
Kobuk
Selawik
Selawik Lake
0 25 50 Miles
Subsistence study community
Other community
All resources, lifetime previous to 1985 a
All resources, 2012 b
All resources, lifetime previous to 2016 c
National Petroleum Reserve-Alaska
Outside the BLM's surface authority
Data sources: a) Schroeder et al., 1987 b) Braem et al., 2015 c) Watson 2018
Map prepared by Stephen R. Braund & Associates
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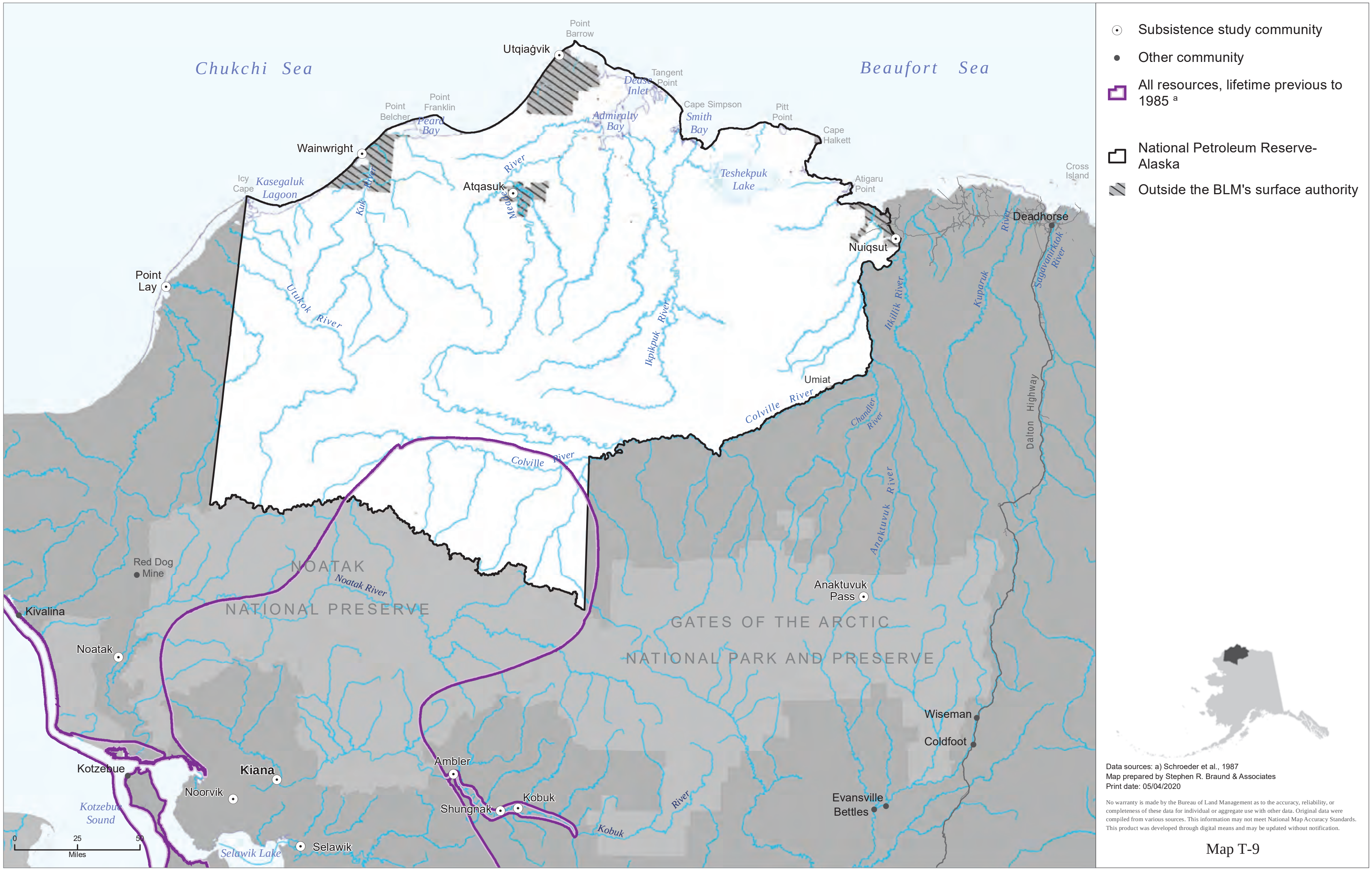
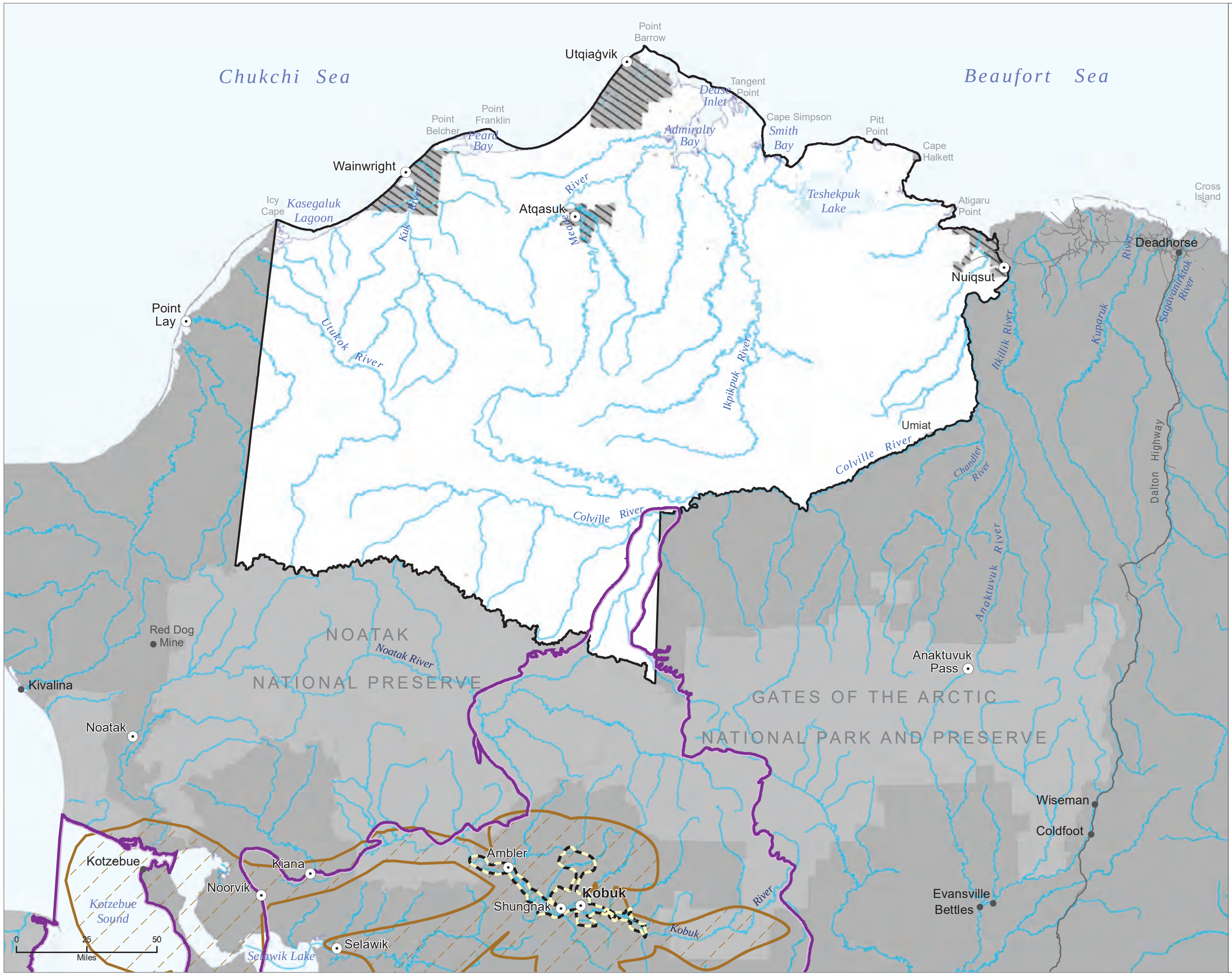
Map T-8

Kiana Subsistence Use Areas, All Studies



Map T-9



Subsistence study community

Other community

All resources, lifetime previous to 1985 [a]

All resources, 2012 [b]

All resources, lifetime previous to 2016 [c]

National Petroleum Reserve-Alaska

Outside the BLM's surface authority

Data sources: a) Schroeder et al., 1987 b) Braem et al., 2015 c) Watson 2018

Map prepared by Stephen R. Braund & Associates

Print date: 05/04/2020

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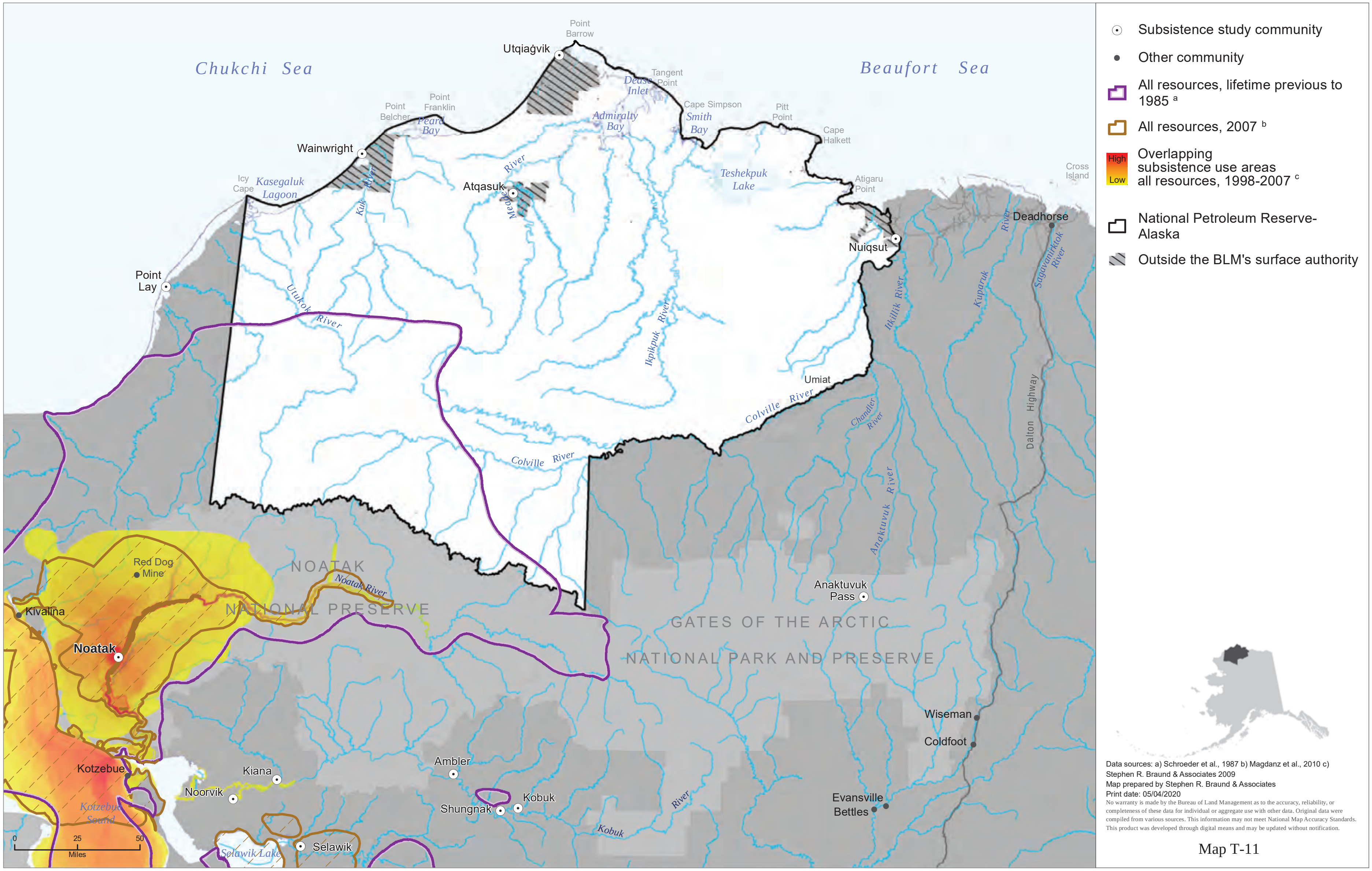
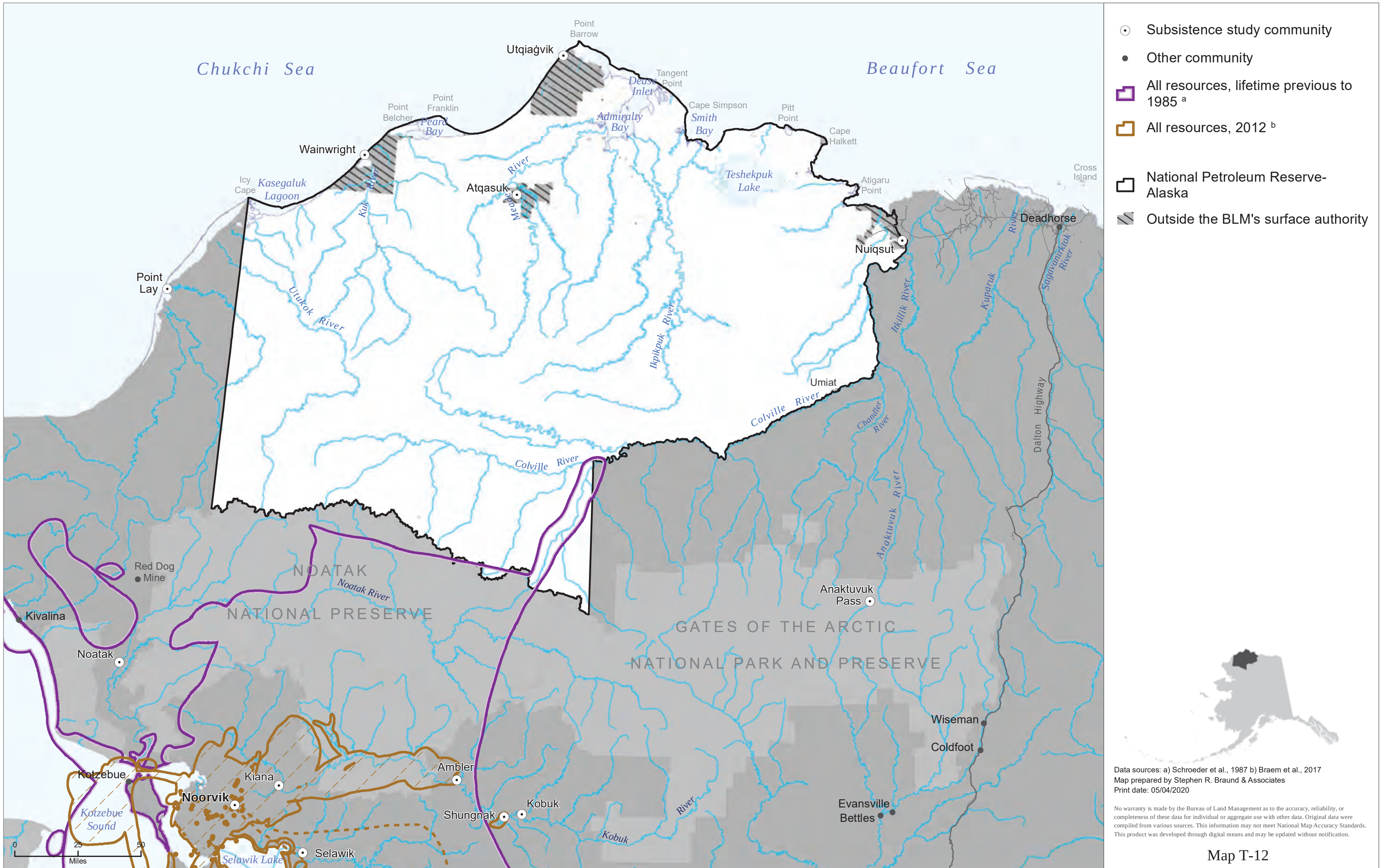
Map T-10



Data sources: a) Schroeder et al., 1987 b) Magdanz et al., 2010 c) Stephen R. Braund & Associates 2009
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

Map T-11

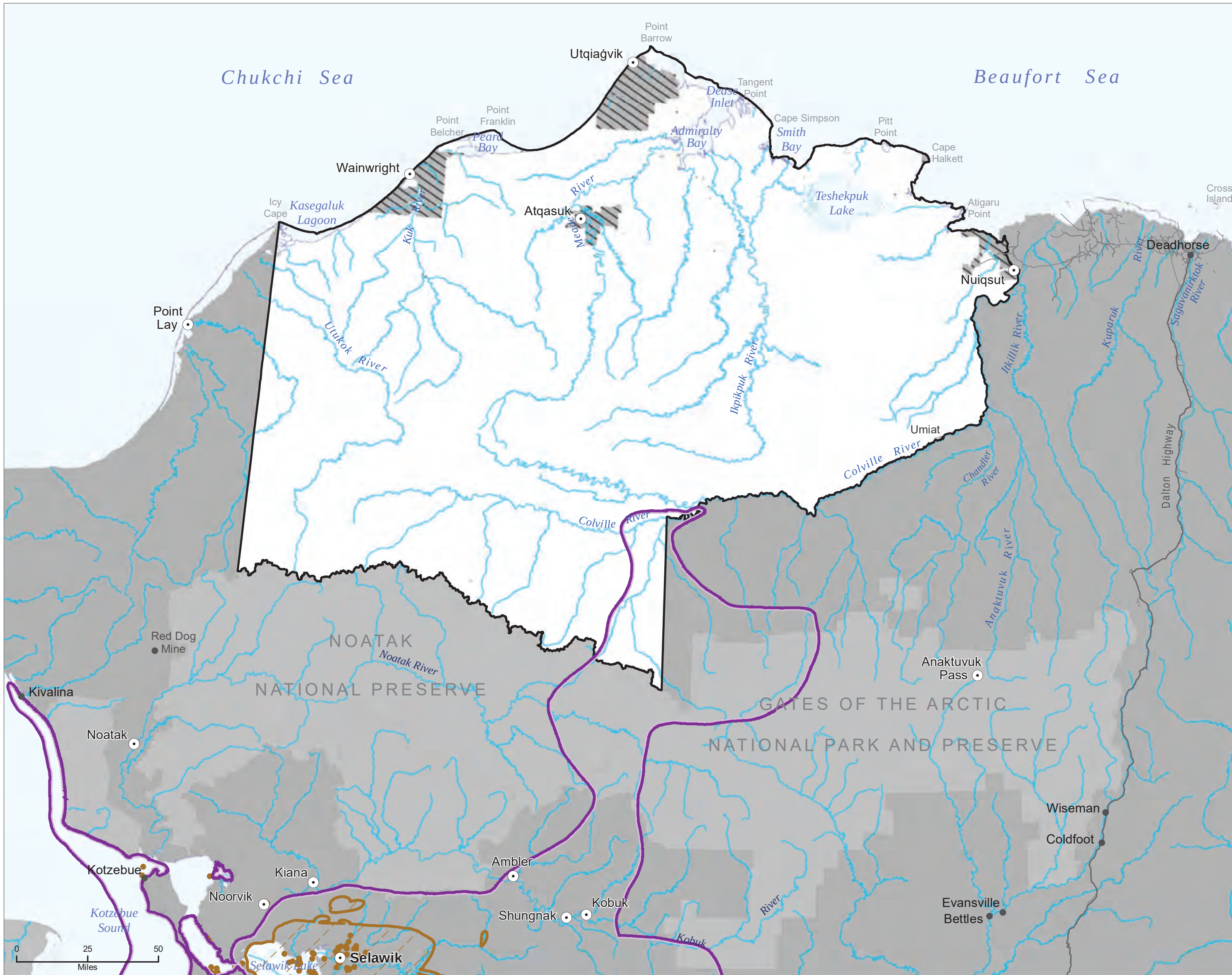


Data sources: a) Schroeder et al., 1987 b) Braem et al., 2017
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map T-12

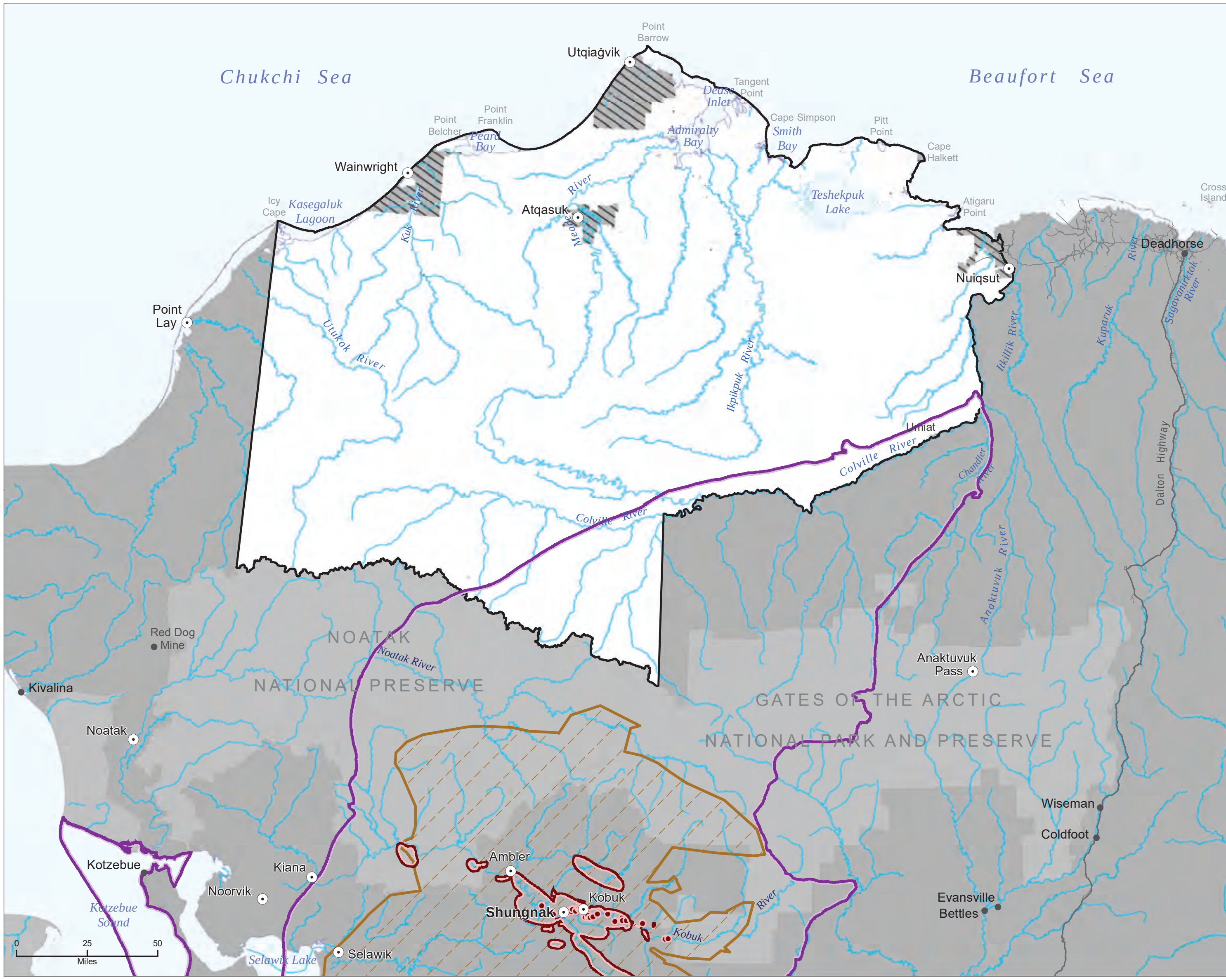
Selawik Subsistence Use Areas, All Studies



- Subsistence study community
- Other community
- All resources, lifetime previous to 1985 [a]
- All resources, 2010-2011 [b]
- National Petroleum Reserve-Alaska
- Outside the BLM's surface authority

Data sources: a) Schroeder et al., 1987 b) Braem et al., 2013
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020

Map T-13



Subsistence study community
Other community
All resources, lifetime previous to 1985 [a]
All resources, 2012 [b]
All resources, lifetime previous to 2016 [c]
National Petroleum Reserve-Alaska
Outside the BLM's surface authority

Data sources: a) Schroeder et al., 1987 b) Braem et al., 2015 c) Watson 2018
Map prepared by Stephen R. Braund & Associates
Print date: 05/04/2020
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.

Map T-14

T.3 REFERENCES

Adams, L. G., R. O. Stephenson, B. W. Dale, R. T. Ahgook, and D. J. Demma. 2008. Population Dynamics and Harvest Characteristics of Wolves in the Central Brooks Range, Alaska.

ADF&G, (Alaska Department of Fish and Game). 2019. "Community Subsistence Information System: Csis. Harvest by Community.", Accessed May 2018. https://www.adfg.alaska.gov/sb/CSIS/index.cfm?ADFG=harvInfo.harvestCommSelComm.

Alaska Consultants Inc., Clyde S. Courtnage, and Stephen R. Braund & Associates. 1984. Barrow Arch Socioeconomic and Sociocultural Description. Technical Report No. 101. Prepared for Minerals Management Service, Alaska OCS Region, Social and Economic Studies Program. Anchorage, Alaska.

Andersen, D., C. Brown, R. Walker, and K. Elkin. 2004. Traditional Ecological Knowledge and Contemporary Subsistence Harvest of Non-Salmon Fish in the Koyukuk River Drainage, Alaska. Technical Paper No. 282. ADF&G, Division of Subsistence.

Andersen, David B., and Gretchen Jennings. 2001. The 2000 Harvest of Migratory Birds in Ten Upper Yukon River Communities, Alaska. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.subsistence.adfg.state.ak.us/TechPap/Tp268.pdf.

Anderson, Douglas D., Wanni Wibulswasdi Anderson, Ray Bane, Richard K. Nelson, and Nita Sheldon Towarak. 1998. Kuuvanmiit Subsistence: Traditional Eskimo Life in the Latter Twentieth Century. National Park Service, U.S. Dept. of the Interior. Washington, D.C.

Bacon, J., T. Hepa, H. Jr. Brower, M. Pederson, T. Olemaun, J. George, and B. Corrigan. 2009. Esimtates of Subsistence Harvest for Villages on the North Slope of Alaska, 1994-2003. North Slope Borough, Department of Wildlife Management. Barrow, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/MASTER20SHDP2094-0320REPORT20FINAL20and2020Errata20info20(Sept202012).pdf.

Bacon, J., T. Hepa, H. Jr. Brower, M. Pederson, T. Olemaun, J. George, and B. Corrigan. 2011. Esimtates of Subsistence Harvest for Villages on the North Slope of Alaska, 1994-2003. North Slope Borough, Department of Wildlife Management. Barrow, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/MASTER20SHDP2094-0320REPORT20FINAL20and2020Errata20info20(Sept202012).pdf.

BLM, (Bureau of Land Management). 2004. Alpine Satellite Development Plan: Final Environmental Impact Statement. U.S. Department of the Interior. Available online at https://purl.fdlp.gov/GPO/gpo84294.

Braem, Nicole M. 2012a. Subsistence Wildlife Harvests in Ambler, Buckland, Kiana, Kobuk, Shaktoolik, and Shishmaref, Alaska, 2009-2010. Special Publication No. SP2012-003. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/specialpubs/SP2_SP2012-003.pdf.

Braem, Nicole M. 2012b. Subsistence Wildlife Harvests in Noorvik, Shungnak, and White Mountain, Alaska, 2008-2009. Special Publication No. SP2011-003. Alaska Dept. of Fish and Game, Division of Subsistence,. Fairbanks, AK. Available online at http://library.state.ak.us/asp/edocs/2012/07/ocn798726160.pdf.

Braem, Nicole M., Patricia Fox, James S. Magdanz, and David Koster. 2013. Subsistence Harvests in Northwest Alaska : Selawik, 2010-2011. Technical Paper No. 389. Alaska Department of Fish and Game, Division of Subsistence,. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/techpap/TP389.pdf.

Braem, Nicole M., Anna R. Godduhn, Elizabeth Mikow, Andrew R. Brenner, Alida Trainor, Seth J. Wilson, and Marylynne L. Kostick. 2018. Key Subsistence Fisheries in Northwest Alaska, 2012-2014. Technical Paper No. 433. Alaska Department of Fish and Game Division of Subsistence. Fairbanks, Alaska. Available online at https://www.arlis.org/docs/vol1/O/1062605181.pdf.

Braem, Nicole M., Tina Kaleak, David Koster, Price Leavitt, Patsy Neakok, James Patkotak, Sverre Pedersen, and Jim Simon. 2011. Monitoring of Annual Caribou Harvests in the National Petroleum Reserve in Alaska: Atqasuk, Barrow, and Nuiqsut, 2003-2007. Technical Paper No. 361. Alaska Dept. of Fish and Game, Division of Subsistence. Fairbanks. Available online at http://library.state.ak.us/asp/edocs/2011/06/ocn739704678.pdf.

Braem, Nicole M., and Marylynne L. Kostick. 2014. Subsistence Wildlife Harvests in Elim, Golovin, Kivalina, Koyuk, Noatak, and Wales, Alaska, 2010-2011. Special Publication No. SP2012-04. Alaska Department of Fish and Game, Division of Subsistence,. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/specialpubs/SP2_SP2012-004.pdf.

Braem, Nicole M., Elizabeth H. Mikow, Andrew R. Brenner, Anna R. Godduhn, Brittany Retherford, and Marylynne L. Kostick. 2017. Chukchi Sea and Norton Sound Observation Network: Harvest and Use of Wild Resources in 9 Communities in Arctic Alaska, 2012-2014. Technical Paper No. 403. Alaska Department of Fish and Game, Division of Subsistence. Available online at http://www.adfg.alaska.gov/techpap/TP403.pdf.

Braem, Nicole M., Elizabeth Mikow, Seth J. Wilson, and Marylynne L. Kostick. 2015. Wild Food Harvests in 3 Upper Kobuk River Communities : Ambler, Shungnak, and Kobuk, 2012-2013. Technical Paper No. 402. Alaska Department of Fish and Game, Division of Subsistence,. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/techpap/TP20402.pdf.

Brower, H. K., and R. T. Opie. 1996. North Slope Borough Subsistence Harvest Documentation Project: Data for Anaktuvuk Pass, Alaska for the Period July 1, 1994, to June 30, 1995. Department of Wildlife Management, North Slope Borough. Barrow, Alaska.

Brower, Harry K., and Taqulik Hepa. 1998. North Slope Borough Subsistence Harvest Documentation Project: Data for Nuiqsut, Alaska for the Period July 1, 1994, to June 30, 1995. Rev. ed. North Slope Borough, Deparment of Wildlife Management. Barrow, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/Subsistence20Harvest20Doc20Report_Nuiqsut_94-95.pdf.

Brown, Caroline L., Nicole M. Braem, Elizabeth H. Mikow, Alida Trainor, Lisa J. Slayton, David M. Runfola, Hiroko Ikuta, Marylynne L. Kostick, Christopher R. McDevitt, Jeff Park, and James J. Simon. 2016. Harvests and Uses of Wild Resources in 4 Interior Alaska Communities and 3 Arctic Alaska Communities, 2014. Technical Paper No. 426. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/techpap/TP426.pdf.

Brown, William E. 1979. Nuiqsut Paisanich: Nuiqsut Heritage, a Cultural Plan. Prepared for the Village of Nuiqsut and the North Slope Borough Planning Commission on History and Culture. Arctic Environmental Information and Data Center. Anchorage, Alaska.

EDAW Inc., Adams/Russel Consulting, Applied Sociocultural Research, Donald G. Callaway, Circumpolar Research Associates, and Northern Economics. 2008. Quantitative Description of Potential Impacts of Ocs Activities on Bowhead Whale Hunting Activities in the Beaufort Sea. MMS OCS STUDY # 2007-062. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at https://www.boem.gov/BOEM-Newsroom/Library/Publications/2007/2007_062.aspx.

Fuller, Alan S., and John C. George. 1999. Evaluation of Subsistence Harvest Data from the North Slope Borough 1993 Census for Eight North Slope Villages for the Calendar Year 1992. North Slope Borough, Department of Wildlife Management. Barrow, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/Master20Report20(Fuller-George2099).pdf.

Galginaitis, Michael. 2006. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2004: Canimida Task 7 Annual Report. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/CrossIsland/AnnualReport2004/index.html.

Galginaitis, Michael. 2008a. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2005: Canimida Task 7 Annual Report. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/CrossIsland/AnnualReport2005/index.html

http://www.arlis.org/docs/vol1/BOEM/CrossIsland/index.html.

Galginaitis, Michael. 2008b. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2006: Canimida Task 7 Annual Report. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/CrossIsland/AnnualReport2006/index.html.

Galginaitis, Michael. 2009. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2007: Canimida Task 7 Annual Report. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/CrossIsland/AnnualReport2007/index.html.

Galginaitis, Michael. 2017. Summary of the 2016 Subsistence Whaling Season at Cross Island. Report prepared for Hilcorp Alaska, LLC by Applied Sociocultural Research. Anchorage, Alaska.

Galginaitis, Michael, and Dale W. Funk. 2004. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2001 and 2002, Animida Task 4 Final Report. OCS Study MMS 2004-030. MMS 2004-030. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/CrossIsland/FinalReport2001-2002/FinalRpt2004.pdf.

Galginaitis, Michael, and Dale W. Funk. 2005. Annual Assessment of Subsistence Bowhead Whaling near Cross Island, 2003, Animida Task 4 Annual Report. OCS Study MMS 2005-025. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/CrossIsland/AnnualReport2003/AnnualReport2003.pdf.

Georgette, Susan. 2000. Subsistence Use of Birds in the Northwest Arctic Region, Alaska. Technical Paper No. 260. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. Available online at http://www.subsistence.adfg.state.ak.us/TechPap/tp260.pdf.

Gonzalez, D., E. H. Mikow, and M. L. Kostick. 2018. Subsistence Wildlife Resources in Buckland, Koyukuk, and Noatak, Alaska, 2016-2017. Alaska Department of Fish and Game, Division of Subsistence, Special Publication No.-005.

Hepa, Taqulik, Harry K. Brower, and Devin Bates. 1997. North Slope Borough Subsistence Harvest Documentation Project: Data for Atqusak, Alaska for the Period July 1, 1994, to June 30, 1995.

Hoffman, David, David Libbey, and Grant R. Spearman. 1988. Nuiqsut, Land Use Values through Time in the Nuiqsut Area. Rev. ed. North Slope Borough; Anthropology and Historic Preservation Section of the Cooperative Park Studies Unit, University of Alaska, Fairbanks. Barrow, Alaska; Fairbanks, Alaska.

Holen, Davin, Sarah M. Hazell, and David S. Koster. 2012. Subsistence Harvests and Uses of Wild Resources by Communities in the Eastern Interior of Alaska, 2011. Technical Paper No. 372. Alaska Department of Fish and Game. Division of Subsistence. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/AlaskaGas/Article/Article_ADFGSubsistence_2012_SubsistHarvestsUsesWild.pdf.

Impact Assessment Inc. 1989. Point Lay Case Study. Technical Report 139. MMS OCS Study No. 89-0093. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region Social and Economic Studies.

Ivie, Pamela, and William Schneider. 1988. Wainwright: Land Use Values through Time in the Wainwright Area. North Slope Borough

Cooperative Park Studies Unit, University of Alaska Fairbanks.

Kassam, Karim-Aly S., and Wainwright Traditional Council. 2001. Passing on the Knowledge: Mapping Human Ecology in Wainwright, Alaska. Arctic Institute of North America. Calgary.

Kofinas, G., S. B. BurnSilver, J. Magdanz, R. Stotts, and M. Okada. 2016. Subsistence Sharing Networks and Cooperation: Kaktovik, Wainwright, and Venetie, Alaska. BOEM Report 2015-023 DOI; AFES Report MP 2015-02. School of Natural Resources and Extension, University of Alaska Fairbanks.

Libbey, David, Grant R. Spearman, and David Hoffman. 1979. "Nuiqsut Synopsis." In *Native Livelihood and Dependence*, 151-161. Anchorage: U.S. Department of the Interior, National Petroleum Reserve in Alaska.

Magdanz, J., H. Smith, N. Braem, and D. S. Koster. 2011a. Patterns and Trends in Subsistence Fish Harvests, Northwest Alaska, 1994-2004. Technical Paper No. 366. Alaska Dept. of Fish and Game, Division of Subsistence, Kotzebue, AK.

Magdanz, James S., Nicole M. Braem, Brad C. Robbins, and David Koster. 2010. "Subsistence Harvests in Northwest Alaska, Kivalina and Noatak, 2007." Alaska Dept. of Fish and Game, Division of Subsistence, Accessed Technical Paper No. 354. http://www.adfg.alaska.gov/techpap/TP354.pdf.

Magdanz, James S., David Koster, Liliana Naves, and Patricia Fox. 2011b. Subsistence Harvests in Northwest Alaska, Buckland and Kiana, 2003 and 2006. Technical Paper No. 363. Alaska Dept. of Fish and Game, Division of Subsistence. Kotzebue, Alaska.

Magdanz, James S., Robert J. Walker, and Ronald R. Paciorek. 2004. The Subsistence Harvests of Wild Foods by Residents of Shungnak, Alaska, 2002. Technical Paper No. 279. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. Available online at http://www.arlis.org/docs/vol1/A/57016852.pdf.

Marcotte, James R., and Terry L. Haynes. 1985. Contemporary Resource Use Patterns in the Upper Koyukuk Region, Alaska. Technical Paper No. 93. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.arlis.org/docs/vol1/A/13346997.pdf.

Mikow, E., N. M. Braem, and M. Kostick. 2014. Subsistence Wildlife Harvests in Brevig Mission, Deering, Noatak, and Teller, Alaska, 2011-2012. Special Publication No. 2014-02. Alaska Department of Fish and Game, Division of Subsistence.

Mikow, Elizabeth, Brittany Retherford, Marylynne L. Kostick, and Anna R. Godduhn. 2016. "Exploring the Subsistence Fisheries of Point Lay and Wainwright, Alaska." https://www.arlis.org/docs/vol1/M/965293136.pdf

http://library.alaska.gov/asp/edocs/2016/12/ocm965293136.pdf.

Naves, Liliana C. 2010. "Alaska Migratory Bird Subsistence Harvest Estimates, 2008, Alaska Migratory Bird Co-Management Council." Alaska Department of Fish and Game, Division of Subsistence, Accessed Technical Paper No. 353. http://www.adfg.alaska.gov/techpap/TP353.pdf.

Pedersen, S. 1995. "Nuiqsut." In *An Investigation of the Sociocultural Consequences of Outer Continental Shelf Development in Alaska. Alaska Peninsula and Arctic*, edited by James A. Fall and Charles J. Utermohle. Anchorage, Alaska: U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region.

Pedersen, S., and C. Hugo. 2005. Anaktuvuk Pass Subsistence Fishery Harvest Assessment: October 2001 through September 2003. Number of Final Report for FIS Study 02-50s vols. Vol. Final Report for FIS Study 02-50. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Management Program.

Pedersen, S., and J. Nageak. 2009. Documentation of Caribou Harvest Levels in Anaktuvuk Pass, June 2006-May 2007. ADF&G, Division of Subsistence. Fairbanks, Alaska.

Pedersen, S., and T. Opie. 1991. Community Subsistence Caribou Harvest Survey: Anaktuvuk Pass 1990-1991. Alaska Department of Fish and Game, Division of Subsistence in Cooperation with City of Anaktuvuk Pass, Nunamiut Corporation, NPS, and NSB. Fairbanks, Alaska.

Pedersen, S., and T. Opie. 1992. Documentation of Caribou Harvest Levels in Anaktuvuk Pass, 1991-92. Division of Subsistence, Alaska Department of Fish and Game and Department of Wildlife Management, North Slope Borough, Barrow. Fairbanks, Alaska.

Pedersen, S., and T. Opie. 1994. Documentation of Caribou Harvest Levels in Anaktuvuk Pass, 1993-94. Alaska Department of Fish and Game, and Department of Wildlife Management, North Slope Borough, Barrow. Fairbanks, Alaska.

Pedersen, Sverre. 1979. Regional Subsistence Land Use, North Slope Borough, Alaska. Occasional Paper No. 21. Anthropology and Historic Preservation, Cooperative Park Studies Unit, University of Alaska, Fairbanks, Alaska. Conservation and Environmental Protection, North Slope Borough, Barrow, Alaska.

Pedersen, Sverre. 1986. Nuiqsut Subsistence Land Use Atlas, 1986 Update. File Report 1986-01. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska.

Pedersen, Sverre, David Libbey, W. Schneider, and C. Dementieff. 1979. Barrow-Atqasuk (Atkasook) Synopsis. Native Livelihood & Dependence: A Study of Land Use Values Through Time. U.S. Department of the Interior, National Petroleum Reserve in Alaska 105(c) Field Study 1. Anchroage, Alaska.

Pedersen, Sverre, and Alfred Linn. 2005. Kaktovik 2000-2002 Subsistence Fishery Harvest Assessment. Study No. 01-101. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program. Anchorage, Alaska.

Satterthwaite-Phillips, Damien, Christopher Krenz, Glenn Gray, and Liz Dodd. 2016. IñuuniałiQput Iḷiḷugu Nunaŋŋuanun: Documenting Our Way of Life through Maps. Northwest Arctic Borough, Subsistence Mapping Project. Kotzebue, Alaska.

Schneider, William, and R. Bennett. 1979. Point Lay Synopsis. In Native Livelihood and Dependence: A Study of Land Use Values through Time. Anchorage, Alaska: National Petroleum Reserve in Alaska U.S. Department of the Interior, 105(c) Land Use Study.

Schneider, William S., Sverre Pedersen, and David Libbey. 1980. The Barrow-Atqasuk Report: A Study of Land Use Values through Time. Fairbanks, Alaska: North Slope Borough; Anthropology and Historic Preservation, Cooperative Park Studies Unit, University of Alaska.

Schroeder, Robert, D. Anderson, and G. Hildreth. 1987. Subsistence Use Area Map Atlas for Ten Kotzebue Sound Communities. Alaska Department of Fish and Game, Division of Subsistence. Juneau, Alaska. Available online at http://www.adfg.alaska.gov/techpap/tp130.pdf.

Spearman, G., S. Pedersen, and W. Brown. 1979. "Anaktuvuk Pass Synopsis." In *Native Livelihood & Dependence: A Study of Land Use Values through Time*, edited by North Slope Borough Contract Staff, 121-140. Anchorage, Alaska: Report prepared for National Petroleum Reserve in Alaska, Work Group 1, Field Study 1. U.S. Department of the Interior National Petroleum Reserve Alaska, 105(C) Land Use Study.

SRB&A. 2003. The Alpine Satellite Development Plan Final Environmental Impact Statement - Field Interviews. Bureau of Land Management Department of the Interior.

SRB&A (Braund, Stephen R. & Associates). 2009. Subsistence Use Areas and Traditional Knowledge Study for Kivalina and Noatak, Alaska: Red Dog Mine Extension Aqqaluk Project, Supplemental Baseline Report. Tetra Tech, Tech Alaska Inc., and U.S. Environmental Protection Agency. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2010a. Mms Ocs Study No. 2009-003: Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow. U.S. Department of the Interior Minerals Management Service, Alaska OCS Region, Environmental Studies Program. Anchorage, Alaska. Available online at http://www.boem.gov/BOEM-Newsroom/Library/Publications/2009/2009_003.aspx.

SRB&A, (Braund, Stephen R. & Associates). 2010b. Nuiqsut Caribou Subsistence Monitoring Project: Results of 2009 Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2011. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Two Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2012. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Three Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2013a. Comida: Impact Monitoring for Offshore Subsistence Hunting, Wainwright and Point Lay, Alaska. OCS Study BOEM 2013-211. US Department of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at https://www.boem.gov/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/BOEM_2013-0211.pdf.

SRB&A, (Braund, Stephen R. & Associates). 2013b. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 4 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2013c. Subsistence Use Area and Traditional Knowledge Studies: Anaktuvuk Pass Appendix. Foothills West Transportation Access Environmental Studies. Alaska Department of Transportation and Public Facilities.

SRB&A, (Braund, Stephen R. & Associates). 2014a. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 5 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2014b. Point Lay Subsistence Use Areas and Traditional Knowledge Interviews. Supported by the North Slope Borough Department of Wildlife.

SRB&A, (Braund, Stephen R. & Associates). 2015. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 6 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2016. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 7 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2017a. Household Caribou Harvest Survey: Point Hope, Point Lay, Wainwright, Barrow, Nuiqsut, and Kaktovik. Results. Submitted to North Slope Borough, Department of Wildlife Management, Barrow, Alaska. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2017b. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 8 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). Unpublished. North Slope Borough Key Informant Subsistence Mapping Project, Barrow and Wainwright. Barrow use area data depict 1987-1989 use areas reported during 59 interviews. Wainwright use area data depict 1988-1989 use areas reported during 19 interviews.

SRB&A, (Braund, Stephen R. & Associates), and (Institute of Social and Economic Research) ISER. 1993. North Slope Subsistence Study: Barrow, 1987, 1988, and 1989. Prepared by S.R. Braund, K. Brewster, L. Moorehead, T.P. Holmes, J.A. Kruse, S. Stoker, M. Glen, E. Witten, D.C. Burnham and W.E. Simeone. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region Social and Economic Studies. Technical Report No. 149 (PB93-198661), OCS Study MMS 91-0086, Contract No. 14-12-0001-30284. Anchorage, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/Braund_North_Slope_Subsistence_Study_Barrow_1987,_1988,_1989_MMS_91-0086.pdf.

SRB&A, (Braund, Stephen R. & Associates), and ISER (Institute of Social and Economic Research). 1993. North Slope Subsistence Study: Wainwright, 1988 and 1989. Prepared for the U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region Social and Economic Studies. Technical Paper No. 147, OCS Study MMS 91-0073. Anchorage, Alaska.

Wainwright Traditional Council, and The Nature Conservancy. 2008. Wainwright Traditional Use Area Conservation Plan.

Watson, Annette. 2018. Ethnographic Overview and Assessment of Gates of the Arctic National Park and Preserve: Subsistence Land Use across the Kobuk Preserve. Cultural Resource Report NPS/GAAR/CRR-2018/001. Fairbanks, Alaska: National Park Service Fairbanks Administrative Center.

Webb, D. D. 1999. Subsistence Waterfowl Harvest Survey Galena, Huslia, Nulato, Kaltag, Hughes, Ruby, 1998, *Progress Report (Koyukuk/Nowitina Refuge Complex (U.S.); 99-02*. Galena, Alaska: Koyukuk/Nowitna National Wildlife Refuge Complex (1999).

Webb, Deborah D., and Koyukuk/Nowitna Refuge Complex (U.S.). 2000. Subsistence Waterfowl Harvest Survey Galena, Huslia, Nulato, Koyukuk, Kaltag, Hughes, Ruby, 1998 and 1999, *Final Report*. Galena, Alaska: Koyukuk/Nowitna National Wildlife Refuge Complex.

Wilson, Seth J., and Marylynne L. Kostick. 2016. Harvest and Use of Wild Resources in Hughes, Alaska, 2014. Technical Paper No. 424. Alaska Department of Fish and Game, Division of Subsistence. Available online at http://www.adfg.alaska.gov/techpap/TP20424.pdf.

Wolfe, R. J., and A. W. Paige. 1995. The Subsistence Harvest of Black Brant, Emperor Geese, and Eider Ducks in Alaska. Prepared for the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Subsistence Division, Juneau, Alaska.

Wolfe, Robert James, and Amy W. Paige. 2002. Subsistence Harvest of Black Brant, Emperor Geese and Eider Ducks in Alaska. Technical Paper No. 234. Alaska Dept. of Fish and Game, Division of Subsistence. Juneau, Alaska. Available online at http://www.arlis.org/docs/vol1/A/50419619.pdf.

YRDFA, (Yukon River Drainage Fisheries Association). 2008. Middle Koyukuk River of Alaska: An Atlas of Fishing Places and Traditional Place Names. Anchorage, Alaska.

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Appendix U

Sociocultural Systems

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations	Full Phrase
ANCSA	Alaska Native Claims Settlement Act
DEW	Distant Early Warning
NPR	Naval Petroleum Reserve
NPR-A	National Petroleum Reserve in Alaska
NSB	North Slope Borough
U.S.	United States

Appendix U. Sociocultural Systems

This appendix provides an overview of sociocultural systems for the Iñupiat of the North Slope, including the history, social/political organization, mixed cash/subsistence economy, and belief systems, with an emphasis on the communities closest to the National Petroleum Reserve in Alaska (NPR-A) planning area (Anaktuvuk Pass, Atqasuk, Nuiqsut, Point Lay, Utqiagvik, and Wainwright).

U.1 History

The Iñupiat are an Alaska Native people whose territory ranges throughout northwest and northern Alaska. Archaeological research indicates that humans have occupied northern Alaska for roughly 14,000 years (Kunz and Reanier 1996). The earliest people entering the North American Arctic were the bearers of the Paleoindian and Paleo-Arctic Traditions. Over thousands of years different cultures came to occupy Arctic Alaska and various parts of the NPR-A area, subsisting on resources available to them and developing various tools for survival. The Thule people, whose culture emerged about 1,000 years ago, are the direct ancestors of the Iñupiat living on the North Slope today and are the forebearers of modern whaling technologies and culture.

At the time of European contact, the North Slope was inhabited by kinship-based groups of Iñupiat who lived in either coastal or inland areas and traveled as needed, depending on food supplies and other factors (Spencer 1984). The coastal settlement pattern was characterized by permanent villages along the coast with outlying minor settlements of both a permanent and temporary nature (Spencer 1976). One reason for the coastal villages' permanence was due to the marine mammal resource base—particularly bowhead whales—from which community members subsisted. On the North Slope, there is evidence for coastal Iñupiaq settlements from Point Hope (Tikigaq) in the west to as far as Demarcation Point near Canada in the east. The Nuiqsut and Kaktovik areas were known as places where Iñupiat and Athabascan people gathered to trade and fish, maintaining connections between the inland areas and the coast (Arctic Slope Community Foundation 2012; Brown 1979; Impact Assessment Inc. 1990b).

The Russians were the first Europeans to explore north of the Bering Strait in the early 1700s; they were soon joined by other European nations, with one goal of these expeditions to discover a northwest passage. Following the sale of Alaska to the United States (U.S.) in 1867, the U.S. government began exploring the region. The first International Polar Expedition to Point Barrow took place from 1881 to 1883 (Murdoch 1892; Ray 1885; Murdoch 1885). In subsequent years, Americans explored the Noatak, Koyukuk, Kobuk, and Colville Rivers (Allen 1887; Stoney 1899). The United States launched more expeditions in 1898 and 1899 to document mineral and other resources (Smith and Mertie 1930). These explorers relied on the local Iñupiat as occasional guides, translators for information, providers of clothing and food, and for access and logistical support (Allen 1887; Stoney 1899; Healy 1887).

Initial contact between the Iñupiat of the North Slope and non-Iñupiaq people occurred in the early nineteenth century with the arrival of European explorers. The first major outside influence on Iñupiaq settlement patterns on the North Slope came with the introduction of commercial whaling. Commercial whalers first entered the Bering Sea in 1848 and in subsequent years expanded their operations as far east as the Beaufort Sea (Bockstoce and New Bedford Whaling Museum 1995). The whalers harvested whales, seals, and walrus; traded with local Iñupiat; and hired them as crew and workers. In some cases the whalers married into Iñupiaq families, becoming traders along the coast between Utqiagvik and Herschel Island

(Bockstoce and New Bedford Whaling Museum 1995). The periodic stranding of whaling crews caught in the moving pack ice resulted in the construction of a refuge station at Utqiagvik in 1889 with 50 bunks and a year's supply of food for survivors. In 1890, the first Presbyterian missionary was assigned to the station as assistant manager and to teach school and start a church (Bockstoce and New Bedford Whaling Museum 1995). To relieve stranded whalers, the U.S. government brought reindeer to the Utqiagvik station (Healy 1887), which began Utqiagvik's reindeer herd that lasted until World War II. Reindeer herding subsequently spread across the North Slope, serving as partial replacement for caribou herds that had declined at the end of the nineteenth century (Chance 1990).

Not only were coastal Iñupiaq settlements and demographics affected, but commercial whaling also affected the inland inhabitants as well. Employment in the whaling industry, as well as access to trade goods, served to concentrate people along the coast, reducing interior populations. Following a decline in populations of caribou and marine mammals, caused in part by demand for these resources to support whalers during the commercial bowhead whaling period (SRB&A and ISER 1993), many Iñupiat had moved to Utqiagvik or Herschel Island where food and medical care were available; by the early to mid-1900s, many residents who had lived along the Arctic coast had relocated to Utqiagvik. By 1914, commercial whaling ended as marine mammal oils, hides, and other products were replaced with cheaper alternatives such as petroleum, spring steel, and early rubber and plastics (Bockstoce and New Bedford Whaling Museum 1995).

In addition to changes in settlement patterns, commercial whaling also affected demographics through the introduction of diseases for which the Iñupiat had no immunity. It has been estimated that between 1854 and 1897, over 50 percent of the Native population in North Alaska died due to disease and famine (Burch 1979). European contact also introduced Native residents to alcohol, resulting in negative social effects.

Local mission schools and trading posts, established during the late 1800s and early 1900s, also had a profound effect on Iñupiaq settlement patterns through centralization of Iñupiat into permanent communities. Compulsory education in local coastal settlements forced many (though not all) of the interior people to abandon their more seminomadic lifestyle and relocate along the coast. Trading posts were often established near missions and schools, and these areas became focal points for the Native population, thus affecting settlement patterns during the early 1900s. Because of the centralization of goods and services, the smaller coastal settlements that had once typified the Iñupiat of the North Slope are also no longer as prevalent. Seminomadic movements, combined with seasonal coastal settlements, had enabled the indigenous population to maximize their use of the environment and harvest resources that were migratory or may have been available only in particular locations.

The Iñupiat today continue to rely on these subsistence resources despite not all resources being available near their communities. Thus, even though the settlement pattern on the North Slope today revolves around permanent communities, in order to continue to access subsistence resources, the Iñupiat have established a network of camps and cabins across the North Slope that mirror the camps and temporary settlements utilized in the past. SRB&A and ISER (1993) observed that the location of cabins in productive habitat was "a strong tradition stemming from the predominant lifestyle prior to the establishment of the town of Utqiagvik and continued to provide an important opportunity for children to learn and begin using subsistence skills."

The collapse of the commercial whaling industry in the early 1900s was followed by an increase in demand for furs and the introduction of reindeer herding as a means to supplement the declining caribou populations. Both the fur trade and reindeer herding filled some of the economic gap left by the decline in commercial whaling in the early 1900s. Sheldon Jackson, a Presbyterian missionary, introduced reindeer herding to

Alaska Natives, and herds were maintained by Iñupiat in the vicinity of Wainwright, Utqiagvik, Nuiqsut, and elsewhere on the North Slope (Jackson 1906). During this time, firearms, tea, flour, and sugar had become a standard part of Iñupiaq life. Fur prices declined during the Depression to the extent that trading companies could no longer afford to send ships to the Arctic and trapping was no longer profitable (Libbey 1983).

Interest in nonrenewable resource exploration and development also grew during the first half of the twentieth century. Prior to the arrival of Europeans, North Slope oil had already been discovered by early Iñupiat who used it as fuel to supplement wood and marine mammal fats (Tailleur 1964). In 1923, President Warren Harding issued an executive order setting aside much of the North Slope as Naval Petroleum Reserve (NPR) number 4 (later changed to NPR in Alaska [NPR-A]) (Smith and Mertie 1930). From 1923 to 1926, U.S. Geological Survey staff surveyed NPR-4, mapping along the rivers, collecting samples, and documenting stratigraphy in exposed rock faces (Smith and Mertie 1930; Paige, Foran; and Gilluly 1925).

In 1943, the U.S. Navy and its contractors arrived in Utqiagvik with equipment and supplies for the exploration of NPR-4 for oil and gas to support the World War II defense effort (Reed et al. 1958). Soon, Utqiagvik was the major debarkation point for equipment, supplies, and personnel surveying the Reserve. Drill rigs and early remote sensing equipment were offloaded and transported from Utqiagvik along pioneering cat trains, and a satellite camp was established at Umiat on the Colville River. The Navy drilled wells in several locations for oil and gas, including gas to run the Utqiagvik camp (Reed et al. 1958). Exploration in the NPR-4 continued after World War II and employed many in Utqiagvik and Wainwright (Reed et al. 1958; Nygren 2001). NPR-4 exploration continued under military control with civilian contractors until 1958 (Reed et al. 1958).

With the advent of the Cold War, additional defensive efforts were undertaken on the North Slope that increased the activity occurring in Utqiagvik and across the North Slope. These activities included increased infrastructure and services as well as opportunities for wage labor for Iñupiaq workers. Among these activities were the construction of Long Range Navigation sites, Distant Early Warning (DEW) line radar sites with White Alice communication sites along the Arctic coast, scientific research at the Naval Arctic Research Laboratory, and the survey of the coast by the U.S. Coast and Geodetic Survey (Reed et al. 1958; Nygren 2001). By 1957, contractors for the Air Force had built 16 DEW line sites on the North Slope with airfields, sea lift areas, gravel pads, roads, dumps, modular housing, hangars, garages, and other infrastructure to support the facilities. The DEW line sites were built at locations formerly used by Iñupiaq hunters, reindeer herders, whalers, and traders, usually on areas of raised ground. The DEW line sites became opportunities for employment for local Iñupiaq, rest stops for travelers, landmarks for navigation, and points of access to public services, such as search and rescue and medical care (Neufeld 2002; Radomes Inc. 2012).

While Utqiagvik remained the administrative and transportation center for the North Slope, by the mid-twentieth century many Iñupiat had begun returning to former traditional habitation sites as Utqiagvik became crowded, competition for subsistence and other resources increased, and the possibility to pursue fur trapping and wage labor expanded after the war. Nunamiut people who had left Utqiagvik for Chandler Lake and the Killik River eventually settled in Anaktuvuk Pass by 1949, drawn by the presence of a local trader and pushed by increasingly strict requirements for Iñupiaq children to go to school (Campbell 1998). Kaktovik people returned to their area as well (Impact Assessment Inc. 1990a). Point Lay and Wainwright expanded as defense jobs grew, aided by other employment at schools and airfields (Impact Assessment Inc.

1989b). Nuiqsut was established in 1973 in an area where Iñupiaq people formerly gathered to trade (Brown 1979).

In 1968, oil exploration taking place to the east of the NPR-A struck the Prudhoe Bay oil field, adding a great deal of pressure to settle the land claims. Negotiations took place between the tribes, the oil companies, executive branch agencies, and Congress for settlement of the issues (Paul 2003). The Alaska Native Claims Settlement Act (ANCSA) was passed in 1971 and transferred a billion dollars and roughly 40 million acres of land to Alaska Native corporations (i.e., ANCSA corporations). The Arctic Slope Regional Corporation became the North Slope regional for-profit corporation under ANCSA, and the Arctic Slope Native Association became the regional nonprofit corporation. In 1971, the Bureau of Indian Affairs recognized the Iñupiat Community of the Arctic Slope as a regional Indian Regional Act tribe (ICAS 2012).

On July 1, 1972, the North Slope Borough (NSB), a first-class borough[1] under the Alaska Constitution, was recognized by the State of Alaska. The NSB had the authority to zone lands in its boundaries, levy property and other taxes, and fulfill the functions set forth for boroughs in the Alaska Constitution; it allowed residents to benefit economically through taxation of the oil and gas industry and provided for infrastructure development and jobs. Construction and development of oil infrastructure began quickly following ANCSA, and planning for the Trans-Alaska Pipeline began in 1973 (Bechtel Corporation 2012).

U.2 COMMUNITY OVERVIEWS

U.2.1 Utqiagvik

The Iñupiaq name, Utqiagvik, means "the place where we hunt snowy owls." Humans have occupied the Utqiagvik area for at least 5,000 years, and continuous occupation of the area began approximately 1,300 years ago. Beginning after European contact in the 1820s, the growth of the commercial whaling and trapping industries brought Iñupiat from across the North Slope to Utqiagvik in pursuit of employment and trade opportunities. After the establishment of the NPR-A, the U.S. Navy established a base camp in Utqiagvik in the late 1940s as a place to launch oil exploration (Jensen 2009). The established mission of the Naval base camp gradually shifted away from exploration, eventually becoming a research laboratory known as the Naval Arctic Research Laboratory. Utqiagvik continued to grow as new economic opportunities, including oil and gas exploration, arose on the North Slope.

U.2.2 Atqasuk

The village of Atqasuk is located approximately 58 miles southwest of Utqiagvik on the Meade River (Schneider et al. 1980). It is a reestablished village of Iñupiaq residents who once lived in a village called Tikigluk (Schneider et al. 1980). Tikigluk was a small coal mine settlement that supplied Utqiagvik's coal after the fur trade collapsed (Braem et al. 2011). By the 1960s, Atqasuk had been abandoned as a result of more job opportunities and available government services in Utqiagvik (Alaska Consultants Inc. et al. 1984). Prompted by passage of ANCSA in 1971, many Native residents moved out of Utqiagvik to live more subsistence-based lifestyles (Alaska Consultants Inc. et al. 1984). Thus, the present-day village of Atqasuk was established.

[1]First-class boroughs may exercise any power not prohibited by law by adopting ordinances. Other types of boroughs in Alaska include unified home rule, non-unified home rule, and second class boroughs. The different classes of boroughs differ in their ability to exercise legislative and other powers (Alaska Department of Commerce 2015).

U.2.3 Nuiqsut

In 1968, the largest oil pool in North America was discovered by Arco at Prudhoe Bay, resulting in a rush to develop the physical and legal infrastructure of Alaska so that production could begin (Coates 1991). Oil development and production at Prudhoe Bay became the nucleus for expanding networks of oil and gas production wells at neighboring fields (Impact Assessment Inc. 1990a, 1990b). After the 1970 passage of ANCSA, 27 families from Utqiagvik permanently resettled Nuiqsut to live in a more traditional manner (Arctic Slope Community Foundation 2012). Many of those who moved there in 1973 had family connections to the area (Impact Assessment Inc. 1990b). The families selected the present location of Nuiqsut for its centrality to subsistence resources and the ease of access to harvest locations inland, along the river and delta, and in the ocean (Brown 1979).

U.2.4 Wainwright

Also known as Ulġuniq, the Wainwright area has been occupied by the Utuqqaqmiut people of the Utuqqaq River, and the Kuugmiut people of the Kuk River for centuries (Kofinas et al. 2016). It is located on the coast of the Chukchi Sea at the Kuk River Inlet, about 90 miles southwest of Utqiagvik (Kofinas et al. 2016). The settlement location for present-day Wainwright was the result of a construction error with the building of a schoolhouse in 1904 (Milan 1964). The original location was meant to be closer to the inlet, but due to ice conditions and convenience, the construction material was unloaded at Wainwright's current location (Milan 1964). A reindeer herder's station and trading post was also built in 1904 under authority of the Bureau of Education to help sustain Wainwright's food supply. The Utuqqaqmiut and Kuugmiut people were taught to herd and trade reindeer, which helped increase Wainwright's population as Alaska Natives transitioned from nomadic to more sedentary lifestyles (Milan 1964).

U.2.5 Anaktuvuk Pass

The Anaktuvuk Pass area has been used by the Nunamiut for at least 500 years and by Iñupiaq predecessor groups for at least 4,000 years (Hall et al. 1985). Historically, the Nunamiut were nomadic and relied heavily on the seasonal migrations of the caribou through the Brooks Range. Decreased caribou populations in the late 1800s and early 1900s resulted in the Nunamiut moving northward toward the coast for jobs related to whaling and trapping, or eastward into Canada where the caribou were more abundant (North Slope Borough 1990). With fur and whaling industries on the decline, a number of Nunamiut families returned to their traditional grounds in the Brooks Range, continuing a seminomadic lifestyle well into the 1950s. The modern village of Anaktuvuk Pass began in 1949 when Nunamiut families from camps at Killik River and Chandler Lake joined those at Tulugak Lake, near the present-day location of Anaktuvuk Pass. A trading post was established, followed by a post office in 1951 and a church in 1958. Residents incorporated as a fourth-class city[2] in 1959. A permanent school was established in 1961, and the community was reclassified as a second-class city in 1971 (Hall et al. 1985).

U.2.6 Point Lay

Point Lay is located on the coast of the Chukchi Sea about 300 miles southwest of Utqiagvik (Braem et al. 2017). Point Lay originated near Icy Cape; a school was built there in 1906 but was later shut down in 1913. The school opened and shut down a handful of times as a result of changing economic conditions on the

[2]Third and fourth class cities were eliminated in the 1970s, and Anaktuvuk Pass is now a second-class city (Morehouse, McBeath, and Leask 1984). Other types of cities in Alaska are first-class cities and home rule cities. A community must have at least 400 permanent residents to incorporate as a first class or home rule city. Cities vary in powers and responsibilities based on their class (Alaska Department of Commerce 2015).

North Slope and fluctuating populations in the vicinity of Point Lay. The school reopened in 1925 but closed the following year. It was then relocated in 1929 to the "old village" on the barrier island across from the current village site, where a DEW line station was built in the 1950s. The increase in available work and the presence of newcomers resulted in the increased availability of alcohol, which led to social problems in the community (Braem et al. 2017). This resulted in people moving away, resulting in closure of the school in 1958. By 1964 there was a single couple living in Point Lay. They decided to move from the "old village" to Point Lay's current location that year. Passage of ANCSA in 1971 prompted former residents and other people to return to Point Lay (Impact Assessment Inc. 1989a).

U.3 Social and Political Organization

Iñupiaq social organization traditionally revolved around the bilateral family unit and their extended kin, in addition to trading partnerships and friendships (Hall 1984). Smaller settlements were often composed of one local family, whereas larger settlements (e.g., the Utqiagvik area) were composed of several local families; however, each local family would have been grouped together and somewhat separate from the other local families. Support and care for one's kin was the driving force behind social organization. Each local family operated under a theme of cooperation, mutual aid, and defense (Spencer 1984). The *qargi*, a communal gathering place, was often a permanent structure that served an important role in organizing social relations. The *qargi* served as a meeting place, particularly for the males in a society, and was also the social center for games, rituals, dances, stories, and other social activities. In addition to the bilateral family unit, trading partnerships and friendships were also part of the social organization (Hall 1984).

The political organization of Iñupiaq societies also revolved around the family unit; however, one role in particular—that of the *umialik*—exerted the most political influence. This term has been translated to mean "boss," "rich man," or "chief" (Chance 1990; Burch 1980). This person served as the head of a local family, but did not have control over groups of local families and particularly not over any larger society or territory (Burch 1980). This position was not passed down through any particular lineage but was acquired based on a number of personal factors, including wealth, charisma, organizational abilities, and knowledge. In coastal communities, an *umialik* was responsible for organizing cooperative hunting activities, such as the bowhead whale hunt. The *umialik* and his wife managed a crew that assisted year-round in preparing for the hunt, hunting, and processing and distributing a whale once it had been harvested (Chance 1990; Burch 1980).

These cooperative hunting activities served to organize members of a society together. Besides the *umialik*, there were several other positions that served both political and other functions. These positions included those of the *umialik's* wife (*nuliaqpak*), specialized hunter or foreman (*ataniq*), and religious shaman (*angatquq*). The *umialik's* wife primarily served to redistribute food and other goods to members of the extended family; the *ataniq* served as an expert in a particular type of hunt or activity; and the *angatquq* served various religious functions.

Following European and American contact, while certain aspects of the social and political organization of the Iñupiat changed, other aspects remained the same. Changes to the social and political organization were a result of various factors, including compulsory education, which led to the centralization of people into permanent villages; the introduction of modern technologies, which altered residents' methods for harvesting and processing subsistence foods; the introduction of a cash economy; the introduction of Christianity; and incorporation of the Iñupiat into new systems of laws and governing systems (Chance 1990).

In general, one might characterize the effects on the social organization after the arrival of Europeans as one that tended to try to "individualize" society and deemphasize the extended kinship network. The introduction of missionaries and Christianization also brought with it less flexible notions of marriage as well as different households roles for males and females, ones in which men were seen as the providers and women served to support and care for the house. The education system also had profound social changes on Iñupiaq society. Compulsory schooling moved education out of the homes and natural environment and into the western education system. The mentality of the education system at the turn of the nineteenth century was also that of “individualization.”

New economic activities brought by the Americans also encouraged different economic and social relations among the Iñupiat (Chance 1990). One example is the reindeer herding industry, which introduced individual ownership and inheritance of food resources versus cooperative hunting, fishing, and gathering of wildlife resources. Other institutions (e.g., school and church) emphasized participation in activities that were not necessarily kin associated (Case 1984). Movement to permanent villages also affected social relations because homes were built to house nuclear, rather than extended, families.

Changes to the Iñupiaq political organization following European and American contact included the introduction of new systems of law, governing systems, and political organizations. Along with the influx of teachers, missionaries, and federal government representatives, village councils began to be formed in the various regions (Case 1984). Many of these councils were reorganized under the Indian Regional Act and continue today. Over the past century, the traditional Native political organization has been replaced by a formalized system of state, federal, and other organizations that are unlike the traditional political organization that once was in place. Native Alaskans have in many ways adapted to the new political system through the establishment of Native entities, including local governments (e.g., state municipalities and boroughs, Native Villages, and Indian Regional Act Councils); economic profit corporations (e.g., Indian Regional Act corporations, cooperative associations, and ANCSA corporations); nonprofit development and service corporations; and multiregional political organizations (e.g., Alaska Federation of Natives and Alaska Native Brotherhood). The NSB, the regional government of the North Slope, was formed in 1972, after passage of ANCSA. The NSB has permitting and taxing authority and regulatory oversight of development on the North Slope. NSB revenue goes toward providing employment opportunities, infrastructure, community services, and schools through North Slope communities.

Despite the changes in social and political organization over time, the core of Iñupiaq social organization is similar on the North Slope today, in that it encompasses not only households and families, but also wider networks of kinship and friends, and individual family groups that depend on the extended family for support. The sharing and exchange of subsistence resources strengthen these kinship ties both within and across regions. The Iñupiat continue to uphold certain traditional social roles, such as those of the whaling captains, whaling crew members, and whaling captains’ wives. Similar to the traditional role of the *umialiks,* today’s whaling captains play a key role in Iñupiaq society and political life. Six North Slope communities, including Nuiqsut, Point Lay, Utqiagvik, and Wainwright, are members of the Alaska Eskimo Whaling Commission and have local whaling captains associations.

Political organizations, while exhibiting the structure of western organizations, have traditional leadership patterns (Case 1984). Village council decisions based on precedent from previous group decisions reflect continuity with the past, and all decisions emphasize the desire to maintain peace and order in the community (Case 1984). The plethora of Native political organizations that have come about as a result of the political change over the past century have successfully adapted western structure to achieve Native goals. Specific examples of these organizations on the North Slope include the NSB, Native Village of

Utqiagvik, Arctic Slope Telephone Cooperative Association, Arctic Slope Regional Corporation, Arctic Slope Native Association, and Alaska Eskimo Whaling Commission.

On the village level, traditional leadership by the *umialik* on the North Slope was replaced by a system that included elected officials serving in a village council presided over by a president or chief. Despite changes over the past two centuries, political positions with Native roots are still present today and being adapted into western political leadership roles. Across the North Slope coastal whaling communities, the position of *umialik*, or whaling captain, is still recognized; many of the traditional roles, including generosity, providing a boat and supplies for the crew, and maintaining egalitarian principles, are practiced. Galginaitis (1984) observed that the people in Nuiqsut regard the office of mayor as an "*umialik*-position," and many of the mayors are recognized *umialiks*.

The NPR-A planning area is within the NSB. The NSB government offices are in Utqiagvik, the seat of government, and have permit authority relevant to the proposed project. Other federal and state agencies, including the U.S. Fish and Wildlife Service who is the land manager for all non-Native land with the 1002 area, have permit authority related to the project. Residents of the eight permanent North Slope communities are members of the regional federally recognized tribe Iñupiat Community of the Arctic Slope; many are shareholders in the Arctic Slope Regional Corporation. Community institutions among North Slope communities generally include a municipal government (Point Lay does not), a tribal government, and a village corporation, in addition to other community-specific organizations such as the Kuukpik Subsistence Oversight Panel in Nuiqsut.

U.4 MIXED CASH/SUBSISTENCE ECONOMY

Historically, subsistence resources formed the economic base of Iñupiaq communities and territories. The Iñupiat relied heavily on wildlife to sustain them, including a diverse resource base of marine mammals (seals, walrus, and whales, primarily among the coastal settlements), large land mammals (caribou and moose), furbearers and small land mammals, marine and riverine fish, ducks and geese, and vegetation.

The Iñupiat traditionally participated in an economy that relied on subsistence resources and utilized trade to acquire goods not readily available in their immediate area. The concept of wealth was based on the number or amount of accumulated foods and goods; those with the most material possessions were the wealthiest. Among the Iñupiat, the *umialik* was often held by the wealthiest position because this person needed to have a surplus of food and property to outfit a whaling crew. Iñupiat participated in extended trade networks that included both formalized and less formal modes of trading (Spencer 1984). Their trade was not limited to other Iñupiat; they also traded with Athabascan peoples farther south in addition to Inuit people to the east and Siberian peoples to the west. Trading often occurred through established trade fairs, such as those at Nigliq, on Barter Island, and as far as Sheshalik in Kotzebue Sound (Burch 1981; Gubser 1965). The Messenger Feasts, which some have argued represent a variation of the potlatches held by Athabascans located to the south, were formal events in which *umialiks* invited other *umialiks* to their community and distributed surplus goods to invited guests as a way of displaying wealth and power.

The economy of the North Slope underwent major changes beginning in the mid-nineteenth century, when commercial whaling introduced a new type of economy to the Iñupiat. During the whaling period, many local Iñupiat were hired as crew members in the whaling fleet. During this period, the whalers introduced the concept of providing goods in payment for local services and hired both interior and coastal Iñupiat. After the whaling industry collapse, fur trapping, trading posts, and reindeer herding were introduced into the local economy. Sale of Native crafts also began during the early twentieth century, and by the 1920s payment in goods was replaced with payment in cash (Spencer 1984). The fur trapping economy disrupted the previous Native economy as it emphasized individual pursuits for cash rather than more cooperative hunting for family and extended kin. The fur trade economy collapsed in the 1930s due to reduced worldwide demand for furs. As a result, many Iñupiaq trappers returned to a more traditional economy that emphasized cooperation and a self-sufficient subsistence mode of life (Chance 1990).

A new form of natural resource exploitation, the development of petroleum reserves, began in the 1940s and is still the driving economic force in today's economy on the North Slope. A number of local Iñupiat were hired as laborers to assist in exploration and development of the Petroleum Reserve (later known as the NPR-A). This development signaled the emergence of a full money economy on the North Slope that would continue to expand over the coming decades (Spencer 1984). Construction of defensive military sites, such as the Long Range Navigation sites, DEW line radar sites, and White Alice communication sites, were also important economic forces during the late 1940s and 1950s. Most of these jobs provided to the local people were temporary jobs, and the Iñupiat still relied on subsistence foods to supplement their wage income. This period marks the transition of the Iñupiaq economy from one that revolved around subsistence to one in which subsistence harvests are supplemented with cash from wage labor.

Today, the Iñupiat of the North Slope continue to rely on subsistence resources while also participating in the cash economy. Like other communities on the North Slope, Nuiqsut and Kaktovik have a mixed, subsistence-market economy (Wolfe and Walker 1985), where families invest money into small-scale, efficient technologies to harvest wild foods (BLM 2008). Subsistence harvests are important in providing food to local households, and these foods are preferred by Natives, especially elders, over store-bought foods. Cash from wage labor is also important in today's economy, as it enables local residents to purchase gas, rifles, ammunition, transportation, and other tools and technologies they need to harvest subsistence resources. ANCSA corporation dividends rely heavily on oil and gas development, and many residents use their dividends as investments into their subsistence way of life. These investments can include gill nets, motorized skiffs, and snowmachines used to conduct subsistence activities; they are not oriented toward sales or profits, but are focused on meeting the self-limiting needs of families and small communities.

For many Iñupiat, traditional hunting and harvesting patterns that revolved around procuring subsistence foods when they were most available now must be balanced with a need for income. Thus, for individuals with full-time jobs, resource harvesting is more likely to occur on weekends. In other cases, the wage provider of the household may not always be able to accompany other household members during certain subsistence activities, but provides the cash for purchasing supplies and fuel. These arrangements, in which one person provides the money for other people to engage in subsistence activities, have become common in today's mixed subsistence-market economy.

The trade networks that characterized the traditional subsistence economy between coastal and inland Iñupiat continue today. In fact, sharing of subsistence foods to other communities and regions is a major component of the mixed economy, and has been facilitated by advancements in rural transportation and technology (SRB&A 2018). According to Kofinas et al. (2016), during a single year of documentation of sharing by Kaktovik households for key species, sharing ties were documented between Kaktovik and 131 nonlocal households spread across 22 other Alaskan communities, two Canadian villages, and 11 locations outside Alaska.

U.5 CULTURAL VALUES AND BELIEF SYSTEMS

Traditional Iñupiaq belief systems consisted of two religious elements: hunting ritual and shamanism. These elements were similar to belief systems held by other Eskimo populations (Spencer 1984). Iñupiaq beliefs originally revolved around a system oriented to the environment and its animals. Following proper hunting rituals was necessary to ensure a successful harvest. These rituals included actions taken prior to the hunt to avoid offending the animals, as well as rituals after an animal had been taken. Examples of rituals that occurred after an animal had been taken included offering fresh water to sea mammals, giving gifts to trapped land animals, and cutting the throat or opening the brain pan to free the soul (Spencer 1984). The more important the resource was to the community, the more elaborate and extensive the rituals and ceremonies associated with it. One of the most important ceremonies on the coast was the Whale Feast (Nalukataq); its inland counterpart was the caribou festival (Spencer 1976).

Shamanism was a second key component to Iñupiaq belief systems. Shamans played specific roles relating to illness, predicting weather, finding lost items, foretelling the future, and speaking to the dead (Spencer 1984; Hall 1984). Despite the existence of shamans in traditional Iñupiaq society, the traditional belief system was largely fatalistic (Chance 1990). In other words, the Iñupiat believed that powers beyond their control governed their environment; their rituals and shamans, while having some influence, might prove ineffective despite their efforts.

Belief systems among the Iñupiat of the North Slope were largely unchanged prior to 1890, even though the region had experienced a number of changes from the whaling industry and various exploratory expeditions. After 1890, a number of Christian missions were established in the region, and rapid changes to Iñupiaq belief systems began to occur. The introduction of Christianity also introduced a rippling effect of changes that altered a number of Iñupiaq cultural values and traditions, particularly those surrounding housing, morality, subsistence, and social organization.

However, despite the changes brought about through the introduction of Christianity, the Iñupiat of the North Slope today retain a strong cultural identity associated with traditional subsistence hunting and harvesting patterns, and many traditional belief systems are strongly held. Contemporary Iñupiaq values strongly mirror traditional ones, and have come to be recognized as follows (NSB 2016):

- Respect for Nature
- Love & Respect for Elders and One Another
- Avoidance of Conflict
- Humility
- Compassion
- Humor
- Cooperation
- Hunting Traditions
- Family & Kinship
- Knowledge of our Language
- Sharing
- Spirituality

Many Iñupiaq values are directly reflected in subsistence activities and practices; others, such as language, family and kinship, humor, compassion, love and respect for elders, humility, avoidance of conflict, and spirituality, reflect the importance of cultural continuity and social and family ties within and among communities (USACE 2012). Language retention rates are relatively high among the Iñupiat of the North Slope, with 71 percent of household heads indicating that use of the Inupiaq language was “very important” in 2016 (SRB&A 2017). This is perhaps evidence of the efforts made by North Slope residents to promote knowledge of traditional values, such as through the establishment of the Department of Iñupiaq History, Language, and Culture; reintroducing the Iñupiaq language into schools; publishing elder conference proceedings; working with archaeologists to continue building their cultural history; and replacing English place names with Iñupiaq ones (Chance 1990).

The presence of both Christian and traditional values and beliefs continues among the Iñupiat today. While many traditional beliefs are no longer ascribed to, Christianity and the traditional belief system have become fused and often exist simultaneously in a single system (John 1996). Although there is primarily a Christian belief system in place, Alaska Natives' reverence for their environment and the traditional concepts of respect for the animals and each other are still in place and practiced. This is clearly seen in the list of values, above, that emphasize respect for nature and hunter success. The Alaska Natives' respect for their environment and the fish and animals is thus an integral part of their belief system.

Coastal North Slope communities maintain a strong maritime culture that centers on the bowhead whale hunt and emphasizes cooperation, participation in hunting traditions, and sharing. Sharing is central to the Iñupiaq worldview and is one of the core values of Iñupiaq culture and society (Alaska Native Knowledge Network 2019). Sharing, in this society, serves to maintain and strengthen social ties within and across communities. As Bodenhorn (2000b) describes it, sharing in Iñupiaq society is "a complex of social actions all of which create and maintain morally valued relations that extend well beyond hunting itself . . . Sharing both maintains social networks among humans and fulfills the social contract between humans and animals." As such, sharing is a central tenant of Alaska Eskimo (Iñupiaq and Siberian Yupik) whaling culture.

Based on her ethnographic research on Iñupiaq sharing, Bodenhorn (Bodenhorn 1988) describes the Iñupiaq concept of sharing beginning with the relationship between animal and hunter. The animal shares itself with the hunter, and the hunters' families share the meat so the animal will want to share itself again. The sharing relationship between animal and hunter is a "spiritual action" for the Iñupiat, which distinguishes it from the Western concept of sharing as a purely economic pursuit or aspect of social dynamics. Sharing is not just limited to subsistence foods. For example, in addition to the animal-hunter relationship, there is an Alaska Eskimo "obligation" to share knowledge with others, particularly younger generations.

Customary practices like *Kivgiq* (the Messenger Feast) and *Nalukataq* or *Qagruq* (the spring Whale Festival) exemplify the interconnectedness of subsistence hunting and sharing within and beyond the community. *Kivgiq,* a drumming, song, and dance celebration that serves as source of pride and collective identity that has been held since ancestral times, was discontinued in the "early 20th century due to social, economic, and environmental pressures," and restarted in 1988 (Ikuta 2007). *Nalukataq* occurs in June after spring whaling to celebrate a successful bowhead hunt. Successful whaling captains and their families prepare large amounts of bowhead and other traditional foods to feed the community and visitors from other communities (Ahmaogak 2000; Bodenhorn 2000a).

Iñupiaq people continue to identify with the places of their ancestors and return to these places to hunt, fish, camp, gather, and process wild foods. Iñupiaq people's relationship to the land is characterized by these subsistence traditions in addition to stories and place names associated with places, trails and travel routes, and landmarks. Thus, to the Iñupiat, protection of traditional lands, waters, and the wild resources that inhabit them is essential to maintaining cultural traditions, knowledge, and identity.

U.6 References

Ahmaogak, M. 2000. Alaska Eskimo Whaling Commission – Overview and Current Concerns. Traditional Whaling in the Western Arctic. National Science Foundation, Office of Polar Programs. Available online at http://www.uark.edu/misc/jcdixon/Historic_Whaling/AEWC/aewc_maggie%20presentation.htm, .

Alaska Consultants Inc., Clyde S. Courtnage, and SRB&A (Stephen R. Braund & Associates). 1984. Barrow Arch Socioeconomic and Sociocultural Description. Technical Report No. 101. Prepared for Minerals Management Service, Alaska OCS Region, Social and Economic Studies Program. Anchorage, Alaska.

Alaska Department of Commerce, Community, and Economic Development (ADCCED). 2015. "Local Government in Alaska." https://www.commerce.alaska.gov/web/Portals/4/pub/2015%20%20LOCAL%20GOVERNMENT%20IN%20ALASKA.pdf.

Allen, Henry T. 1887. "Report of an Expedition to the Copper, Tananá, and Kóyukuk Rivers, in the Territory of Alaska, in the Year 1885 : Made under the Direction of General Nelson A. Miles, Commanding the Department of the Columbia." In *Ex. doc. / 49th Congress, 2nd session, Senate no. 125*. Washington D.C.: U.S. Government Printing Office.

Arctic Slope Community Foundation. 2012. "Communities." Accessed January 2012. http://www.arcticslopecommunity.org/communities/.

Bechtel Corporation. 2012. "Web Page for the Trans Alaska Pipeline System Project.", Accessed Feburary 2012. http://www.bechtel.com/trans-alaska_pipeline.html

BLM, (Bureau of Land Management). 2008. Northeast National Petroleum Reserve-Alaska Final Supplemental Integrated Activity Plan/Environmental Impact Statement. edited by (United States Department of the Interior) DOI. Anchorage, Alaska.

Bockstoce, John R., and New Bedford Whaling Museum. 1995. Whales, Ice, and Men : The History of Whaling in the Western Arctic. 2nd printing with corrections. ed. Seattle, Washington: University of Washington Press in association with the New Bedford Whaling Museum.

Bodenhorn, B. 2000a. The Cost of Sharing. Traditional Whaling in the Western Arctic. . Office of Polar Programs National Science Foundation. Available online at http://www.uark.edu/misc/jcdixon/Historic_Whaling/AEWC/aewc_maggie%20presentation.htm.

Bodenhorn, B. 2000b. "It's Good to Know Who Your Relatives Are but We Were Taught to Share with Everybody: Shares and Sharing among Inupiaq Households. ." In *The Social Economy of Sharing: Resource Allocation and Modern Hunter-Gatherers*, edited by George W. Wnzel, Grete Hovelsrud-Broda and Nobuhiro Kishigami, 27-60. Osaka, Japan: National Museum of Ethnology.

Bodenhorn, Barbara. 1988. Documenting Inupiat Family Relationships in Changing Times. Edited by Language and Culture and the Alaska Humanities Forum. Prepared for the North Slope Borough Commission on Inupiat History. Utqiagvik, Alaska.

Braem, Nicole M., Tina Kaleak, David Koster, Price Leavitt, Patsy Neakok, James Patkotak, Sverre Pedersen, and Jim Simon. 2011. Monitoring of Annual Caribou Harvests in the National Petroleum Reserve in Alaska: Atqasuk, Barrow, and Nuiqsut, 2003-2007. Technical Paper No. 361. Alaska Dept. of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://library.state.ak.us/asp/edocs/2011/06/ocn739704678.pdf.

Braem, Nicole M., Elizabeth H. Mikow, Andrew R. Brenner, Anna R. Godduhn, Brittany Retherford, and Marylynne L. Kostick. 2017. Chukchi Sea and Norton Sound Observation Network: Harvest and Use of Wild Resources in 9 Communities in Arctic Alaska, 2012-2014. Technical Paper No. 403. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/techpap/TP403.pdf.

Brown, William E. 1979. Nuiqsut Paisanich: Nuiqsut Heritage, a Cultural Plan. Prepared for the Village of Nuiqsut and the North Slope Borough Planning Commission on History and Culture. Arctic Environmental Information and Data Center. Anchorage, Alaska.

Burch, Ernest S., Jr. 1979. "Indians and Eskimos in North Alaska, 1816-1977: A Study in Changing Ethnic Relations." *Arctic Anthropology* 16 (2):123-151.

Burch, Ernest S., Jr. 1980. Traditional Eskimo Societies in Northwest Alaska. Alaska Native Culture and History. Edited by Y. Kotani and W. Workman. Senri Ethnological Studies 4. National Museum of Ethnology. Senri, Osaka, Japan.

Burch, Ernest S., Jr. 1981. The Traditional Eskimo Hunters of Point Hope, Alaska: 1800-1875. Utqiagvik, Alaska: North Slope Borough.

Campbell, John Martin. 1998. North Alaska Chronicle : Notes from the End of Time : The Simon Paneak Drawings. Santa Fe, N.M.: Museum of New Mexico Press.

Case, David S. 1984. Alaska Natives and American Laws. Revived from 1978 ed. Fairbanks, Alaska: University of Alaska Press.

Chance, Norman A. 1990. The Iñupiat and Arctic Alaska: An Ethnography of Development, *Case Studies in Cultural Anthropology*. Fort Worth, Texas: Holt, Rinehart and Winston,.

Coates, Peter A. 1991. The Trans-Alaska Pipeline Controversy: Technology, Conservation, and the Frontier. Bethlehem, Pennsylvania; London, England; Cranbury, New Jersey: Lehigh University Press; Associated University Presses.

Galginaitis, M., C. Chang, K. Macqeen, A. Dekin Jr., D. Zipkin. 1984. Ethnographic Study and Monitoring Methodology of Contemporary Economic Growth, Sociocultural Change and Community Development in Nuiqsut, Alaska (Nuiqsut Case Study). U.S. Department of the Interior, Minerals Management Service, Alaska Ocs Region Social and Economic Studies No. 96. Springfield, Virginia.

Gubser, Nicholas J. 1965. The Nunamuit: Eskimo Hunters of the Caribou. New Haven, CT: Yale University Press.

Hall Jr., Edwin S. 1984. "Interior North Alaska Eskimo." In *Handbook of North American Indians, Volume 5: Arctic*, edited by David Damas, 338-346. Washington, D.C.: Smithsonian Institute Press.

Hall Jr., Edwin S., S. Craig Gerlach, Margaret B. Blackman, and North Slope Borough. 1985. In the National Interest : A Geographically Based Study of Anaktuvuk Pass Iñupiat Subsistence through Time. 2 vols. Utqiagvik, Alaska: North Slope Borough.

Healy, Michael A. 1887. Report of the Cruise of the Revenue Marine Steamer Corwin in the Arctic Ocean in the Year 1885. U.S. Revenue Cutter Service. Washington, D.C.: Govt. Print. Off.

Ikuta, H. 2007. " Iñupiaq Pride: Kivgiq (Messenger Feast) on the Alaskan North Slope." *Etudes/Inuit/Studies* 31 (1-2):343-364.

Impact Assessment Inc. 1989a. Point Lay Biographies. Technical Report 140. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region Social and Economic Studies. Anchorage, AK.

Impact Assessment Inc. 1989b. Point Lay Case Study. Technical Report 139. MMS OCS Study No. 89-0093. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region Social and Economic Studies. Anchorage, AK.

Impact Assessment Inc. 1990a. Subsistence Resource Harvest Patterns: Kaktovik. Final Special Report. OCS Study MMS 90-0039. Anchorage, AK.

Impact Assessment Inc. 1990b. Subsistence Resource Harvest Patterns: Nuiqsut. Final Special Report. OCS Study MMS 90-0038. Anchorage, AK.

Iñupiat Community of the Arctic Slope (ICAS). 2012. "Welcome Section." Accessed February 2012. www.inupiatgov.com.

Jackson, Sheldon. 1906. Fifteenth Annual Report on Introduction of Domestic Reindeer into Alaska with Maps and Illustrations. 1905. U.S. Government Printing Office. Washington D.C.

Jensen, Anne M. 2009. Archaeological and Cultural Resources Reconnaissance for the Barrow Gas Fields Upgrades Project, North Slope, Alaska. Petrotechnical Resources of Alaska, Inc. Utqiagvik, AK: LLC UIC Science.

John, P. 1996. The Gospel According to Peter John, with Commentaries. . Fairbanks, AK: Alaska Knowledge Network, University of Alaska Fairbanks.

Kofinas, G., S. B. BurnSilver, J. Magdanz, R. Stotts, and M. Okada. 2016. Subsistence Sharing Networks and Cooperation: Kaktovik, Wainwright, and Venetie, Alaska. BOEM Report 2015-023 DOI; AFES Report MP 2015-02. School of Natural Resources and Extension, University of Alaska Fairbanks. Fairbanks, AK.

Kunz, M., and R. Reanier. 1996. "The Mesa Site, Iteriak Creek." In *American Beginnings: The Prehistory and Paleoecology of Beringia*, edited by F. West. Chicago, IL: University of Chicago Press.

Libbey, David. 1983. Kaktovik Area Cultural Resources Survey: Preliminary Report. North Slope Borough. Utqiagvik, AK.

Milan, Frederick A. 1964. "The Acculturation of the Contemporary Eskimo of Wainwright, Alaska." *Anthroplogical Papers of the University of Alaska* 11 (2):1-95.

Morehouse, T., L. McBeath, and L. Leask. 1984. Alaska's Urban and Rural Governments. Institute of Social and Economic Research and Department of Political Science, University of Alaska. Lanham, MD: University Press of America.

Murdoch, J. 1885. Catalogue of Ethnological Specimens Collected by the Point Barrow Expedition. In Report of the International Polar Expedition to Point Barrow, Alaska, in Response to the Resolution of the House of Representatives of December 11, 1884. Washington, D.C.: U.S. Government Printing Office.

Murdoch, John. 1892. Ethnological Results of the Point Barrow Expedition. Washington, D.C.: Government Printing Office.

Network, Alaska Native Knowledge. 2019. "Inupiat Ilitqusiat." Accessed July 2019. http://www.ankn.uaf.edu/curriculum/Inupiaq/Ilitqusiat/index.html.

Neufeld, D. 2002. The Distant Early Warning (Dew) Line: A Preliminary Assessment of Its Role and Effects Upon Northern Canada. Calgary, Alberta: Arctic Institute of North America.

North Slope Borough. 1990. Anaktuvuk Pass: Land of the Nunamiut. . Utqiagvik, Alaska: Language North Slope Borough Commission on Iñupiat History, and Culture.

NSB, (North Slope Borough). 2016. North Slope Borough 2015 Economic Profile and Census Report. Available online at http://www.north-slope.org/assets/images/uploads/NSB_Economic_Profile_and_Census_Report_2015_FINAL.pdf.

Nygren, Rear Admiral Harley D. 2001. Oral History Transcript -Transcript of Interview November 1, 2001. Edited by Brian Shoemaker. Available online at https://kb.osu.edu/dspace/bitstream/handle/1811/38816/Nygrentranscript1.pdf?sequence=1.

Paige, S., W. Foran, and J. Gilluly. 1925. A Reconnaissance of the Point Barrow Region, Alaska. . Washington, D.C.: U.S. Government Printing Office.

Paul, F. 2003. Then Fight for It! The Largest Peaceful Redistribution of Wealth in the History of Mankind and the Creation of the North Slope Borough. . Victoria, B.C.: Trafford Publishing.

Radomes Inc. 2012. Database and Historical Information Regarding Radar, Communications and Air Defense Installations and Technology. . Available online at http://www.radomes.org/.

Ray, Lt. P.H. 1885. Ethnographic Sketch of the Natives of Point Barrow. Part Iii in Report of Theinternational Polar Expedition to Point Barrow, Alaska, in Response to the Resolution of the House of Representatives of December 11, 1884. Washington, D.C.: U.S. Government Printing Office.

Reed, John Calvin, Geological Survey (U.S.), and United States. Office of Naval Petroleum and Oil Shale Reserves. 1958. Exploration of Naval Petroleum Reserve Numbers 4 and Adjacent Areas, Northern Alaska, 1944-53. Part 1, History of the Exploration. Geological Survey professional paper. 301. Washington D.C.: U.S. Government Printing Office. Available online at http://purl.fdlp.gov/GPO/gpo85858.

Schneider, William S., Sverre Pedersen, and David Libbey. 1980. The Barrow-Atqasuk Report: A Study of Land Use Values through Time. Fairbanks, Alaska: North Slope Borough; Anthropology and Historic Preservation, Cooperative Park Studies Unit, University of Alaska.

Smith, Philip S., and John Beaver Mertie. 1930. Geology and Mineral Resources of Northwestern Alaska, *Bulletin 815*. Washington, D.C.: U.S. Government Printing Office.

Spencer, Robert F. 1976. The North Alaskan Eskimo: A Study in Ecology and Society. Mineola, NY: Inc. Dover Publications.

Spencer, Robert F. 1984. "North Alaska Coast Eskimo." In *Handbook of North American Indians, Volume 5: Arctic*, edited by David Damas, 320-337. Washington, DC: Smithsonian Institute Press.

SRB&A, (Braund, Stephen R. & Associates). 2017. Social Indicators in Coastal Alaska, Arctic Communities. Final Report. OCS study. Technical Report No. BOEM 2017-035. U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region. Anchorage, Alaska. Available online at http://www.arlis.org/docs/vol1/BOEM/OCS/2017/2017-035.pdf.

SRB&A, (Braund, Stephen R. & Associates). 2018. Description of Alaskan Eskimo Bowhead Whale Subsistence Sharing Practices: Including an Overview of Bowhead Whale Harvesting and Community-Based Need. Submitted to Alaska Eskimo Whaling Commission. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates), and (Institute of Social and Economic Research) ISER. 1993. North Slope Subsistence Study: Barrow, 1987, 1988, and 1989. Prepared by S.R. Braund, K. Brewster, L. Moorehead, T.P. Holmes, J.A. Kruse, S. Stoker, M. Glen, E. Witten, D.C. Burnham and W.E. Simeone. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region Social and Economic Studies. Technical Report No. 149 (PB93-198661), OCS Study MMS 91-0086, Contract No. 14-12-0001-30284. Anchorage, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/Braund_North_Slope_Subsistence_Study_Barrow_1987,_1988,_1989_MMS_91-0086.pdf.

Stoney, Lt. G.M. 1899. "Explorations in Alaska." In *Proceedings of the United States Naval Institutue*, 799-851. Annapolis, MD: United States Naval Institute.

Tailleur, I. 1964. Rich Oil Shale from Northern Alaska. Article 148 in Short Papers in Geology and Hydrology, Articles 122-172, Geological Survey Research 1963. U.S. Geological Survey Professional Paper 475-D. Washington, D.C.: U.S. Government Printing Office.

USACE, (U.S. Army Corps of Engineers). 2012. Point Thomson Project Eis, Final Environmental Impact Statement. 3 vols. JBER, AK: U.S. Army Corps of Engineers, Alaska District, Alaska Regulatory Division CEPOA-RD.

Wolfe, R., and R. Walker. 1985. Subsistence Economies in Alaska: Productivity, Geography, and Development Impacts. Alaska Department of Fish and Game, Division of Subsistence. Juneau, Alaska.

Appendix V

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

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ACRONYMS AND ABBREVIATIONS

Acronym	Full Phrase
CEQ	Council on Environmental Quality
EO	executive order
NEPA	National Environmental Policy Act

Appendix V. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

President William J. Clinton issued Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, in 1994. Its purpose is to focus federal attention on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities. The EO directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations to the greatest extent practicable and permitted by law.

When determining whether effects are disproportionately high and adverse, EO 12898 directs agencies to consider the following:

- Whether there is, or will be, an effect on the natural or physical environment that significantly (as defined by the National Environmental Policy Act [NEPA]) and will adversely affect a minority or low-income population or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority or low-income communities or Indian tribes, when those impacts are interrelated to impacts on the natural or physical environment.
- Whether environmental effects are significant (as defined by NEPA) and are having now or may have in the future an adverse impact on minority or low-income populations or Indian tribes. This would be any environmental effects that would appreciably exceed, or are likely to appreciably exceed, those on the general population or other appropriate comparison group.
- Whether the environmental effects occur, or would occur, in a minority or low-income population or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

The Council on Environmental Quality (CEQ) guidance on environmental justice under NEPA directs federal agencies to apply CEQ guidance with flexibility and to consider them a point of departure rather than conclusive direction in applying the terms of EO 12898 (CEQ 1997).

The study area for the environmental justice analysis is as follows:

- The three tiers of communities that use subsistence resources in the planning area, as described in Chapter 3 of the Final IAP/EIS, Section 3.4.3
- All communities in the North Slope Borough, except for Prudhoe Bay/Deadhorse

Prudhoe Bay/Deadhorse is not included because it is an industrial enclave, with all of its population living in group quarters. Apart from Kaktovik, Point Hope, and Prudhoe Bay/Deadhorse, all communities in the North Slope Borough are Tier 1 communities.

In addition, the study area includes non-bounded communities. In accordance with the guidance in CEQ (1997), in identifying minority and low-income populations, the environmental justice analysis considers as a community a geographically dispersed set of individuals who share a common direct or indirect effect on the human environment as a result of the proposed action.

This analysis identified minority and low-income populations in place-based study area communities, using the 2017 American Community Survey 5-year data provided by the U.S. Census Bureau (2019). The analysis based minority status determinations on identifying all persons other than those who self-identify in the census as both White and non-Hispanic or Latino. The analysis based low-income status determinations on identifying individuals living in poverty in the previous 12 months.

This analysis identified a study area community as an area of potential environmental justice concern if (1) the minority population exceeds 50 percent or (2) the minority or low-income population is meaningfully greater than the minority or low-income population percentage in a reference population. For the purposes of this analysis, the population of Alaska is the reference population.

The decision threshold, when there is a "meaningfully greater" percentage of minority or low-income individuals than in the reference population, is based on the following equation:

> (minority or low-income population in study area community/total population in study area community)
>
> divided by
>
> (minority or low-income population in reference area/total population in reference area)

If the equation results in a number greater than 1, there is a greater proportion of minority or low-income individuals residing in the study area community than in the reference population.

Table V-1 presents population, minority, and low-income characteristics of study area communities and other geographic extents, such as relevant boroughs and Alaska as a whole. Communities for all three tiers are included. The communities that did not meet the environmental justice criteria are Fairbanks, Wiseman, and Bettles.

Table V-1
Environmental Justice Metrics in Study Area Communities

Geographic Location	Associated with Alaska Native Tribe	Total Population	Minority Population Metric: White (Percent)[1]	Minority Population Metric: Black or African American (Percent)[2]	Minority Population Metric: American Indian or Alaska Native (Percent)[2]	Minority Population Metric: Asian (Percent)[2]	Minority Population Metric: Pacific Islander (Percent)[2]	Minority Population Metric: Other (Percent)[2]	Minority Population Metric: Hispanic or Latino (Percent)[3]	Minority Population Metric: Minority (Percent)[4]	Minority Population Metric: Area of Potential Concern?	Low-Income Population Metric: Unemploy-ment Rate (Percent)	Low-Income Population Metric: Median Household Income (in Dollars)	Low-Income Population Metric: Individuals Below Poverty Level (Percent)	Low-Income Population Metric: Area of Potential Concern?
State of Alaska	–	738,565	61.5	4.9	19.6	8.1	1.9	1.9	6.8	38.5	–	7.7	76,114	10.2	–
Fairbanks North Star Borough	–	100,031	83.8	6.7	11.5	4.8	0.9	1.2	7.7	28.9	–	8.0	76,250	7.7	–
Fairbanks	No	31,853	57.5	12.7	13.7	6.6	1.6	2.0	11.9	42.5	No	9.4	60,658	11.9	No
Nome Census Area	–	9,869	23.1	1.4	80.6	2.1	0.5	0.1	2.4	85.1	–	16.6	53,821	24.9	–
Brevig Mission	Yes	421	0.7	1.4	99.3	0.0	0.0	0.0	0.0	99.3	Yes	30.8	33,750	59.3	Yes
Elim	Yes	296	1.7	0.0	98.3	0.0	0.0	0.0	0.7	98.3	Yes	25.5	39,375	25.5	Yes
Golovin (Cheenik)	Yes	123	4.9	0.0	94.3	0.0	0.0	0.8	0.8	95.1	Yes	11.5	50,000	19.5	Yes
Koyuk	Yes	248	2.0	0.0	97.6	1.2	0.0	0.0	0.0	98.0	Yes	36.0	36,429	41.1	Yes
Nome	Yes	3,793	27.3	3.3	64.1	2.2	1.1	0.3	5.8	72.7	Yes	9.6	81,389	11.8	Yes
St. Michael	Yes	441	1.1	0.2	98.9	0.0	0.5	0.0	0.0	98.9	Yes	21.3	42,813	23.3	Yes
Shaktoolik	Yes	282	1.1	0.0	98.9	1.1	0.0	0.0	0.0	98.9	Yes	20.5	56,875	16.0	Yes
Shishmaref	Yes	522	6.5	0.6	92.7	0.2	0.0	0.0	0.0	93.5	Yes	18.8	34,583	37.3	Yes
Stebbins	Yes	500	2.2	0.0	97.8	0.0	1.2	0.0	0.0	97.8	Yes	23.9	37,679	33.9	Yes
Teller	Yes	184	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	Yes	15.0	33,750	37.5	Yes
Unalakleet	Yes	685	11.7	0.7	75.2	14.0	0.0	0.0	0.1	88.3	Yes	12.0	61,250	13.5	Yes
Wales	Yes	159	0.6	0.0	99.4	0.0	0.0	0.0	0.0	99.4	Yes	12.0	31,250	41.4	Yes
White Mountain	Yes	173	9.2	0.0	90.8	0.0	0.0	0.0	0.0	90.8	Yes	21.2	38,125	30.6	Yes
North Slope Borough[5]	–	6,836	25.5	2.2	77.3	8.3	4.3	1.3	3.9	89.6	–	18.1	76,776	13.6	–
Anaktuvuk Pass	Yes	290	11.7	1.0	87.2	0.0	0.0	0.0	1.7	88.3	Yes	50.4	56,667	33.6	Yes
Atqasuk	Yes	172	1.7	0.0	98.3	0.0	0.0	0.0	0.0	98.3	Yes	11.6	61,250	19.2	Yes
Utqiagvik	Yes	4,383	13.0	2.9	68.6	12.8	6.5	1.6	4.6	87.0	Yes	14.2	82,964	11.2	Yes
Nuiqsut	Yes	395	7.8	0.0	90.9	0.0	1.5	0.0	0.0	92.2	Yes	23.1	82,813	9.3	No
Point Hope	Yes	629	3.8	2.2	94.1	1.4	0.0	2.9	6.0	96.2	Yes	32.3	60,417	20.0	Yes
Point Lay	Yes	273	4.4	0.0	92.7	0.0	1.5	0.0	4.8	95.6	Yes	22.4	58,750	20.2	Yes
Wainwright	Yes	513	6.2	0.2	93.8	0.0	0.0	0.0	2.3	93.8	Yes	15.9	71,250	13.5	Yes
Kaktovik	Yes	181	9.9	2.8	94.5	0.0	0.0	0.0	0.0	97.2	Yes	15.7	60,417	10.8	Yes

Geographic Location	Associated with Alaska Native Tribe	Total Population	Minority Population Metric: White (Percent)[1]	Minority Population Metric: Black or African American (Percent)[2]	Minority Population Metric: American Indian or Alaska Native (Percent)[2]	Minority Population Metric: Asian (Percent)[2]	Minority Population Metric: Pacific Islander (Percent)[2]	Minority Population Metric: Other (Percent)[2]	Minority Population Metric: Hispanic or Latino (Percent)[3]	Minority Population Metric: Minority (Percent)[4]	Minority Population Metric: Area of Potential Concern?	Low-Income Population Metric: Unemploy-ment Rate (Percent)	Low-Income Population Metric: Median Household Income (in Dollars)	Low-Income Population Metric: Individuals Below Poverty Level (Percent)	Low-Income Population Metric: Area of Potential Concern?
Northwest Arctic Borough	–	7,715	15.1	1.0	85.0	1.8	0.5	1.0	2.5	88.9	–	20.1	61,533	25.3	–
Ambler	Yes	299	3.3	0.0	96.3	0.0	1.0	0.0	0.0	96.7	Yes	22.2	44,500	27.8	Yes
Buckland	Yes	627	1.8	0.0	97.4	0.2	0.0	0.6	0.6	98.2	Yes	42.2	41,932	22.5	Yes
Deering	Yes	152	1.3	0.0	92.1	6.6	0.0	0.0	0.0	98.7	Yes	14.3	44,375	13.2	Yes
Kiana	Yes	284	3.5	0.0	95.4	1.1	1.4	0.0	0.0	96.5	Yes	31.0	42,813	37.5	Yes
Kivalina	Yes	678	5.2	0.6	94.2	0.0	0.0	0.0	0.6	94.8	Yes	20.3	48,750	31.1	Yes
Kobuk	Yes	152	5.3	0.0	94.7	0.0	0.0	0.0	9.2	94.7	Yes	26.7	52,500	39.5	Yes
Kotzebue	Yes	3,276	20.4	1.7	73.2	2.7	0.9	1.9	4.9	79.6	Yes	11.9	88,047	16.2	Yes
Noatak	Yes	424	0.9	0.7	98.6	0.0	0.0	0.0	0.0	99.1	Yes	29.5	50,000	28.8	Yes
Noorvik	Yes	579	4.8	0.0	95.2	0.0	0.0	0.0	0.0	95.2	Yes	29.5	48,750	32.2	Yes
Selawik	Yes	813	1.4	0.0	98.6	0.0	0.0	0.0	0.0	98.6	Yes	36.1	35,625	46.6	Yes
Shungnak	Yes	280	13.2	0.7	80.0	6.8	0.0	0.0	0.0	86.8	Yes	26.4	39,688	31.9	Yes
Kusilvak Census Area	–	8,129	7.6	1.2	94.6	0.6	0.2	0.0	1.6	96.2	–	28.8	36,468	39.1	–
Kotlik	Yes	726	1.9	1.2	97.8	0.0	0.0	0.0	0.0	98.1	Yes	17.0	41,667	44.2	Yes
Yukon-Koyukuk Census Area	–	5,453	27.9	0.5	76.3	0.7	0.1	0.2	2.1	78.7	–	19.7	37,819	25.5	–
Allakaket	Yes	186	10.2	0.0	82.8	2.2	0.0	0.0	4.8	89.8	Yes	35.8	27,250	28.8	Yes
Bettles[6]	No	74	68.9	0.0	31.1	0.0	0.0	0.0	0.0	31.1	No	N/A	68,125[f]	0.0	No
Galena	Yes	473	32.1	0.2	63.6	1.7	0.0	0.0	2.5	67.9	Yes	11.0	74,375	10.4	Yes
Hughes	Yes	77	0.0	0.0	89.6	10.4	0.0	0.0	0.0	100.0	Yes	10.5	34,375	28.6	Yes
Huslia	Yes	397	8.1	0.0	91.9	0.0	0.0	0.0	1.8	91.9	Yes	22.6	40,000	24.2	Yes
Kaltag	Yes	165	8.5	0.0	91.5	0.0	0.0	0.0	0.0	91.5	Yes	35.4	27,500	18.8	Yes
Koyukuk	Yes	54	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	Yes	19.2	15,417	42.6	Yes
Nulato	Yes	276	2.9	1.4	97.1	0.0	0.0	0.0	0.0	97.1	Yes	30.2	38,333	31.4	Yes
Wiseman	No	9	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	No	0.0	N/A	0.0	No

Sources: U.S. Census Bureau 2019; National Conference of State Legislatures 2018
"–" = Not applicable
N/A = Datga not available
[1]Alone, non-Hispanic or Latino
[2]Alone or in combination with one or more other races
[3]Hispanic or Latino; can be of any race
[4]100 percent, minus White, non-Hispanic, or Latino
[5]Statistics for North Slope Borough exclude Prudhoe Bay/Deadhorse.
[6]Median household income data for Bettles are from DCCED 2019.

V.1 References

Alaska Department of Commerce, Community and Economic Development (DCCED), Division of Community and Regional Affairs. 2019. Community Database Online. Internet website: https://dcra-cdo-dcced.opendata.arcgis.com/.

CEQ (Council on Environmental Quality). 1997. Environmental Justice Guidance under the National Environmental Policy Act. Internet website: https://www.epa.gov/sites/production/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf.

National Conference of State Legislatures. 2018. Federal and State Recognized Tribes. Internet website: http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx.

U.S. Census Bureau. 2019. American FactFinder: American Community Survey. Internet website: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml.

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Appendix W

Economic Considerations

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS	Full Phrase
ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADOLWD	Alaska Department of Labor and Workforce Development
NPR-A	National Petroleum Reserve in Alaska
NSB	North Slope Borough

Appendix W. Economic Considerations

Table W-1
Population of the Potentially Affected Communities and Areas, 2010 to 2018

Area	2010	2011	2012	2013	2014	2015	2016	2017	2018	Percent Change
North Slope Communities	–	–	–	–	–	–	–	–	–	–
Anaktuvuk Pass	324	323	343	358	325	357	355	356	372	15
Atqasuk	233	243	234	248	230	243	222	225	234	0
Kaktovik	239	247	244	262	252	244	244	235	238	0
Nuiqsut	402	426	427	452	446	450	471	483	499	24
Point Hope	674	667	667	684	654	680	673	678	693	3
Point Lay	189	183	196	215	190	213	213	233	230	22
Utqiagvik	4,212	4,316	4,432	4,510	4,477	4,546	4,467	4,484	4,497	7
Wainwright	556	570	563	542	554	555	557	572	561	1
NSB	**9,430**	**9,576**	**9,707**	**9,872**	**9,729**	**9,889**	**9,804**	**9,867**	**9,925**	**5**
Alaska	**710,231**	**722,159**	**730,603**	**736,071**	**736,423**	**737,022**	**739,676**	**737,847**	**736,239**	**4**

Source: Alaska Department of Labor and Workforce Development (ADOLWD) 2019a

Table W-2
Comparison of 2015 Population Estimates or North Slope Communities, ADOLWD versus North Slope Borough (NSB) Census

Community	ADOLWD Estimate	NSB Census/ DCCED-Certified
Anaktuvuk Pass	324	375
Atqasuk	229	248
Kaktovik	251	262
Nuiqsut	444	449
Point Hope	651	697
Point Lay	189	242
Utqiagvik	4,469	4,825
Wainwright	553	550

Source: NSB 2015

Table W-3
Employment and Total Wages in Potentially Affected Communities

Area	Residents Employed		Employment Sector			Total Wages
	#	%	Private	Local	State	
Anaktuvuk Pass	150	68	35	115	0	$4,075,079
Atqasuk	112	76	19	93	0	$3,535,983
Kaktovik	125	71	41	84	0	$4,958,179
Nuiqsut	193	75	73	120	0	$5,919,157
Point Hope	301	67	117	183	1	$8,023,956
Point Lay	106	77	15	91	0	$3,479,948
Utqiagvik	2,044	71	875	1,155	14	$111,007,143
Wainwright	219	63	72	147	0	$6,659,365

Source: ADOLWD 2019b

Table W-4
Resident Employment by Sector: Nuiqsut

Industry	Number of Employees	Percent
Local government	120	62.2
Other	29	15.0
Trade, transportation, and utilities	17	8.8
Construction	13	6.7
Professional and business services	7	3.6
Natural resources and mining	3	1.6
Leisure and hospitality	2	1.0
Information	1	0.5
Educational and health services	1	0.5
Total	**193**	**100**

Source: ADOLWD 2019c

Table W-5
NSB Employment by Sector

Industry	Number of Employees	Percent
Local government	1,988	61.0
Educational and health services	321	9.8
Trade, transportation, and utilities	305	9.4
Professional and business services	228	7.0
Construction	142	4.4
Financial activities	79	2.4
Leisure and hospitality	70	2.1
Other	48	1.5
Natural resources and mining	37	1.1
Information	19	0.6
State Government	15	0.5
Manufacturing	9	0.3
Total	**3,261**	**100**

Source: ADOLWD 2019d

Table W-6
City of Nuiqsut Fiscal Year 2019 Budget

Revenues	Amount ($)	Percent
Hotel Taxes	250,000	10
Tobacco excise taxes	100,000	4
Licenses and permits	150	0
Contracted services	95,963	4
Enterprises: bingo receipts	157,678	6
Rentals	85,000	3
Pop sales/concessions	3,500	0
Subtotal: Locally Generated Revenues	**692,291**	**26**
State community revenue sharing	81,000	3
NSB revenues	230,000	9
Federal revenues (NPR-A impact funds)	1,409,064	54
ASRC grants	10,000	0
Impact mitigation funds	200,000	8
Subtotal: Outside operating revenues	**1,930,064**	**74**
Total operating revenues	**2,622,355**	**100**

Source: City of Nuiqsut: Authorized Budget Revenues and Expenditures for July 1, 2017, through June 30, 2018 Document available through Financial Documents Delivery System (Alaska Department of Commerce, Community, and Economic Development (ADCCED 2019a).

Table W-7
NSB Local Governments' Fiscal Year 2018 Operating Revenues by Source

Local Government	Locally Generated Revenues		Outside Revenues		Total
	Amount	Percent	Amount	Percent	
Anaktuvuk Pass City	$643,749	58	$457,732	42	**$1,101,481**
City of Atqasuk	$349,000	78	$101,152	22	**$450,152**
City of Kaktovik	$1,117,380	76	$346,523	24	**$1,463,904**
Nuiqsut City	$692,291	26	$1,930,064	74	**$2,622,355**
Point Hope	$221,745	35	$412,897	65	**$634,642**
Utqiagvik	$1,263,000	44	$1,618,500	56	**$2,881,500**
Wainwright	$213,172	63	$127,888	37	**$341,060**

Source: ADCCED 2019a
Note: The City of Atqasuk (refers to the general fund operating revenues only). In fiscal year 2018, the city budget included $746,000 of special revenues, not included in the general fund from Gaming NP.

Table W-8
Summary of NPR-A Impact Mitigation Grants Awarded, by Community

Fiscal Year	NSB	Anaktuvuk Pass	Atqasuk	Utqiagvik	Nuiqsut	Wainwright	Total
87	$3,772,137	$0	$689,000	$825,000	$1,342,720	$611,380	$7,240,237
89	$937,000	$0	$0	$0	$0	$0	$937,000
90	$0	$0	$176,112	$361,881	$57,900	$240,852	$836,745
91	$200,000	$0	$21,181	$287,299	$30,500	$51,020	$590,000
92	$0	$0	$84,130	$146,951	$55,841	$80,456	$367,378
93	$0	$0	$50,000	$200,000	$90,000	$107,126	$447,126
94	$0	$0	$4,167	$6,440	$4,167	$4,167	$18,941
95	$0	$0	$8,172	$7,662	$3,320	$6,385	$25,538
00	$24,485,348	$0	$199,000	$3,280,000	$311,369	$0	$28,275,717
02	$14,658,997	$0	$0	$493,940	$90,000	$0	$15,242,937
03	$988,048	$0	$298,057	$400,000	$0	$0	$1,686,105
04	$22,509,376	$0	$368,621	$2,133,460	$0	$0	$25,011,457
05	$2,100,586	$0	$0	$180,000	$250,000	$0	$2,530,586
06	$21,570,075	$0	$1,016,468	$1,693,201	$468,000	$0	$24,747,744
07	$2,750,562	$0	$345,867	$744,073	$438,000	$0	$4,278,502
08	$7,720,197	$0	$203,576	$2,312,514	$221,774	$105,157	$10,563,218
09	$2,039,473	$0	$238,000	$2,285,000	$335,000	$349,000	$5,246,473
10	$10,743,224	$0	$226,500	$3,800,000	$608,847	$589,269	$15,967,840
11	$9,724,099	$257,703	$403,474	$6,541,120	$1,296,284	$1,516,704	$19,739,384
12	$292,458	$536,985	$300,000	$1,600,000	$595,000	$245,000	$3,569,443
13	$1,451,133	$348,872	$493,940	$1,600,000	$976,181	$228,000	$5,098,126
14	$685,419	$180,000	$489,233	$906,142	$575,000	$648,119	$3,483,913
15	$1,000,000	$256,831	$150,000	$2,318,636	$0	$0	$3,725,467
16	$0	$571,536	$147,070	$1,600,000	$609,478	$447,500	$3,375,584
17	$0	$0	$218,000	$975,000	$410,000	$249,925	$1,852,925
18	$0	$0	$0	$889,392	$0	$222,123	$1,111,515
19	$5,851,848	$0	$393,061	$2,597,690	$1,409,064	$788,523	$11,040,186
Total	**133,479,980**	**2,151,927**	**6,523,629**	**38,185,400**	**10,178,445**	**6,490,706**	**197,010,087**

Source: ADCCED 2019b

Table W-9
Estimated Potential Employment Effects under the Hypothetical Unconstrained Scenario/Alternative D

Type	Type and Activity	Low Development		Medium Development		High Development	
		Annual Average	Peak	Annual Average	Peak	Annual Average	Peak
Direct Effects	Exploration and development drilling	1,190	1,980	830	1,880	1,580	4,870
	Construction	2,930	2,930	2,000	7,380	3,070	8,580
	Production	120	340	770	930	1,010	1,530
Indirect Effects	Exploration and development drilling	1,740	2,890	1,210	2,740	2,310	7,120
	Construction	1,340	1,340	920	3,380	1,410	3,930
	Production	100	270	620	750	820	1,240

Table W-10
Estimated Potential Labor Income Effects (in Millions of 2018$) under the Hypothetical Unconstrained Scenario/Alternative D

Type	Type and Activity	Low Development		Medium Development		High Development	
		Annual Average	Peak	Annual Average	Peak	Annual Average	Peak
Direct Effects	Exploration and development drilling	$224	$374	$160	$350	$300	$920
	Construction	$410	$112	$280	$1,030	$430	$1,200
	Production	$18	$50	$110	$140	$150	$230
Indirect Effects	Exploration and development drilling	$87	$145	$60	$140	$120	$360
	Construction	$112	$112	$80	$280	$120	$330
	Production	$5	$15	$30	$40	$40	$70

Table W-11
Estimated Government Revenues (in Millions of 2018$) under the Hypothetical Unconstrained Scenario/Alternative D

Category	Low Development		Medium Development		High Development	
	Annual Average	Total	Annual Average	Total	Annual Average	Total
NSB property taxes	$30	$1,098	$100	$3,110	$210	**$6,800**
State royalties	$150	$4,770	$480	$14,850	$1,010	**$31,310**
State taxes	$400	$12,920	$1,190	$38,220	$2,520	**$80,630**
Federal royalties	$150	$4,770	$480	$14,850	$1,010	**$31,310**

W.1 References

ADCCED. 2019a. Financial Documents Delivery System. FY 2018 and FY 2019 budget documents for the local government entities in the North Slope Borough. Internet website: https://www.commerce.alaska.gov/dcra/dcrarepoext/Pages/FinancialDocumentsLibrary.aspx.

_____. 2019b. NPR-A Impact Mitigation Grant Program Report to the First Session of the Thirty-first Alaska Legislature. Internet website: https://www.commerce.alaska.gov/web/Portals/4/pub/2019%20Report%20to%20the%20Legislature.pdf.

ADOLWD. 2019a. Population estimates, Cities and Census Designated Places, 2010 to 2018. Internet website: http://live.laborstats.alaska.gov/pop/index.cfm.

_____. 2019b. Alaska Labor and Regional Information (ALARI), employment and total wages information. Internet website: http://live.laborstats.alaska.gov/alari/.

_____. 2019c. Alaska Labor and Regional Information (ALARI), Nuiqsut employment by sector. Internet website: http://live.laborstats.alaska.gov/alari/.

_____. 2019d. Alaska Labor and Regional Information (ALARI), North Slope Borough employment by sector. Internet website: http://live.laborstats.alaska.gov/alari/.

NSB. 2015. North Slope Borough 2015 Economic Profile and Census Report. North Slope Borough. Department of Planning and Community Services. Internet website: http://www.north-slope.org/your-government/nsb-2015-economic-profile-census-report.

Appendix X

Public Health and Safety

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Appendix X. Public Health and Safety

Table X-1
Population Demographics in Affected Environment Villages

Village	Population Size	Percent American Indian or Alaska Native	Median Age	Percent of Residents Over the Age of 65	Percent of Residents Under the Age of 18
North Slope Borough					
Anaktuvuk Pass	290	87.2	25.0	9	41
Atqasuk	172	98.3	24.5	9	37
Kaktovik	181	94.5	27.8	6	33
Nuiqsut	395	90.9	25.4	5	37
Point Hope	629	94.1	25.6	6	41
Point Lay	273	92.7	19.5	2	48
Utqiagvik	4,383	68.6	29.2	8	35
Wainwright	513	93.8	28.0	5	36
Northwest Arctic Borough					
Ambler	299	96.3	26.9	9	37
Kiana	284	95.4	25.3	5	38
Kobuk	152	94.7	18.3	4	49
Kotzebue	3,276	73.2	29.3	8	30
Noatak	424	98.6	26.4	6	36
Noorvik	579	95.2	25.7	5	39
Selawik	813	98.6	24.0	6	43
Shungnak	280	80.0	22.5	6	46

Source: U.S. Census ACS 2017

Table X-2
Leading Causes of Death in the North Slope Borough (2011–2013)

Cause of Death	North Slope Borough			State of Alaska		
	Rank	Number of Deaths	Rate (Age-Adjusted)	Rank	Number of Deaths	Rate (Age-Adjusted)
Cancer	1	35	233.7	1	2,870	168.3
Heart disease	2	16	105.2	2	2,146	54.4
Unintentional injuries	3	13	79.6	3	1,104	57.9
Chronic lower respiratory diseases	4	9	109.8	4	579	39.5
Suicide	5	7	23.8	6	480	22.1

Source: ABVS 2018
Note: Rates are per 100,000 persons, age-adjusted to U.S. year 2000 standard population.

Table X-3
Educational Attainment

Location	Percent High School Graduate or Higher
Alaska	92
North Slope Borough	87
Anaktuvuk Pass	75
Atqasuk	70
Kaktovik	83
Nuiqsut	70
Point Hope	70
Point Lay	82
Utqiagvik	80
Wainwright	75

Source: U.S. Census ACS 2017

Table X-4
Percentage of Food Insecure Households in the North Slope Borough, 2015

Community	Percent of Food Insecure Households
North Slope Borough	24
Anaktuvuk Pass	54
Atqasuk	31
Kaktovik	10
Nuiqsut	9
Point Hope	25
Point Lay	9
Utqiagvik	25
Wainwright	24

Source: NSB 2015

Table X-5
Overweight and Obesity Among North Slope Borough Households, 2012

Location	Overweight (Percent)	Obese (Percent)
Alaska	37	28
North Slope Borough	33	39
Anaktuvuk Pass	32	23
Atqasuk	26	38
Kaktovik	34	32
Nuiqsut	28	33
Point Hope	29	48
Point Lay	17	46
Utqiagvik	34	40
Wainwright	36	41

Source: NSB 2012

X.1 REFERENCES

ABVS (Alaska Bureau of Vital Statistics). 2018. 2013-2017 Alaska Resident Leading Causes of Death. Internet website: http://dhss.alaska.gov/dph/VitalStats/Documents/PDFs/Leading%20Causes%20of%20Death%202013-2017.pdf.

NSB (North Slope Borough). 2012. Baseline community health analysis report. North Slope Borough. Department of Health and Social Services. July 2012. Internet website: http://www.northslope.org/assets/images/uploads/BaselineCommunityHealthAnalysisReport.pdf.

______. 2015. North Slope Borough 2015 Economic Profile and Census Report. North Slope Borough. Department of Planning and Community Services. Internet website: http://www.north-slope.org/your-government/nsb-2015-economic-profile-census-report.

U.S. Census ACS (U.S. Census American Community Survey). 2017. U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates. Internet Website: https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t.

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Appendix Y

Traditional Knowledge Compilation

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NPR-A IAP EIS
Traditional Knowledge Compilation

September 19, 2019

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LIST OF ACRONYMS

ADF&G	Alaska Department of Fish and Game
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
EIS	Environmental Impact Statement
IAP	Integrated Activity Plan
MMS	Mineral Management Service
NPR-A	National Petroleum Reserve – Alaska
SRB&A	Stephen R. Braund & Associates
USACE	United States Army Corp of Engineers

1.0 Traditional Knowledge Compilation

This report provides a compilation of available traditional knowledge that has been documented in the six North Slope communities of Point Lay, Wainwright, Utqiaġvik (formerly Barrow), Nuiqsut, Atqasuk, and Anaktuvuk Pass since 1976 and which is relevant to the National Petroleum Reserve – Alaska (NPR-A). Traditional knowledge is defined in a broad sense to include local observations and information that residents have provided regarding their physical, biological, and social environment. In response to a request from the Bureau of Land Management (BLM) that traditional knowledge be considered in the writing of the NPR-A Integrated Activity Plan (IAP) Environmental Impact Statement (EIS), EMPSi subcontracted Stephen R. Braund & Associates (SRB&A) to review existing sources of traditional knowledge and compile the information into a report. The purpose of this compilation is to provide relevant traditional knowledge organized by various resource topics for consideration and incorporation in the EIS by the EIS resource authors.

SRB&A organized the traditional knowledge quotes using the section headings that are similar to those used in the NPR-A IAP EIS structure. When reviewing the quotes, EIS authors should review the entire document as the quotes often address multiple topics and not just the topic under which SRB&A categorized them (e.g., vegetation and caribou traditional knowledge addressed in the same quote but only categorized under vegetation).

2.0 Methods

The study team reviewed a variety of sources including the Alaska Department of Fish and Game (ADF&G), Division of Subsistence technical papers; Bureau of Ocean Energy Management (BOEM)/Bureau of Safety and Environmental Enforcement (BSEE), Bureau of Land Management (BLM), Mineral Management Service (MMS) and United States Army Corp of Engineers (USACE) public hearings conducted for EISs; and federal, Native organization, and academically funded studies. The study team's initial review also included a number of studies such as subsistence studies, ethnographies, and EISs which are informed by or incorporate traditional knowledge. For the purposes of this review, the study team only documented sources that contained primary traditional knowledge (e.g., direct quotes included as part of a traditional knowledge or subsistence study, academic publication, or federal public hearings). The study team also only included quotes directly attributed to residents from the six North Slope communities, which are most likely to have direct observations related to the NPR-A.

Each quote identifies the community that provided the observation and the citation for the document. Both the community identifier and publication year attached to the quote provide important context and should be kept in mind when reviewing the quotes for applicability to the NPR-A IAP EIS. For example, some quotes dating from the early 1980s may describe effects associated with seismic survey methods that are no longer being used and may not be applicable to more current seismic survey methods.

The study team focused on compiling quotes that contained traditional knowledge applicable to the nature of development and relevant to impacts and mitigation associated with the IAP, or that contained traditional knowledge about the environment in and around the NPR-A. For example, with caribou, the study team focused on quotes describing knowledge about past impacts to caribou that could parallel potential impacts from future projects described in the IAP or quotes that focused on caribou habitat and movement in the NPR-A. The study team did not include more general traditional knowledge describing overall caribou distribution, migration, behavior, health, or abundance.

For several resource topics, SRB&A identified little to no traditional knowledge relevant to the NPR-A IAP/EIS in the 80 sources reviewed for this compilation. Topics lacking traditional knowledge included Geology and Minerals, Soil Resources, Sand and Gravel Resources, Environmental Justice, Recreation, Wild and Scenic Rivers, Wilderness Characteristics, and Transportation. Other such as Petroleum Resources, Paleontological Resources, and Visual Resources had only a few traditional knowledge quotes identified. The lack of traditional knowledge identified for the above topics does not mean that local residents are not knowledgeable about those topics, but rather that the sources reviewed did not focus on those topics. Furthermore, during the compilation, the study team categorized traditional knowledge quotes under the resources they were most directly related to; thus, some of the above topics may be addressed indirectly under other resources, in which case SRB&A identified the primary topic where related traditional knowledge could be found in the report. Additional reasons for the lack of traditional knowledge for certain topics that are relevant to the NPR-A IAP EIS include the following:

- A majority of the sources available for review were public scoping testimony, and residents' testimony usually focuses on the issues of greatest concern, and thus do not include traditional knowledge for all physical, biological, and social topics addressed in an EIS.
- Resource topics overlap in their focus, and traditional knowledge that is categorized as one topic may also pertain to another (e.g., socioeconomic/environmental justice, hazardous materials and contaminated sites/human health and safety/air quality).

While SRB&A's review included all major topics addressed in the NPR-A IAP EIS, SRB&A emphasized topics of concern that have been raised by local residents in the past including air quality, water resources, caribou, fish and fish habitat, noise, subsistence, sociocultural systems, economy, and public health. SRB&A also emphasized traditional knowledge that addressed key topics/questions provided to SRB&A by the EIS resource section authors. Where applicable, SRB&A added these topics as subheadings (e.g., Caribou under Terrestrial Mammals, Water Quality under Water Resources). SRB&A also added additional subheadings under several of the resource topics when there were many quotes that could be categorized under several themes. SRB&A's review also did not include a review of residents' issues and concerns regarding development in general or any mitigation measures proposed by residents in past projects.

3.0 Results

3.1 Introduction

SRB&A reviewed 80 sources of traditional knowledge from publications dating between 1976 and 2019 (Table 3-1). The table lists each of the sources reviewed and provides relevant traditional knowledge topics addressed in each source under Physical, Biological, and Social environment headings. The table also includes a heading of Other that primarily identifies if the source included scoping comments and issues and concerns. The following sections provide traditional knowledge quotes by the NPR-A IAP EIS sections.

Table 3-1: Traditional Knowledge Topics by Source

Citation	Physical Environment	Biological Environment	Social Environment	Other
(ABR Inc., Sigma Plus Statistical Consulting Services, Stephen R. Braund & Associates, and Kuukpik Subsistence Oversight Panel Inc. 2007)	Climate and Meteorology, Water Resources, Solid and Hazardous Waste	Fish	Subsistence Uses and Resources	—
(BLM 1982)	Water Resources	—	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 1997a)	Acoustic Environment	—	Terrestrial Mammals	Scoping Meeting / Issues and Concerns
(BLM 1997b)	Paleontological Resources, Solid and Hazardous Waste	—	Cultural Resources, Subsistence Uses and Resources, Public Health	Scoping Meeting / Issues and Concerns
(BLM 1998a)	—	Terrestrial Mammals	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 1998b)	—	Terrestrial Mammals	—	Scoping Meeting / Issues and Concerns
(BLM 1998c)	—	Birds, Terrestrial Mammals, Marine Mammals	Landownership and Uses, Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 1998d)	—	Subsistence Uses and Resources	Public Health	Scoping Meeting / Issues and Concerns
(BLM 2002)	—	Terrestrial Mammals	Landownership and Uses, Subsistence Uses and Resources, Sociocultural Systems	Scoping Meeting / Issues and Concerns
(BLM 2003a)	Acoustic Environment	Fish, Birds, Terrestrial Mammals	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2003b)	Water Resources	Wetlands and Floodplains, Terrestrial Mammals, Marine Mammals	Subsistence Uses and Resources, Sociocultural Systems, Public Health	Scoping Meeting / Issues and Concerns
(BLM 2003c)	—	Terrestrial Mammals	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2003d)	Water Resources	Terrestrial Mammals	Subsistence Uses and Resources	
(BLM 2004a)	Vegetation	—	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2004b)	Renewable Energy	Fish	—	Scoping Meeting / Issues and Concerns
(BLM 2004c)	Water Resources	Birds, Terrestrial Mammals	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2004d)	Vegetation	Terrestrial Mammals	Subsistence Uses and Resources, Economy	Scoping Meeting / Issues and Concerns
(BLM 2004e)	—	—	Economy	Scoping Meeting / Issues and Concerns
(BLM 2004f)	Climate and Meteorology	Vegetation, Fish, Terrestrial Mammals	Landownership and Uses, Subsistence Uses and Resources, Sociocultural Systems	Scoping Meeting / Issues and Concerns
(BLM 2007)	—	Wildland Fire, Terrestrial Mammals	—	Scoping Meeting / Issues and Concerns

Citation	Physical Environment	Biological Environment	Social Environment	Other
(BLM 2014a)	—	—	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2014b)	—	—	Subsistence Uses and Resources, Economy, Public Health	Scoping Meeting / Issues and Concerns
(BLM 2014c)	—	—	Subsistence Uses and Resources, Sociocultural Systems	Scoping Meeting / Issues and Concerns
(BLM 2016a)	—	—	Public Health	Scoping Meeting / Issues and Concerns
(BLM 2016b)	—	Vegetation	—	Scoping Meeting / Issues and Concerns
(BLM 2018a)	—	Terrestrial Mammals	Subsistence Uses and Resources, Economy	Scoping Meeting / Issues and Concerns
(BLM 2018b)	—	Cultural Resources	—	Scoping Meeting / Issues and Concerns
(BLM 2018c)	Physiography	—	Economy, Public Health	Scoping Meeting / Issues and Concerns
(BLM 2019a)	Renewable Energy, Petroleum Resources	Birds, Terrestrial Mammals	—	Scoping Meeting / Issues and Concerns
(BLM 2019b)	Physiography	Birds, Terrestrial Mammals	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2019c)	—	—	Public Health	Scoping Meeting / Issues and Concerns
(BLM 2019d)	—	—	Cultural Resources, Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(BLM 2019e)	—	Terrestrial Mammals	—	Scoping Meeting / Issues and Concerns
(BOEM 2011)	Climate and Meteorology	Fish	Sociocultural Systems	Scoping Meeting / Issues and Concerns
(BOEM and BSEE 2013)	—	Marine Mammals	Subsistence Uses and Resources	Scoping Meeting / Issues and Concerns
(Braem, Mikow, Brenner, Godduhn, Retherford, and Kostick 2017)	Acoustic Environment	Birds	Subsistence Uses and Resources, Sociocultural Systems	—
(Braund, Lawrence, Sears, Schraer, Regehr, Adams, Hepa, George, and Von Duyke 2018)	—	Marine Mammals	—	—
(Brewster and George No Date)	Water Resources	Fish	Subsistence Uses and Resources	—
(Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016)	—	Fish	Subsistence Uses and Resources, Sociocultural Systems Public, Health	—
(Brown 1979)	—	—	Subsistence Uses and Resources	—
(Carothers, Cotton, and Moerlein 2013)	—	Fish	—	—
(EDAW Inc., Consulting, Research, Callaway, Associates, and Economics 2008)	Acoustic Environment. Water Resources	Marine Mammals	Subsistence Uses and Resources	—
(FEA 1976)	Acoustic Environment, Water Resources	Fish, Terrestrial Mammals	Subsistence Uses and Resources,	Scoping Meeting / Issues and Concerns
(HDR Alaska 2015)	—	Fish, Terrestrial Mammals	—	—

Citation	Physical Environment	Biological Environment	Social Environment	Other
(Mager 2012)	—	—	Subsistence Uses and Resources	—
(MBC Applied Environmental Sciences 2004)	Climate and Meteorology, Physiography, Water Resources	Wetlands and Floodplains, Fish	Subsistence Uses and Resources, Economy, Public Health	—
(McBeath and Shepro 2007)	—	Fish	—	—
(MMS 1979a)	Water Resources	Cultural Resources	—	—
(MMS 1979b)	Water Resources	Terrestrial Mammals, Marine Mammals	Cultural Resources, Public Health	Scoping Meeting / Issues and Concerns
(MMS 1982)	—	Fish, Birds	—	Scoping Meeting / Issues and Concerns
(MMS 1990)	—	—	Economy	Scoping Meeting / Issues and Concerns
(MMS 1997)	Acoustic Environment	—	—	Scoping Meeting / Issues and Concerns
(MMS 2001a)	—	Terrestrial Mammals	—	Scoping Meeting / Issues and Concerns
(MMS 2001b)	—	Fish	—	Scoping Meeting / Issues and Concerns
(MMS 2006)	—		Public Health	Scoping Meeting / Issues and Concerns
(MMS 2007a)	—	Birds, Terrestrial Mammals, Marine Mammals,	Subsistence Uses and Resources	—
(MMS 2007b)	Acoustic Environment	Marine Mammals	—	Scoping Meeting / Issues and Concerns
(MMS 2007c)	—	Fish	—	Scoping Meeting / Issues and Concerns
(MMS 2009a)	—	Fish, Terrestrial Mammals	Public Health	Scoping Meeting / Issues and Concerns
(MMS 2009b)	—	Marine Mammals	Sociocultural Systems, Public Health	Scoping Meeting / Issues and Concerns
(Spearman and Nageak 2005)	—	Fish	—	—
(SRB&A 2003)	Acoustic Environment, Solid and Hazardous Waste	Fish, Birds	Subsistence Uses and Resources	—
(SRB&A 2009)	Air Quality, Acoustic Environment, Physiography, Water Resources, Solid and Hazardous Waste	Vegetation, Wetlands and Floodplains, Fish, Terrestrial Mammals	Landownership and Uses, Cultural Resources, Subsistence Uses and Resources, Sociocultural Systems, Economy, Public Health	—
(SRB&A 2010a)	Acoustic Environment	Fish, Birds, Terrestrial Mammals	Subsistence Uses and Resources	—
(SRB&A 2010b)	—	Terrestrial Mammals	Subsistence Uses and Resources, Sociocultural Systems, Economy, Public Health	—
(SRB&A 2011a)	Climate and Meteorology, Water Resources	Fish, Birds, Marine Mammals	Subsistence Uses and Resources	—
(SRB&A 2011b)	Acoustic Environment	Terrestrial Mammals	Subsistence Uses and Resources, Visual Resources	—

Citation	Physical Environment	Biological Environment	Social Environment	Other
(SRB&A 2013a)	Climate and Meteorology, Acoustic Environment, Solid and Hazardous Waste	Fish, Terrestrial Mammals, Marine Mammals	—	—
(SRB&A 2013b)	—	Terrestrial Mammals	—	—
(SRB&A 2013c)	—	Wildland Fire, Fish, Terrestrial Mammals	Subsistence Uses and Resources	—
(SRB&A 2014a)	Solid and Hazardous Waste	Terrestrial Mammals	Subsistence Uses and Resources, Visual Resources	—
(SRB&A 2014b)	Climate and Meteorology	Fish, Birds, Terrestrial Mammals, Marine Mammals	Cultural Resources, Subsistence Uses and Resources, Sociocultural Systems	—
(SRB&A 2015)	Petroleum Resources	Terrestrial Mammals	Subsistence Uses and Resources, Sociocultural Systems, Visual Resources, Public Health	—
(SRB&A 2016)	—	—	Subsistence Uses and Resources	—
(SRB&A Unpublished-a)	Climate and Meteorology, Physiography, Water Resources	Vegetation, Wildland Fire, Fish, Birds, Terrestrial Mammals	Cultural Resources, Subsistence Uses and Resources, Sociocultural Systems, Economy	—
(SRB&A Unpublished-b)	Climate and Meteorology, Air Quality, Acoustic Environment, Physiography, Paleontological Resources, Water Resources	Vegetation, Wetlands and Floodplains, Wildland Fire, Birds, Terrestrial Mammals	Cultural Resources, Subsistence Uses and Resources, Sociocultural Systems, Public Health	—
(USACE 1983)	Acoustic Environment	—	—	—
(USACE 2010)	Acoustic Environment	—	—	Scoping Meeting / Issues and Concerns
(Wolfe 2013)	—	Marine Mammals	—	Scoping Meeting / Issues and Concerns
(Worl and Smythe 1986)	—	—	Cultural Resources, Sociocultural Systems	—

3.2 Physical Environment

3.2.1 Climate and Meteorology

At my home I have a barometer and have learned how to read it. This year and the past few years, I have noticed changes that occur. The barometer would indicate that a wind from the west would be coming and then out of the blue an east wind would come and vice versa. So it seems like our weather cycle has done a circle. So what is occurring with the weather is actually opposite of what the barometer is indicating that it should do. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

It's unpredictable nowadays. Sometimes we wait and wait for the wind to die down before we go out boating. The last time they brought the whale in those boaters were really wet. Well [the ice] is not as thick as it used to be. We hope that the ice doesn't break off when the wind [comes in] from the northeast. (Wainwright) (SRB&A 2013a)

Easterly direction wind, we're going to be shallow…. East wind we get shallow waters. Westerly winds, southwest winds will push it in. (Point Lay) (SRB&A 2011a)

It's taking longer to become stationary ice. We can have an open ocean in January because the wind has broken it up. We can have big piles of ice on the barrier island. (Point Lay) (SRB&A 2011a)

And just being a hunter, I've noticed the ice is not as thick as it used to be. We're losing two weeks out of the year in the spring, thawing out too early. And then in the fall time, we're gaining over two weeks before it freezes up again. (Utqiaġvik) (BLM 2004f)

The past five years have been very unusual. There has been an early spring thaw out. We would be boating when it wasn't the time for us to be boating. This weather has been a phenomenon. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

I am now 82 years old and can remember since the time I was 9, when there used to be slow transitions from cold conditions to warm conditions. Now, these transitions from cold to warm are fast and abrupt. Fall used to freeze fast and now it is the reverse, the fall freeze is slow. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

A long time ago the Elders, when she was able to remember her surroundings, our Elders have spoken that the earth was going to shift. It is shifting today. Climate change in the Arctic, blizzards, snowstorms in the Lower 48, those are the kind of changes that the Elders have spoke of. And I, for one, I am witnessing this today. One day we will not have any winter. There will be no winter on this Arctic. The North Slope is going to be like Lower 48, ice and snow free. We will be able to travel year-round by boat. There will be vessels out there, either for industrial or commercial, which will be open. And it's already opening. (Nuiqsut) (BOEM 2011)

Of course, the ice has changed. [Hunting partner] and I used to go out and find pack ice, and it was different weather. It would have its own weather. Gray and wet and windy. It was less long and 30 feet high. We haven't seen that for 20 years. We've seen ice that's eight to 12 feet thick on top, which means it's 30 to 40 feet below. That's out deeper or it gets grounded. There's still that kind of ice going by and it's doing some gouging. It gets stuck. We're looking for ice that gets stuck because that's where the ugruks are. Near any inlet you can get in behind it but not too far. (Point Lay) (SRB&A 2011a)

The only thing that I'm worried about is the ice conditions, the thickness of the ice, we're getting less. Ever since about three years ago I started noticing it. Taking a little longer to freeze out there. A lot longer this year. Usually we won't see any open water out there for a mile. This time of year, we seen a lot of open water. Usually the whole area is just solid ice where we can just travel by snowmachine and not worry about falling through. (Point Lay) (SRB&A 2014b)

The ice is, like, an inch lesser than it used to be. When you fish lots, you notice the difference. That's been in the past three, four years. The water levels in the rivers are lower than what they used to be when it freezes. About six inches lower than it used to be. The lagoon ice used to freeze over six feet. It used to take us hours with an ice pick to get a hole. And now it only takes about a half an hour, 45 minutes. We check the ice ever year, and we've been busting through to water at four feet, and it used to be six feet. That's in January when the sun comes back; we go do the check for the ice, the thickness. (Point Lay) (SRB&A 2011a)

About five years ago [the ice started changing]. You can tell it's just getting less. I hope there's more ice this year, or next year. We'll see, we'll measure the ice. The ice we got that whale on, the whale wasn't supposed to go on the ice [because it was so thin], but we actually got it up. (Point Lay) (SRB&A 2011a)

[The weather is] changing [and becoming] warm. [It is] warmer up north, [in] Barrow. In Nuiqsut [the weather] don't change that much. But Barrow, it's warmer than this place! People they talk about it. They say the weather is getting warmer. Now it's down to 20 below. Or 35 [below] or so. I don't know what makes the temperature change in winter. Those people down Barrow they talk about "it's getting warmer and warmer every year" down there. I don't know from what. It used to be c-o-o-o-o-ld! Changing something, I don't know. (Anaktuvuk Pass) (SRB&A Unpublished-a)

There's been a different winter, in which there was a sound that was like a big bang and all of a sudden there was a storm that sets in. You couldn't even see across the street to the outhouse. (Anaktuvuk Pass) (SRB&A Unpublished-a)

This year we got a lot of snow, more than usual. You can tell, there's a lot of little snow in areas and now it's way up drifting. Where you're camping in those places, you used to camp right next to the hillside, now it's drifting every year. I think snow is getting more and more. Snow this year, there is a lot all over. This year we had a bad one. [It has been] snowing every day. I came down every morning and say "it's snowing again?!" We got a lot of snow all over. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Melting, the climate. Global warming. Those ponds are not just forming but drying out. Permafrost shifting and melting more heat I suppose. Not evaporating and draining. In the last few years. I know it happens but it seems to be happening in the last few years. If you go to a lake that you know to be deep or a hole or anything, when you come to the edge of it has gone down on the edges. I would say throughout up here to Barrow and Deadhorse. (Nuiqsut) (SRB&A Unpublished-b)

It, the weather that has caused the water temperature to rise. Because of the tundra up here is hot. It affects the water and the river flows into the Beaufort Sea and today it is a lot warmer than it has been in the past. It is changing with the climate change that we are experiencing. (Nuiqsut) (SRB&A Unpublished-b)

When I was growing up the weather was a lot warmer in both summer and winter. During the years past it has changed to where… in March when I was growing up the weather would start warming up. In like November, December, January, February, that would be the coldest part of the year. Today they still are but March is to. It is unusual to see something like this, where it is over 50 below to where it is cracking the tundra in March. When it cracks it makes a lot of noise, it never used to do that when I was young today it is changing. Our weather is so different compared to what I observed in the 40s and 50s. Today we don't have any [prevailing] wind directions. (Nuiqsut) (SRB&A Unpublished-b)

The changes are due to possibly climate change. It was bound to happen because our elders have been speaking about it. They would think that there would never be blizzards or cold fronts. I am surprised there is a cold front now. It is very unusual to have weather like this without wind. We don't have, we don't know if there is going to be a blizzard or not. It used to be a lot warmer and windier when we were kids, today it is different. As for the ocean current I cannot speak to that, because that is for men to speak of. I can speak on the land issues because that is what I have experienced. (Nuiqsut) (SRB&A Unpublished-b)

In the fall time we get real strong winds, and then again in the winter. Last year we had 75 mile an hour winds in town which was pretty crazy. It doesn't happen all the time. Not really anything new. It is what you expect when you live up here. Sometimes it gets a little bit warmer when it gets windy, and when there is no wind at all it can be like 80 below with no wind. When it got windy it warmed up. It pushes all the wind from down south, it depends on the direction. It will get windy on the coast, if it is nice here it can be windy out there. You go to get away from the mosquitos. (Nuiqsut) (SRB&A Unpublished-b)

Back then we used to have more thunder clouds more thunder more rain more massive flooding and a combination of hail storms that we would see when we were young. Today we don't see that, those thunder storms we would see in the past and hardly any of those hail storms. It seems like they used to have more in the area. The weather pattern is changing every season. Hail storms usually started in August and September and those times used to be a rainy season and now it seems like it is a lot warmer. During my time it was hot with a lot of thunder storm... Now we hardly see those types of storms anymore. We used to have massive blizzards but today we hardly have any blizzards. (Nuiqsut) (SRB&A Unpublished-b)

Back then we would have massive amounts of snow; lots of blizzards and a lot of snow. Some of the areas on the river bank and the slopes would be covered in snow and those cliffs up there [Colville Bluffs?] are strait down and those cliffs would be gradual slopes with all of the snow. Today you don't see many blizzards and less snow overall. There are changes within my lifetime. We see less snow less blizzards and less snowfall today. That is why we have less water during the breakup time. (Nuiqsut) (SRB&A Unpublished-b)

We get less [snow] storms now. What I'm thinking is global warming, because down states they're getting all the snow. Before I left Anchorage, it got 16 inches. Here, we finally got some snow. Couple years, four years ago, we got every street filled to the housetops. You couldn't even see the truck going by. [There were] walls of snow. The school bus, you could only see the school bus that much [over the top of the snow]. It's

> *more like getting colder and colder and some days it will get warm, and when you look at the lagoon you would see some [open] spots.* (Point Lay) (SRB&A 2014b)

3.2.2 Air Quality

See traditional knowledge provided in the PUBLIC HEALTH section for traditional knowledge that is also applicable to this section.

> *Yes, we always see it every year. A haze, a dirty haze in the winter, all the haze goes down to ground level.* (Nuiqsut active harvester; Experience timeline: 1980 and ongoing; Experience location: Kuparuk on over to Nuiqsut. SRB&A Interview 2007). (SRB&A 2009)

> *This fall I went out boating. I drove into a haze just off the Point (Barrow). It gave me a headache. It only stayed a few days until the wind blew it out. A big old, yellow cloud. I thought it came from the east, the oil field area.* (Barrow active harvester; Experience timeline: 2006; Experience location: Pt. Barrow. SRB&A Interview 2007). (SRB&A 2009)

> *Our air quality is a concern. The industry is moving closer to us. They are burning waste oil and natural gas. This is in combination with what is coming up from down south with the warm air and then dropping down in the cold air.* (Barrow active harvester; Experience timeline: 2001 and ongoing; Experience location: Barrow, Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

> *Air quality compared to how it was a long time ago has gotten a lot worse. I never notice the yellow haze around Nuiqsut when I was a kid. I started noticing it when Alpine came. I know when we are getting close to Prudhoe and that's how I know when I am getting close. When we drive there. We would go to get gas and see the yellow haze, now it is all around here now too. One of my aunts, she was a community healthy aid. She has noticed a lot of asthma in the last few years and that it's on the rise. You can see it on YouTube, she talks about all of that.* (Nuiqsut) (SRB&A Unpublished-b)

> *The air pollution too. You can see it on a real nice day. There is a yellow haze if you look out you can see it. You probably could see it now. It's that way. Even in summer time you can see it too when it is a nice sunny day and you can see that yellow stuff.* (Nuiqsut) (SRB&A Unpublished-b)

> *The winds too, they go back and forth a lot of the time. I have seen the wind change direction really quickly it seems like it all blows back to the same spot. If you can see the smog out there you know that it is somewhere in town. If you drive on the dump road past the natural gas station and you have your heater on in your truck it will suck it into your truck and give you a headache. You will smell the natural gas every time. All the toxins and carbon monoxide, when you release the pressure you see a big flame up in the air. All that exhaust we are breathing that I know.* (Nuiqsut) (SRB&A Unpublished-b)

> *Sometimes it will look darker and sometimes it will look lighter. Occasionally I will look out and it will be brown instead of yellow. I think that the winter is worse because there is no moisture in the air so all of the toxins just hang out there. You can tell if you stay here the whole winter and then summer comes around and it's different.* (Nuiqsut) (SRB&A Unpublished-b)

> *At Alpine. It's about this time of the year that you start seeing that yellow haze and black smoke from the industry. All the way to Prudhoe Bay. You can see that yellow haze, it looks almost like lights. On the east side to by Oliktok and towards Kuparuk. And there might be some offshore at Northstar and Endicott. Those were also traced some particles going out.* (Nuiqsut) (SRB&A Unpublished-b)

> *When they do flare ups all of the chemicals that they are dividing from the oil, and what has to be re-burned. Not all of it is burned. It is blown away before it even starts burning. Some of those fluid, chemicals are blown by the wind so it is carried elsewhere. They call that a flare up every time there is a lot of pressure or when they are separating oil or a lot of chemicals. It has to be cleaned, and divided with sand/silt/water. Other chemicals that are combustible are flared up. Some of it is not burned it is blown elsewhere. And also the acid rain that brings down those chemicals.* (Nuiqsut) (SRB&A Unpublished-b)

> *It seems like there is a lot of smog lately. It seems like there is a lot of pollution.* (Nuiqsut) (SRB&A Unpublished-b)

3.2.3 Acoustic Environment

Noise Effects on Subsistence Activities and Resources

See traditional knowledge provided in the SUBSISTENCE - NOISE, TRAFFIC, AND HUMAN ACTIVITY section for traditional knowledge that is also applicable to this section.

Onshore/Terrestrial Areas

> *The fact that we are not used to it (noise) affects us. I know more of the traditional hunters would much rather have it how it was, the quietness. You could hear the animals coming in, maybe the sounds geese and ducks make. And not just the sound but the smell. Walrus' for one you can smell. You can also smell the algae that comes up from the sea bottom and gets green. When that happens you know there is some kind of marine life out there. Waterfowl or maybe seagulls.* (Nuiqsut) (SRB&A Unpublished-b)

> *The concern I have is with [my aunt]'s fish camp there. It's right by Alpine. And it upsets us because they run those airboats, on land and water and the noise scares off our game. They run wherever they want to with those choppers too. My aunt calls 'em noise makers. We can't pick eggs no more because they disrupt the birds and other game too.* (Nuiqsut active harvester; Experience timeline: 2000 and ongoing; Experience location: Nigelik Channel. SRB&A Interview 2007). (SRB&A 2009)

> *When we were growing up we were always told to keep quiet. They can hear very well. We were taught this from our ancestors. We were told not to yell or holler. They can hear very well.* (Wainwright active harvester; Experience timeline: 1951 to present; Experience location: Wainwright. SRB&A Interview 2007). (SRB&A 2009)

> *Just to recall back in my time when we was in that area fishing with a hammer - you could use a hammer to strike right on the ice -observing the fish below you - you can strike right on the ice itself, stun the fish and kill it and kill it. That's how sensitive a noisemaker would be in any of these areas. I would say that permafrost would have the same effect, the detonation of a strong impact could be used in the permafrost.* (Utqiaġvik) (FEA 1976)

First time [I experienced an impact] last year was when I saw a couple of airboats up there [Nigliq Channel]. You can hear them things for miles and miles. I've heard people complain about them when they go up river. That was in late May right before it broke up, that is when they start with the airboats and then they are there throughout the summer, on the main channel. There's just so much activity going on with the oil company, they are just trying to check up on everything, make sure there's no spills or nothing. (SRB&A Nuiqsut Interview May 2010). (SRB&A 2010a)

Airboats, they got airboats that are too loud [whole delta area.] That is every summer, July, August, end of June. You can hear the airboat before you ever see it. One time we had an accident a couple of summers ago, and we needed an assist from Conoco Phillips, a guy [fell] in the river, and we heard this thing coming, and it was so loud that we could hear it before we could ever see it. They do exercises, like a lot of oil-spill exercises. It's too shallow for [other kinds of boats] like they could use a jet unit, but they use an airboat for when it's too shallow. They have no access other than the use of the airboat. And then sometimes down by CD4 you will have an airboat and a small medium cargo boat, there is a little slough in there by CD4 and that's the one that they want to dredge in there and try to get into the lake, and then they could use that as a staging area as a possible use for area for oil spill response, but the community said no and then they rejected the application for the permit for that. (SRB&A Nuiqsut Interview May 2010). (SRB&A 2010a)

What they mentioned about the noise, and I guess that's why the fish are not coming back or they're depleting. That's one of the things you should study or monitor as you said. This drilling, you can barely hear it up, you know, up on the ground, but down it goes deeper and, you know, noise travels further especially I guess if it's close to the water. And I'm just saying that that could be the cause. And, as you may or may not know, we all love ahnalik here and we need it, too. So we need that for our subsistence. (Utqiaġvik) (BLM 2003a)

The air boats, every time they go do their surveys, or checking their Conexes, they disrupt anything that is there and us too. And the caribous will take off, or the seals will pop down; anything that is near that [noise], they take off. (SRB&A Nuiqsut Interview April 2010). (SRB&A 2010a)

They have those airboats that do that training. We do have a lot of airboats down there. They have access to a boat ramp at CD 4, and then you have those zodiac boats that come around from CD3 and they come around and go in this channel. I've seen how many that come around and go in. It has to be in this area. They come out from these two [channels]. And you know that the community is not informed about when they are going to have an exercise about those airboats. If we would know, that would inform our hunting. And now they have a bigger one [airboat] that is bigger than the two-seater. They are louder than the planes [airboats]. You could hear them before you could see them. That is a concern to the area. That would be during the duration of the summer. Sometimes it could go later, like mid August. (Nuiqsut) (SRB&A 2010a)

I've got my camp down there [on Nigliq Channel]. There is always traffic through the river all through the summer, the loud boats all summer. And across is my brother's [cabin]. They drive around until September (June through September). They always come from somewhere from the ocean and then the go through the river all the way to Nanuq, and then they always go back out. (Nuiqsut) (SRB&A 2011b)

Plenty [of traffic]. Especially those boats with loud noise. Go through my allotment every summer. Really loud, you can hear them from a distance. Airplane, helicopter fly everyday. Even small planes, sometimes, Summer, in summer, mostly always fly. They always go through towards Fish Creek, land by my allotment, helicopters down there. Every summer, in July, June. I never see much in August, I always go up river moose hunting. They got three of them [airboats]. They can go through the shallow water. Lots of noise. Some of them get spooky. That noise is no good for an animal. Yeah, when some of the caribou get spooked, they run off. When they get spooked the just start running away. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010a)

I think I've heard that concern now from two other persons that directly told me that the existing seismic is already impacting subsistence hunters as we speak, that the seismic area has no game. The impacts, like Harry said, has scared and run the game off in one direction from that area already and numerous trips made by at least half a dozen hunters have attested that, that they've gone from the east side of the Ikpikpuk and Chipp River to the west side, where they're not there in that seismic area anymore. So these people have purchased gasoline and planned their trips just to find out that the seismic is in that area already and went up to those areas of normal hunting and the game is not there. So I just wanted to support Harry's comments in that sense. (Utqiaġvik) (BLM 1997a)

Humming coming from the infrastructure and facilities. If you are in proximity you hear it. 2-3 miles. And there are some occasions that they are flaring up their gas how they flare up and you can see a big flame and hear it too if the wind is right and it is coming this way. (Nuiqsut) (SRB&A Unpublished-b)

Some of the animals behave abnormally. Anytime they hear a noise they gather in a bunch. They don't know which way to go. I guess when they build the ice roads, all the noise and lights causes them to behave differently. When you get them by surprise, they know what way to go, but if you get in front of them, they bunch up and wait on you. (Barrow active harvester; Experience location: around Barrow area and further inland. SRB&A Interview 2007). (SRB&A 2009)

You know I just wanted to mention what some of my personal observations with what's happening with that seismic out there and that seismic displacing the animals, I just wanted to pass this on for your information and I didn't see any furbearers except for the foxes, the red foxes and the different faces anyway. I didn't see no wolves out there, no tracks or anything like that. I was on my way back home just this Saturday and met up with my cousin and he just said, yeah I just ran into a set of wolverine tracks and followed them 26 miles one direction, and he didn't take a close look at the tracks and he started following the trail and it had just been scared away from where the activity was occurring, which was up on the tops against that southeast side of Teshekpuk up in this Pikes dunes out there and he found the den and the rig had just gone by. I just happened to be there when he was following the trail and coming back, he said he just followed the trail 26 miles one direction and the wolverine had just made a bee line from where the seismic activity was going on, it had been scared away from its den, it was just moving out. And there was no caribou in the area, well you know I'd seen that, I made these trips up to my cabin, it's up and the Ikpikpuk River and I've observed the displacement of the wildlife over the winter. I've been going back and forth since December to just last week and I've seen the different areas where they've been over the winter, and I just wanted to bring that out, of my personal observations where, and I just wanted to back up what Noah and what Warren was saying about, you know, I'm *not going to be opposing any development or the different phases of the development. I just want to put that on record.* (Utqiaġvik) (BLM 1997a)

They tend to drive the game away. The caribou in particular, not so much the fish. They migrate all the time. The caribou are moved off by the noise. In September when they're all fat, the same with the spawning fish. In the early 1980s, rollagons, seismic crews, and ice roads started. I hunt wolverines and wolves in winter, occasionally. But there are so few wolverines now, maybe because of the noise.... I do a lot of geese hunting; they're not as affected by the seismic crews, even when they're nesting. I do that in spring, right after whaling. Now they came up with that bird flu, I hope I don't get that! (Barrow active harvester; Experience timeline: 1982 and ongoing; Experience location: by Teshekpuk, south end in the river. SRB&A Interview 2007). (SRB&A 2009)

I do a lot of fishing. It will certainly change the migration of fish through gravel extraction or adding on. I have seen when the barges dock out here, and all the noise pollution from the engines. We all know that water is a good conductor for noise. As sensitive as they are, any noise will affect the migration route. The gray whales and belugas go to a certain point, and then go around it. This affects the fish species as well. During the storms and the barge dock, I have a net out by the point in Elson Lagoon. I get less fish. When the barges leave, I get more fish. (Barrow active harvester; Experience timeline: 2002 and ongoing; Experience location: Elson Lagoon. SRB&A Interview 2007). (SRB&A 2009)

Nearshore/Marine Areas

When a captain came in to talk to me, I knew he was going to say that the whales are displaced [by noise] farther than you scientists think they are. But some of them would also talk about 'spookiness'; when the whales were displaced out there and when the whaler would get near them, they were harder to approach and harder to catch (USDOI, MMS, 1997, USDOI, MMS, Herndon, 2001 [2002-2007 5-Year]). (Utqiaġvik) (MMS 2007a)

A lot of whales are traveling farther out than before. Five years ago they would go right off the point; now it is 20-30 miles. Too noisy, there has been a big change since seismic activity. (Utqiaġvik) (EDAW Inc. et al. 2008)

Twenty-two years ago, the Federal Government refused to listen to our people on issues related to the size and health of the bowhead whale population. Yet today, after the millions of dollars the North Slope Borough has had to spend on this, they must acknowledge that our Whaling Captains were right all along. Again, seven years ago, we were ignored [when we told the National Marine Fisheries Service and ARCO Alaska that seismic noise caused the bowhead whale migration to deflect off shore]and again millions of dollars were spent to find that, again, our Whaling Captains were right. Despite this history, when we speak today on issues related to bowhead whale behavior, we continue to be scoffed at or ignored. I ask you, how successful would a bowhead whale subsistence hunter be if he did not have an intimate knowledge of the whale's behavior? (Utqiaġvik) (EDAW Inc. et al. 2008)

Of all the animals that I've known, the wolves are, when you are hunting them, they're very noise sensitive, but more so are the bowhead whales. Any noise that they hear, they respond to that by going, moving away from it. A lot of times polar bears are different.

Their curiosity can kill them very easy. They go toward the noise or anything that moves, they go for that. (Nuiqsut) (SRB&A 2003)

Noise redirects marine mammals away from shore and toward the ice pack. It makes it more dangerous for hunters. (Wainwright active harvester; Experience location: offshore Wainwright. SRB&A Interview 2007). (SRB&A 2009)

Industrial noise, vibration, aircraft, including choppers. They're way louder than airplanes. I guess the animals always hear the noise and they go further out. We used to go out and there'd be a lot of seals out there. Now we have to further out to get them. Ugruk too. We used to go to Imaliktuk Island (Eider Island) when the weather gets real bad, but that place is real close to that oil island, and now they don't want us going there without escort; or we might have a barrier we can't go past, like a line. It's just really noisy now. Before Alpine was built it used to be nice and calm and you could just hear ice. Now, during the summer, when they're real active you could hear them 20 miles away and the noise travels better on the ocean than on the land. You can really hear it. (Nuiqsut active harvester; Experience timeline: since 2000 and ongoing; Experience location: Alpine/Eider Island. SRB&A Interview 2007). (SRB&A 2009)

One of the real concerns that we've got with this type of development is noise. Noise is something that maybe two or three years ago was much quieter all respects than now, but people are becoming much, much more concerned about the influence of noise on particularly the migratory route of the bowhead, and a lot of this happen to be related to a very clear situation that seems to be developing here in Barrow, and that is that since 1977, I think it is, there's only been one bowhead caught here in Barrow in the fall time, and from talking to a fair number of whaling captains here in Barrow, the feeling is that the animals in the fall are just steadily moving further and further out to sea off of Point Barrow. Thomas Albert. (Utqiaġvik) (USACE 1983)

And that the whales are sensitive to seismic sounds, to drilling sounds, to ship sounds, et cetera, et cetera. So the concern, of course, is, especially with barging, is why I asked about the timing of the barges, that the potential for the tugs that are pushing or pulling the barges, as well as the barges themselves, very feasibly will deflect bowheads. And so there's a concern about the subsistence hunts in Kaktovik, Nuiqsut and Barrow, and making sure that those hunts aren't disrupted, but also making sure that impacts to the whales themselves and to the kinds of the survival reproduction of the whales is not impacted. Robert Suyden. (Utqiaġvik) (USACE 2010)

The noise impacts have a devastating effect on fall whaling as demonstrated during the 1989 fall hunt in Barrow. All the meat was lost because our hunters had to go to great distances to hunt due to industrial activity east of Barrow. -Karen Burnell. (Utqiaġvik) (MMS 1997)

The whales are very sensitive to noise and water pollution. In the spring whale hunt, the whaling crews are very careful about noise. In my crew, and in other crews I observe, the actual spring whaling is done by rowing small boats, usually made from bearded sealskins. We keep our snow machines well away from the edge of the ice so that the machine sound will not scare the whales. In the fall, we have to go as much as 65 miles out to sea to look for whales. I have adapted my boat's motor to have the absolute minimum amount of noise, but I still observe that whales are panicked by the sound when I am as much as 3 miles away from them. I observe that in the fall migration, the bowheads travel in pods of 60 to 120 whales. When they hear the sound *of the motor, the whales scatter in groups of 8 to 10, and they scatter in every direction* (NSB, Commission on History and Culture, 1980; USDOI, MMS, 2003a). (Utqiaġvik) (MMS 2007a)

And the other thing is when it comes to the sound, we know from our ancestors, from history, from our Inupiat history that they didn't dare go near the ocean once -- they didn't even speak above a whisper because the whales were so sensitive to noise. This is documented. And I just listened to some whaling captain saying -- and I never thought of it when my brother's whaling crew that I'm a part of go down every year, where they urinate, you know, have a little bathroom area there, that this one crew didn't even let it accumulate because the whales and the animal smell was so sensitive. They can smell real sensitive. Dorcas Stein. (Utqiaġvik) (MMS 2007b)

Noise Levels and Effects Associated with Aircraft

See traditional knowledge provided in the SUBSISTENCE - NOISE, TRAFFIC, AND HUMAN ACTIVITY section for traditional knowledge that is also applicable to this section.

When we had the helicopter and the coal mine open, we had no caribou close to Point Lay at all, anywhere. All year round. For how many years…so then we started making rules and regulations for air traffic for the coal mine so we set down how high helicopters and airplanes could fly, and they're still going on to this day on these studies. Even with the walrus, the helicopters and the airplanes have to stay above 1500 feet or more…after our coal mine shut down, we noticed the caribou migration slowly started coming back, and then I say these past 2 years is the most I ever seen caribou hanging around Point Lay [since before the activity]. Not in herds but just in little pods—maybe 5 pods, 7 pod, 10 pod. But at least they're hanging around now. (Point Lay) (Braem et al. 2017)

Mainly aircraft over-flights. They've kind of been scaring the caribou. Last year I was waiting for a herd coming towards the river. And then that BP twin otter came over, maybe 2,000 feet off the ground, and those caribou turned right around and headed a different direction. (Nuiqsut active harvester; Experience timeline 2006; Experience location: Between Kokumak Channel and Colville. SRB&A Interview 2007). (SRB&A 2009)

There was a plane yesterday that was flying really low that we were wondering about. It kind of looked like Era's caravan, but it wasn't at the right time. We were wondering what was going on, and we got mad cause there was caribou out there that they were scaring. They were flying lower than the street poles. (Point Lay) (SRB&A 2013a)

Especially in the Alpine area. You can hear them in town. It will scare the caribous. They will be easily spooked for days. They will just start running and keep on running and running. With that chopper it likes to go on the rivers and around here the way the rivers are there are two river split apart and then go together and the caribou are in the middle. And the birds are trying to avoid the activity and noise. (Nuiqsut) (SRB&A Unpublished-b)

With caribou, this summer there was a chopper going around. It was about 40 miles west and south of Barrow. That chopper, they were so spooked. The helicopter scared the caribou. Maybe they think all the noise from the rotors is gunfire. When you're out there for a couple weeks hunting and the game keep getting scared off, it gets old.

(Barrow active harvester; Experience timeline: 2006; Experience location: Southwest of Barrow. SRB&A Interview 2007). (SRB&A 2009)

Planes. We were at our camp, choppers and planes were scaring caribou. We had to go further out. About 35 miles southeast of here, near our camp. (Barrow active harvester; Experience timeline: 2006; Experience location: small lakes out there [Barrow area]. SRB&A Interview 2007). (SRB&A 2009)

When we were way down by the Chandler area and there was air traffic going on over here at Umiat and that red and white plane of Alpine kept following the river and scaring the caribou like he is doing it on purpose. We have bright clothes on and he knew we were there and he made a couple passes and made the caribou run further inland. That was wrong. Red and white plane. We had the caribou in our sight and plane comes and it took off and turned back around and did the same thing and same path and that pissed us off. Right between those two rivers. Just following the river. We had the caribou in our sight waiting for a good shot and we heard the plane and they just took off. That was in July. Red and white, Alpine. Four boats waiting for them caribou. (Nuiqsut) (SRB&A 2010a).

3.2.4 Renewable Energy

Several traditional knowledge observations in the reports discussed the renewable nature of subsistence resources and the importance of preserving and utilizing these "renewable" resources.

We, the Inupiat people in Atqasuk and the Arctic Slope and Barrow that have survived and rely on subsistence resources to sustain our livelihood. Even today these include the residents of Wainwright because they are heavy users on the renewable resources form Ikpikpuk to Wainwright to Colville River. And we need to maintain these protective setbacks for stipulations on our renewable resources on which we have survived and maintained our subsistence livelihood, and support those persons that are in need of subsistence who are trying to draft these stipulations and protect our renewable resources in the advent of oil and gas exploration in NPR-A. (Atqasuk) (BLM 2004b)

These are the renewable resources that we depend upon for tradition use for subsistence so those are the things that can be funded by these things _____ (59:44.67) gravel roads permitted and potential um renewable resources for our community to protect, enhance our fresh water lakes that have fish bearing lakes. Those are very important lakes and we have to protect in the Teshekpuk area even in the NPRA. (Utqiaġvik) (BLM 2019a)

And for those like himself and those of the community need to also voice more concerns to protect our renewable resources, even in lakes where there are no drainages, because these lakes with no drainages have over wintering fishes, habitat fish habitat, that they -- in these deep lakes. A concern besides that is of the early warming weather, the thawing of permafrost can cause some lakes and have early drainages and may cause some lakes to drain even with fish in it, and that that needs to -- those needs are very sensitive, especially lakes that are near ravines or rivers that should not be encroached upon. And that needs to have a more sensitive protection. (Atqasuk) (BLM 2004b)

3.2.5 Physiography

See traditional knowledge provided in the WATER RESOURCES section for traditional knowledge that is also applicable to this section including comments on permafrost and erosion.

Permafrost

There's reports, recent reports, even at Prudhoe Bay, where the permafrost is even affecting the infrastructure with oil and gas where they had to close down wells because of that. (Nuiqsut) (BLM 2018c)

We are dealing with a lot of permafrost subsidence not just in Point Lay but across the North Slope. I'm sure that, BLM should be aware of that. Having any infrastructure put in place there needs to be a permafrost study put in place first to sustain the infrastructure that's supposed to be put in place to allow for the oil and gas. I think that's a must need that if you're going to build infrastructure up here that you need to look at the land underneath it to make sure that it's stable and able to hold that type of infrastructure. Any special buildings where there's permafrost that is subsiding and you are putting infrastructure there if there's special engineering that is put in place, I want record of that special engineering of that infrastructure. (Point Lay) (BLM 2019b)

I am sure that the melting, or the process of making the soil deeper, with the permafrost underneath, the soil is not very deep. There are times when an area has dropped maybe three feet down and there is ice underneath. (Anaktuvuk Pass) (SRB&A Unpublished-a)

If the sun starts shining on the big rocks, and the sun warms them up, it affects the permafrost when the exposed rocks get warm. (Anaktuvuk Pass) (SRB&A Unpublished-a)

She was mentioning that there is some water [from melting permafrost]; there used to be areas where it's walkable but now it has some deep water. Even in the midst of those rocks there is a lot of water coming, there's water in those areas. And it's staying there in the summer time. (Anaktuvuk Pass) (SRB&A Unpublished-a)

About coastal areas, the ice is being affected somehow by the changing permafrost. There are some areas that are not usable anymore; you know, this methane that seeps out of the ground and if its enclosed in a cellar, people have died in there. You can't smell it, you can't see it, and if you breath it you can die. So the permafrost is getting thinner there is more chance of cracks in it, and if ice cellars are down through permafrost and then they aren't useable anymore. And the water level is [higher] and seeping down and flooding areas. (Anaktuvuk Pass) (SRB&A Unpublished-a)

You probably know how water melts the ice. It eats through it. My experience, I have been going out boating every year and seeing how the land changes. It makes that one area shallow and wider, and the water flows where it can flow the easiest. I have seen a lot of change in the river. It moves a lot of gravel. The routes that we used to use going upriver it used to be pretty deep. Now in my lifetime I have seen the mud move in the river. The gravel and mud will move the water into certain places. There is land, or ground that hasn't been touched in so many years and the mud and gravel will get onto it. Water works really quick on that permafrost. The more it melts the more the ground will start falling in the river. (Nuiqsut) (SRB&A Unpublished-b)

If the water hits it, it will erode the permafrost really fast. If it is just exposed to the light it takes a lot longer than if it is exposed to the water. I have seen dry permafrost stay around for 10 years and not do anything. (Nuiqsut) (SRB&A Unpublished-b)

No, but those pipelines that go over the rivers, now that will affect the river. There are those pipes that they sink that are filled with Freon and they keep the ground frozen. That is the only place I would see permafrost aggravation. Seems like they didn't go far enough away from the river. I bet those permafrost things will begin falling over. (Nuiqsut) (SRB&A Unpublished-b)

Erosion

We noticed changes in the landscape along the river from erosion. We first had a sod house then a cabin. But we had to move the cabin 150 feet from the river because of erosion. We used to have a cellar located 100 feet from the river that eroded away. There was lots of ice [permafrost] where our cellar was and it eroded away very fast. And the water level is coming up higher than in the past when it used to be east winds. The west wind causes the water to rise. The ice movement was so tremendous that it started affecting the landscape and eroding the bluffs. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

With the main ice pack receding, the storms are affecting our banks -- eroding them. Many cellars have been affected by erosion. If the ice pack was nearby, the storms wouldn't be as severe. We used to have a house with land. After so many storms, the door was next to the bank. (Wainwright) (SRB&A 2009)

The ice movement was so tremendous that it started affecting the landscape and eroding the bluffs. The water level is coming up a lot higher than it used to. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

The erosion is more noticeable down there, at the mouth of the Colville [River] down there, I know. Maybe they aren't paying attention to that. People from Barrow do a lot of boating and they say some of those, where they use to go in the small inlets, some of those are just loaded [with silt] and [they] can't use them anymore. I have no information; you have to talk to them. This part here [mouth of the Colville River], or Nuiqsut maybe has more to say about that. (Anaktuvuk Pass) (SRB&A Unpublished-a)

One thing you have to know about building anything around here you have to build it in land to make it last any length of time. We notice all the erosion all the time. It's not a new thing. They have always known about erosion. You have to build further away from the river if you want it to last. (Nuiqsut) (SRB&A Unpublished-b)

Atigaru Point has been eroding a lot. I used to dock at the point and it never got shallow…. (Nuiqsut) (SRB&A Unpublished-b)

… Atigaru Point is now forming lakes and stuff inside the bay too. I see a lot of changes at Eskimo Island, there used to be a small island that was right on the other side of Atigaru Point. Eskimo Island has grown twice or triple as it was back then. It used to be a small island now it is expanding. Either the water has dropped but it is mainly gravel. The high part is tundra. (Nuiqsut) (SRB&A Unpublished-b)

Also that side has erosion control because it is on the oil field side. There are big concrete blocks that protect the coastline from the surf. (Nuiqsut) (SRB&A Unpublished-b)

…I think it is because of the Colville crossing, the bridge they slot it at the end of the season, it seems to the oil companies that it helps but it is still causing flooding. The

> *water gets so high, I think the bridge, the Colville Bridge is underwater before it goes out. That is probably what causes erosion down that way because of the force of water that is behind it. The currents definitely help with erosion.* (Nuiqsut) (SRB&A Unpublished-b)

> *Where there is ice it is eroding and where there is grass on the tundra there is a change in the weather pattern. Particularly where there is ice it will eroded. Nigliq, there used to be a big mass of tundra but that is gone now.* (Nuiqsut) (SRB&A Unpublished-b)

3.2.6 Geology and Minerals

See traditional knowledge provided in the PALEONTOLOGICAL RESOURCES section for traditional knowledge that is also applicable to this section.

3.2.7 Petroleum Resources

> *Same thing with crude oil, guess what we've been using it for thousands of years. It's called ______ (01:15:32.99) oil seeps that go on the tundra that we harvested and there's a lot of historical knowledge behind that. There's some basis for using crude oil just in its raw form for energy on the Slope. It's a prime topic to be talked about in such a way that Arnold described it a little bit ago.* (Utqiaġvik) (BLM 2019a)

> *Yeah, like a couple of years ago – two summers ago – let's see, right across here [near Kachemach], I have been going to this lake with my boat but now what we noticed is that there is some bubbles are coming up in the lake and we thought, 'that is not fish; that must be methane gas.' One time I took my nephew in there, we were looking for caribou, and I happened to go inside that creek and when we got to that lake, we saw a lot of bubbles coming up. That methane lake. It is right on his aaka's land. We stay away from that area now. I checked it out this summer, and it is still bubbling.* (Nuiqsut) (SRB&A 2015)

3.2.8 Paleontological Resources

> *Also like to view into the realm of paleontology, and emphasize an area I think it's around Ocean Point on the Colville, where there's a large paleontological site that has been investigated for many years by paleontologists from UAF, I just wanted to point that out as an important area.* (Nuiqsut) (BLM 1997b)

> *The Colville River region is very well known for that. We will happen by the tusks, Ivory, bones. I am quite sure that it is over there.* (Nuiqsut) (SRB&A Unpublished-b)

3.2.9 Soil Resources

See traditional knowledge provided in the PHYSIOGRAPHY section for traditional knowledge that is also applicable to this section.

3.2.10 Sand and Gravel Resources

See traditional knowledge provided in the PHYSIOGRAPHY section for traditional knowledge that is also applicable to this section.

3.2.11 Water Resources

See traditional knowledge provided in the PHYSIOGRAPHY section for traditional knowledge that is also applicable to this section.

Watersheds, Rivers, and Streams

Teshekpuk Lake Area

> *Teshekpuk Lake is a source land. It is a source land that offers relief, nutrition, rebirth and a health to a culture. It must be respected. This is not your place. It is not my place. So, we must use traditional wisdom here. I did not hear that when I stepped into the room. You spoke of technology, new technology. You spoke of expert science. I want you to leave this room thinking source land.* (Utqiaġvik) (BLM 2003d)

> *And the recent clean up that we did out here, there was so much contaminants that the government did a band-aid job. I was there. I was their operator. I had questions for them, but I was never answered. I asked them why are we doing a band-aid job and how many years of field spill -- then I would not want to see that around Teshekpuk Lake. That's our subsistence, you know. There's a -- I heard there's a big fish in there and nobody caught for years. I heard stories of that big fish that come through the ice, and one day I want to catch that big fish. A big healthy fish, and I wouldn't want it to be contaminated.* (Utqiaġvik) (BLM 2003d)

Other Rivers in NPR-A

> *Ikpikpuk River is a migrating river. It migrates. It moves and sometimes it moves 300 feet a season...What is our -- these boundaries that they are putting at a half mile, three quarter of a mile on the rivers, erodes, I mean, you know, there's some real tough questions in there. But we know that the rivers still migrate. You will see how much the rivers have moved within these years, they've moved miles.* (Utqiaġvik) (BLM 2004c)

> *The Meade River. You see all the ground falling down in the river. Not just there, but other spots. It's getting wider and wider. You can tell. Especially when it rains.* (Atqasuk active harvester; Experience timeline: since 2005 and ongoing; Experience location: Meade River near Atqasuk. SRB&A Interview 2007). (SRB&A 2009)

> *Underneath the tundra, starting from Tavie's [Daniel Leavitt] cabin on the Mayuabiaq, there are a lot of underground rivers. A lot of fish go through there. Those are good fish that come from those underground rivers. Big, fat fish. They're aanaakjiq coming in the mouth of the river. They don't know which way they come from. I've seen them just coming out of the shallow part of the river. They're the best fish from the shallow part of the river. And there's lots of little fish like that. They came from the swamp. They're really good fish.* (Utqiaġvik) (Brewster and George No Date)

> *The people up there would like to see a three mile buffer zone from each side of the river. They don't want to see any roads going across this river. By that, I mean you have three proposed roads going across the Colville and going across Fish Creek on one of these road corridors. There is the initial drilling for the entire NPR-A program that we will be starting soon is based within a few hundred feet from this river. We are adamant and persistent and presume that we should try and stop this because it's one of the most highly prized rivers that we have in the country where the people are concerned. By that, I mean without a buffer zone, where we will protect these rivers, it don't make any difference whether you drill three miles from the ocean shore or fifty miles up the river. It still drains into the entire river stream. Therefore, you have a prevailing chance of destroying the whole river all at one crack. Sam Talak* (Utqiaġvik) (BLM 1982)

We're pretty much contained here, but rivers that are attached to the Colville [River], those are very very important. You know that proposed road [to Umiat]? Those rivers have great value to us for the purpose of not creating, we don't have a lot of fish to talk about but when there are fish they are one of the biggest change of diet, just for a small while. And those are the things that people don't ever look at, and that proposed criss-crossing of those rivers to Umiat, there are five rivers we talk about, and the migratory routes for caribou. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Nearshore Marine

When the weather is warm, [there is an] overflow from ocean, in July. It changes the fish coming in. [I saw that] in [the] last few years. When the overflow from saltwater is coming in [from a west and southwest wind], it coincides with warm spell of the weather. (Nuiqsut) (ABR Inc. et al. 2007)

Before the ice did not break. Now the ice is always breaking. We used to know the currents, when the ice would go in, come out—nowadays, it is unpredictable. (Utqiaġvik) (EDAW Inc. et al. 2008)

When it's south wind we get high water: South to southwest wind. North and northeast wind, everything gets shallow, except for around this time of year [September]. With a slight north wind [in the fall], it won't get shallow in the [Kasegaluk] lagoon. At the beginning of summer it will look like you can walk across almost. (Point Lay) (SRB&A 2011a)

Dirty water, [Kasegaluk] lagoon, the water will be coming in blue, but eventually it pushes all the dirty water and it will slowly turn blue in every inlet. It doesn't happen all at once. You'll end up with a whole blue lagoon. All the blue water will be by the spit side, first, and then it'll take all the dirty water away from the mainland side and turn it blue. (Point Lay) (SRB&A 2011a)

We're seeing first-year ice instead of multi-year ice. Arctic Ocean is melting. Our ice is melting. (Point Lay) (SRB&A 2011a)

We had seismic on the ocean last year and some fishermen don't catch fish anymore. They blame the seismic and air guns because one guy said you were lucky if you get two fish. That was under ice fishing. Usually you get lots. That's with the qaaktaq. This is why I want them to follow the seismic where they blast and see what it's doing to the animals. It'd be better if they search for oil and gas on land rather than the ocean. That way they can have a better chance to work if something happens with their drills. If they have an accident, this way they can cap it. It's easier than in the ocean. Without affecting our hunting areas. I don't want to see any development in our hunting areas or on the rivers where we go fishing. And the calving grounds and bird nesting grounds and any kind of animal that lives there. Their denning grounds. And without damaging the tundra where they work, or lakes that are connected to the rivers. (Wainwright) (SRB&A 2009)

Water Quantity

He's concerned about why a lot of these lakes and rivers are getting too shallow. He's found where they…these seismigraphic testing. He's even seen them at the edge of Tsukpuk Lake and he's…he can't help but blame something like that because there's lakes where they just could put part of a fish net and they will get fish. When they stop *for lunch with just part of a net in the water but now even people try with two hundred foot nets and still don't get that much. There is one lake where you can't find any fish at all. Daniel Leavitt, through interpreter.* (Utqiaġvik) (MMS 1979a)

The streams, little rivers, whatever you call them, where they shoot out from Tsukpuk Lake, they used to be able to go in boats in those but they can't even go on them. Some of them less than half an inch of water on them. Daniel Leavitt, through an interpreter. (Utqiaġvik) (MMS 1979a)

The lakes are shallower than what I used to know. They're draining out. Or some of them are just flats now. No water in them. The outlets into the rivers have opened. (Utqiaġvik) (Brewster and George No Date)

There's a difference right now in this river [Meade River]. When I was growing up with my parents, there were thousands of fish here, but now there's fish but not as plentiful as when I was growing up. When I was growing up we used to check the net three times a day and it used to be full, but now they don't get as full. I'm talking about aanaakjiq. When I was growing up this river used to be high tide constantly, but it's draining down. It's getting shallower. That's why I think there aren't as many fish. Since the river is getting shallower here the fish don't come out from the lakes no more. 'Cause there's no more river drainage, or overflow from the river in to fill these creeks. That's why I think there's not as much fish as there used to be. (Utqiaġvik) (Brewster and George No Date)

I remember when the delta was deeper, in 1940, and now it is shallower. When the water is shallower during the winter, the delta freezes and gets grounded therefore there are not so many fish around. This year there was a lot of west wind and more currents; therefore there was good fishing. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

When it snows before it freezes, it causes slush to block the mouth of the river; we move [our] nets; the current pushes the slush toward mouth, the mouth is shallow; it leaves snow at the mouth of river when the wind comes from the west. (Nuiqsut) (ABR Inc. et al. 2007)

The ice has changed, even Contact [Creek] that comes through the village. Kids use to go to the end of the creek and get little fish, but this fall, but this summer it never emptied; it used to dry up in August. It never happened until October so that affected the ice formation on the river… …There must be some warmer water someplace that keeps it running and the water temperature has risen; the temperature of the water probably has changed. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Back then the river was the same as it had always been. It has never gone down below the level. Today it has changed. The river is shifting and the river is getting shallower and further up there are sandbars that are getting higher and higher. Some of the creeks that connect to the lakes… unable to go in those creeks for fish or whatever they are subsisting for. For the Colville River it is changing a lot. The pattern of the current is shifting because the rivers are not one strait deep way, today we have to maneuver around the sandbars. I noticed that the rivers are getting wider because of the current is pushing the water down river, that current is shifting. (Nuiqsut) (SRB&A Unpublished-b)

In 1973 I moved here from Barrow I was originally from Atqasuk and Barrow and we moved here by snow machines. There was nobody over here at that time. One year here, more than that, I know so many times we would take the shortcut to the Colville River using the Putu (main access channel in the 1970s to get to the Colville), today that river is dry. It is all dried up. We used to use that as a shortcut to go way up there. (Nuiqsut) (SRB&A Unpublished-b)

I think it was three years after we came from Barrow. It started drying gradually and then it came to a point where it was no longer access to the Colville by boat… Back then we noticed that we used to have massive flooding and that is because there was a lot of water coming down from the foothills and mountains but now we don't see that much of it. One summer we had a massive flood, it changed when we first got here, there used to be massive flooding as time goes by, gradually, it has changed to where it is drying. The water level has really gone down from what it was in 1973. That is why the Putu has gone dry because gradually the water level has gone down. It is not like we have those massive floods like we had in the past. We hardly see that today. It has so changed. It is hot, [in July] the temperature has changed because the sun is a lot closer and the moon is a lot closer to us. July is when it gets really hot. That is about the time of the year when the Colville gets hot, the river gets warmer too. (Nuiqsut) (SRB&A Unpublished-b)

Chandler River has changed in the past. It used to have access going in and our but today it is all gone and it is shallow. For some reason it has gone down and we don't have the same access to the Colville we used to. It is all different. It is hard to get to the deeper channels. It has changed from the passed from where it is today. They have a difficult time getting into the river. It is a unique moose hunting area and it is wolf and wolverine hunting area. There are lots of rabbits now. It is an important place for subsistence hunting along with the Anaktuvuk River. Today sometimes we don't have access to go in there but there are areas we depend on for moose and Chandler and Anaktuvuk are important rivers. (Nuiqsut) (SRB&A Unpublished-b)

I haven't experienced it, but I am sure that the lake will dry out in that area. With the permafrost. It will make a river to it and dry out that lake. I haven't seen that. The water moves a lot over the ground. It will make its way through. The water won't stop until it has settled. It will flow down until it finds a spot to stop. Once you are on the river you watch it for years and years. There is a lot of difference. My experience going out every year, I look at the land, I like looking and it is changing a little bit. It hurts a little. It will make me go different directions and think about the animals. It bothers me not knowing how to go up again, if I have to buy different equipment or a new motor. It will take a piece of the land and I can't stop it. Every year it changes, every year. The water has to go somewhere. (Nuiqsut) (SRB&A Unpublished-b)

With the lakes drying out I don't remember where but we caught a caribou and walked past a pond that was super dried out. It was like a big crack 40 feet away and I think that's why it leaked out. (Nuiqsut) (SRB&A Unpublished-b)

I stick by the coast in that area [by Oliktok], but when I go to Alpine I see that the lake they use is getting lower. They use it for everything. It's their main source of water. They use it all the time. They must use them a lot. We have used our lake over here and it hasn't gone down or anything. It has always stayed the same. (Nuiqsut) (SRB&A Unpublished-b)

Some of the lakes are drying up further up river, there used to be lakes further up river and now it is drying up and there is no lakes at all. The changing has to be with the weather pattern and whether or not more ice is being exposed on the river. Where those ice areas are the tundra sinks and erodes. (Nuiqsut) (SRB&A Unpublished-b)

They say that during winter the water on the lakes and ponds are refreshed by ponds but they are really extracting a lot of water for their use in these camps. I think [community member] has a strong point, how much water these development projects are going to use water. They are important spawning areas out there too. How can they minimize that impact? They are using the river to ice chips to build ice roads and they pump a lot of water from the river to these ice roads every year those are being extracted. The only way to reduce that is to have a permanent road to connect these places. Not just to Nuiqsut but also to the different oil pads. Eventually there will be an ice road to Pt. Thompson. (Nuiqsut) (SRB&A Unpublished-b)

I remember my surrounding and growing up around Colville Delta the Colville Delta had not changed, it was normal. The river break-ups were stronger in the 40s and 50s and the industry had hardly been around to destroy or damage the environment. And speaking of wetlands, the wetlands were abundant during the breakup and summer. There were more wetlands back then than today. Today they are getting dryer due to the lack of rain. There used to be an abundance of rain that would feed the wetlands and ponds. The thunder [storms] would bring rain but today we do not have those thunder [storms] that bring the rains. As for the lakes, I cannot speak because I do not know how they are today. Along the coastal line, particularly at Oliktok Point, that area used to be a nice big tundra before it was touched by exploration and today Oliktok is no longer tundra because it was expanded with gravel by the industry. There used to be a small creek but that isn't there anymore because industry has been expanding the point to put drill rigs and buildings… during the summer we used to go to Thetis Island to hunt seals and reindeer seals. There used to be an abundance of seals but today that has changed because the industry is there and they have changed the patterns of the current. It has changed because the oil companies are here and they are destroying the original land and expanding the gravel. Lots of the tundra that was once there are now lost. As far as what the Colville has done in the past, today it has changed. When I was growing up, in the 40s and 50s the Colville was once a big Colville Delta, there were no erosions then. When we came back in 1973 to reestablish the village… We could show you on a map. There used to be a point 5 or 6 miles upriver there was a point but that is gone now. Down towards the end there is a fishing cabin and, on the west side of the bend that area is eroding a lot to. (Nuiqsut) (SRB&A Unpublished-b)

Number 1 is: All drilling operations, will take a lot of water. That means the same thing will happen like they did in Sagavanirktok River. They ran it dry, completely dry twice in one year. And, if that happens in the Colville River or any of these places that are printed up here -- like the lakes, the big lakes and river -- if any one of those go dry, the animals are goi- -- the fish are not going to be there. That's destroying the villages. Raymond Neakok. (Utqiaġvik) (BLM 1982)

I noticed in the first exploration that some of these lakes, especially Shinmar-Rock have dropped about two to three feet loss of water, a depth which is known to be about eight feet. At the time I noticed it-it went down to about five to six feet -and therefore it cannot support any more fish because a tremendous amount of water has been lost in that first exploration at Shinmar-Rock. We enjoy these fish because we know where they're at - and during the winter whenever we need them we can go and get them but these lakes *that I mentioned I would say they are zero fish in them -and even if I was to go in an emergency to survive on these fish I wouldn't be successful.* (Utqiaġvik) (FEA 1976)

Water Quality

What about pumping millions of gallons of water out of streams that cisco depend on for oxygen and habitat? If [there is] no oxygen or a place to spawn, that is different from what they know; they will not go there anymore. When you extract thousands of gallons of water, it changes the temperature of those streams or lakes. (Nuiqsut) (ABR Inc. et al. 2007)

When we get this west wind we get a lot of water, the water gets real dirty. That's the time we try to go way upriver, when we get this west wind. All three rivers fill up. East wind is when it drains out. Same thing. North wind drains it out. Northwest current still comes in, southwest it still comes in, [and] southeast it still goes out. (Point Lay) (SRB&A 2011a)

The lakes have changed, I'm sure there are other areas where activities will certainly affect them. [I am] not too familiar with that [project] area, but things around here like the gravel pit over here. I'm sure they will put some padding, using gravel. Where they get the gravel will affect the area, close to the river. The river will get mudded, where the fish are in that area. The rivers here aren't being affected, but there are, knowing how human activities are affecting the creeks, the small rivers coming down from the lakes. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Last summer the water near Alpine in the Colville River delta was 70 degrees. What is happening? What will happen if development continues at these rates? (Nuiqsut) (BLM 2003b)

Even [Eleanor Lake] that is here is not usable here, where we used to get ice and get water. We can't use it anymore because there has been too much human activities; you know, skidoos and snowmachines spill oil, and it makes it not useful. (Anaktuvuk Pass) (SRB&A Unpublished-a)

There are whale bones and old ruins at Pingkok Island. The lands and its wildlife, fish, have changed today. For example, Putu used to have a free flowing channel. Now, last year, it had to be physically channeled. Two years ago, my brother Paul went to fish at Itkillikpaat where he ordinarily fished. He came back with no fish. We used to catch fish anytime we put a hook in. The Itkillik River is now rusty colored. There are even a bridge at Puviksuk. This river used to be glassy clear, as I have known it. These are the effects of past activity. Bessie Ericklok. (Nuiqsut) (MMS 1979b)

3.2.12 Solid and Hazardous Waste

Mayor Rossman Peetook indicated that that he would like to talk about the area that is being used for NPR-A, Alaska EIS. That area is being used for subsistence area uses and will probably be polluted if the industry takes over the land. He's very concerned about that because he wanted to use the example that the DEW line sites have been left vacant. There's pollution there that's never been cleaned up, and he feels that that same thing will probably be there if the industry or the seismic people use that area oil and gas. He is not against oil and gas leasing. But that he feels that until such time that better technology is available to be used in order to safeguard the area for fish for the caribou, for water fowl, these are very important to the lifestyle of our people. He knows *also that Teshekpuk Lake, there's all kinds of various fish there available. And what it would what would happen if something drastic happened there, and then the livelihood of the people that are dependent for subsistence what will happen to them.* (Wainwright) (SRB&A 2003)

Down by Icy Cape there's been a lot of reports of sick animals in that area. There's a few people who have gone down there. When they walk up on the land they noticed that there's drums buried in the ground from the old DEW line site. They didn't dispose of their fuels the right way. That's why everybody thinks the animals are getting sick. (Point Lay) (SRB&A 2013a)

Cause of the fast motion of the Colville, that's getting close to where the contaminated buried sites, cause each year, the erosion on the Colville seems to be faster every year. I travel a lot on the Colville during the summer months, especially when the moose season's opened up and we noticed that the erosion, every year it's faster. (Nuiqsut) (BLM 1997b)

Contaminants and drums were found in the rivers near the runway. A lot went in our rivers; that could be one factor to review. (Nuiqsut) (ABR Inc. et al. 2007)

We've got that Umiat, the erosion of the Umiat dump is floating through the river. That's a possibility, that the caribou might have been hanging out at that area. That's where the caribou's actually coming from. We've been finding containers, material containers along the river, you know? From the Umiat dump. The river actually eroded the ground and the dump is falling into the river. We left it [on the tundra]. (Nuiqsut) (SRB&A 2014a)

3.3 BIOLOGICAL RESOURCES

3.3.1 Vegetation

See traditional knowledge provided in the CLIMATE AND METEOROLOGY section for traditional knowledge that is also applicable to this section.

This is an effect. I've seen it. I have to go further and further out to get our food. Our ice pack is getting smaller. Our ice is not freezing. Used to be nine to 10 feet thick, now it's four feet thick. Our climate is changing. It affects our plants, like our salmonberries. If rain is low, it will affect us. We mainly need salmonberries for vitamins. We are mainly meat eaters so we need the berries to prevent scurvy. (Wainwright) (SRB&A 2009)

Berries used to grow in abundance one year and don't grow the next year and now its seasonal, every summer. Salmon berries, blueberries, black berries are growing every summer. Before, there was a break. Seems like the berries are more prevalent, and they grow every summer now. And there used to be a break from year to year. Now there's no break. So the wet summer helps the plants. (Anaktuvuk Pass) (SRB&A Unpublished-a)

And on the tundra travel, there's always never any snow on the foothills, because I've been hunting up there. There's always -- the snow is always blown off on the top, on top of the foothills because of the wind. And I thought there would have to be a foot of snow or something for the Cat trench to start. And there's always not enough snow so you tear up the vegetation. No matter what you do, you tear up the vegetation because the wind blows up -- blows so much in the North Slope. There is always not enough *vegetation -- I mean snow to cover all the vegetation. And that's why I would keep that -- keep the traveling at a minimum instead of extending the days of travel for the seismic crews and the oil companies. I think that would be something to think about too. Because I've seen them plow theirselves right through bushes, those little willows along the creeks. If you break a willow, it takes over 30 years or something for it to grow back. So you've got to keep that in mind.* (Utqiaġvik) (BLM 2004f)

You look at Pik Dunes up there, you somehow char up the tundra a little bit, and because of the rate of revegetation is so slow, that sand, if you rip open the sand, the desert storm ripple effect can happen. So it's a very sensitive tundra we have. (Utqiaġvik) (BLM 2004a)

The changes in transportation has caused a lot of trails and changes to the water accumulation in these areas. There's a lot more ponding in areas that have been used for ice roads and other activities. The ponding creates crevices in the land and it damages the vegetation. There's areas that were available for nesting and such that get under water after the usage occurs. There's increased concentration to activities from our community because there's diversion from other areas that are already being developed and are being explored and developed. So those increased concentrations from our village are now into the areas of this Northeast NPR-A. (Nuiqsut) (BLM 2004d)

Less berries. We used to go right out here and have berries and stuff. We don't hardly ever see berries anymore. When we go to the traditional spots that my grandma went there are still berries out there. It's cause I used to do that all the time when I was young. Me and my friend would be ptarmigan hunting with slingshots and eat berries at the same time. After a while we just stopped seeing them all the time. I don't really know why, they just stopped I guess. (Nuiqsut) (SRB&A Unpublished-b)

The ice roads, when they melt you can see where the road has been. I don't' know what they use, they use lake water and make ice chips and spread them where the road is going to be. Then they put regular water on it. I think it's cause it [the road] stays there a lot longer. They just don't grow; it's completely brown where the road goes. (Nuiqsut) (SRB&A Unpublished-b)

In Nigliq we used to get buckets of berries and now we hardly get any. (Nuiqsut) (SRB&A Unpublished-b)

In the Colville Delta region the vegetation were abundant to the point where you could smell them. Now we cannot smell them anymore. You have to get closer to their patches now to find them. They have been gradually depleting. (Nuiqsut) (SRB&A Unpublished-b)

Since we left the Colville Delta region in the 1950s coming back in 1973 I noticed that the changes had already happened. The plants and the vegetation and the berries that grew a lot were abundant and now there are hardly any. The willows, the leaves were edible because they grow in abundance and they were just like having dinner salad and now you don't have those today we don't eat what we would have eaten off of the bush. (Nuiqsut) (SRB&A Unpublished-b)

> *Like the rhubarb doesn't grow anymore. I saw some at Fish Creek but I don't see them anymore. I noticed that when we were young we used to pick rhubarb and eat them off of the shorelines and now there is hardly any.* (Nuiqsut) (SRB&A Unpublished-b)

> *They are not really that sensitive; they seem really strong because of the soil. It has a lot of nutrients. You could sell it like miracle grow the soil. It is even better. My cousin was growing a plant that took 6 months to grow, with our soil it grew like huge. The reason is that we have such a short summer.* (Nuiqsut) (SRB&A Unpublished-b)

Shrubby Plant Species

> *Well you know it is obvious that climate change and development is something that, you know that's happened – 10 years ago you are not going to see these willows growing along the road side but now we're seeing those a lot– and now we're seeing land otters that we don't, we don't normally see coming or new animals migrating up North – that's climate change effects – because of how geographically (unclear) may be.* (Nuiqsut) (BLM 2016b)

> *There are some birch trees growing, and cottonwood. Birch wood or cottonwood trees are growing here. That didn't use to happen.* (Anaktuvuk Pass) (SRB&A Unpublished-a)

> *There's birch trees, over here [pointing east]. I don't know why they are growing now. We always have alders, they are always here.* (Anaktuvuk Pass) (SRB&A Unpublished-a)

> *There are spruce trees right here to the south now, just close by.* (Anaktuvuk Pass) (SRB&A Unpublished-a)

3.3.2 Wetlands and Floodplains

See traditional knowledge provided in the WATER RESOURCES section for traditional knowledge that is also applicable to this section.

> *With the satellite programs, I, too, am very concerned about satellite -- the crossing of the Nigliq Channel, the bridge design, as well as CD-4 as well as CD -- I believe it's 7, the most southern site. Nuiqsut has not experienced, neither has Alpine, what we call the 100 year Colville flood. We've only experienced a 25 year flood and with that 25 year flood, it came very close affecting those areas. Now, with the 100 year flood that hasn't occurred -- and I know you have data of what a 100 year flood might look like, but when we first moved here in Nuiqsut, that 100 year flood -- the whole plains down there was covered except for the hill down there. And we haven't seen that ever since we've been here in the 30 some years we've been here. But, you know, the industry needs to know of these dangers Mother Nature brings out on these sites and areas. There are things that -- you can do all the protections you can do, we can have all the policies and stipulations in places, but when Mother Nature's forces come in line, there's nothing any of us can do to stop her of what she's planning to do. And this 100 year flood will come and it will occur and it will devastate those well sites that will go into the Nigliq Channel.* (Nuiqsut) (BLM 2003b)

> *Every year we get flooding in the Niġlik Channel, and every time at the mouth the ice builds up and carries gravel or sand and then slows down and drops gravel. So every year it drops more gravel and it gets further out. The channel, mouth of the river, is*

getting shallow. (Nuiqsut, Experience location: Nuiqsut. SRB&A Interview 2007). (SRB&A 2009)

During the break up of Kuukpik River, there used to be floods all the way up to Kayuqtusiluk. During the ice break up of 1945 the water level rose 20-30 feet. I haven't seen that since. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

Back in the 70's we used to have major flooding. The whole place looked like an island. You could see the hill over here like an island with water covering the whole land. That will probably happen again in the future when we start getting more snow. (Nuiqsut) (SRB&A Unpublished-b)

They used to have really big floods, I haven't seen the river go up that high in a long long time. (Nuiqsut) (SRB&A Unpublished-b)

3.3.3 Wildland Fire

For some reason the caribou haven't been coming as far east [toward Colville River]. There haven't been as many caribou lately. It's just variability in the migration. They had that huge fire in here a couple years ago. So much smoke poured out of there it might have kept them from coming. I don't know. Maybe they got out of the habit of coming here. (Utqiaġvik) (SRB&A 2013c)

And it's just sad to see that also the fire that came in July, how it affected the migration. And we -- we talk with the borough, and they wanted that fire to burn out itself, but it didn't. And like Charlie said, it takes about 50 years to grow them lichens. And where the fire is, I think it burned a lot of that. And we'll just have to see next year where the migration will be. (Anaktuvuk Pass) (BLM 2007)

We do get the effects. It covers the whole Umiat area. Forest fire comes from the interior and over the Brooks Range. The whole village area will be affected by the smoke. You can smell that burning all of the way up here. It doesn't go away right away it stays in the area for a while. Even when the tundra fire up… visibility was zero up there. Majority of the caribou migrating south accidently turned around and headed south. The moose was driven down river because of the smoke. (Nuiqsut) (SRB&A Unpublished-b)

[There are] fires down south, over there [tundra fires]. Inside the house it's getting stinky from the smoke. You can't see the mountains for two days. Planes can't even make it. [The wind blows] both ways north and south. [We have] east wind and west wind. It goes through the valleys. The mosquitoes come when [there is] no wind outside, [when it is] hot. (Anaktuvuk Pass) (SRB&A Unpublished-a)

3.3.4 Fish

See traditional knowledge provided in the ACOUSTIC ENVIRONMENT, WATER RESOURCES, and SUBSISTENCE USES AND RESOURCES sections for traditional knowledge that is also applicable to this section.

Salmon, Whitefish, and Other Fish Observations

Whitefish

Mr. Ahvakana: Thank you. Thomas Itta, Sr. was born and raised in the vicinity of Teshekpuk Lake, Cape Halkett is the place were he was born. Ever since he could remember he used that area for subsistence hunting. And all those lakes that are there visible, all of them, have fish in them. And he also stated that all the rivers that are around Teshekpuk Lake all flow into that lake and , therefore, they do have fish also. That Teshekpuk Lake from the beginning that we could remember that's been passed on by--from generation to generation. Our forefathers had stated that there's fish there that nobody knows that exist in that lake. (Atqasuk) (SRB&A 2003)

Get qaaktaq in the Kuugaagruk River [Inaru] around December, although that's getting late, it's getting too cold. The qaaktaq come up the river later than the other fish. They're milling around and then they decide to come up later for some reason. We don't get a whole lot, like they do in Nuiqsut. In October on the Chipp River, you can catch qaaktaq going upriver. You can catch more of them later in the season, like December or January, rather than in October. I don't know why they do that. Maybe they're out on the coast and then they come in? You can get qaaktaq in all of the river drainages, including Chipp, but only a few of them. You get them, but not a whole lot of them. We get the ones that are going up river in October. I haven't seen any with eggs then. Although have seen qaaktaq in Nuiqsut with eggs starting to grow in them. Maybe they spawn in the springtime so in the winter when they're being caught the eggs are just starting to grow. Then they will be bloated with eggs by the spring. (Utqiaġvik) (Brewster and George No Date)

Food for qaaktaq is less. They used to have shrimp in their stomach in the past; now it is like they are eating mud. (Nuiqsut) (ABR Inc. et al. 2007)

Before industry came, they [qaaktaq] were always healthy: size was larger, the amount of fat was higher. After the causeway, they are smaller, unhealthy, their food is unhealthy; they are eating something different. In the past, they had shrimp in the stomachs, when they were caught before the causeways were built. (Nuiqsut) (ABR Inc. et al. 2007)

I get qaaktaq at the mouth of the Chipp River before I go home, before freeze-up. I use a three inch mesh net. I also get them at the mouth of the Alaqtaq River, where it enters Pittalugruaq Lake [Pittallukruak Lake]. Also, I've seen qaaktaq all the way up to Chipp 9. I've caught them in my net. I've caught them up that far. We eat them fast. They're choice fish. (Utqiaġvik) (Brewster and George No Date)

Qaaktaqs are known by their white fins. They don't have a black tip. The large cisco are blue. And it looks like you couldn't see the scales. And they're about that thick. There used to be a lot of them when I was going up to my camp. Back in them years when I'd go with a canoe I would sometimes get started too late. And I just go around the Point [Point Barrow] on the other side, towards the [Elson] Lagoon side. And then drop my net from the boat, along the edge of the boat. By Nuvualuaq [Plover Point]. But you have to watch closely because there are a lot of seals and loons and other animals going through that deep channel, including walrus. (Utqiaġvik) (Brewster and George No Date)

The boundaries of paikjuk doesn't go beyond that area that's west of Alaqtaq. I've never seen it beyond that. That's kind of why I protected that area from seismic. I didn't want to lose sight of that only fish that I know called paikjuk. It's a beautiful colored fish. They are located only in that area. By Warren Matumeak's. Alaqtaq. From here, going over toward the Tasiqpatchiaq. I went through there one time before there was this break into Chipp River. And this old man that fished here talks about them and he goes up into the Chipp River up to where Charlie Edwardsen was fishing then, too. And Paul Kignak's camp. East. I've never seen them west of the river. But the west of the river, those fish become to look like lake trout family. Some big ones. And the aanaakjiq up where those lake trout were, were different color than the ones we were getting at the river. I don't know if they can spawn together maybe. I don't know if lake trout can participate in that. That large lake near Chipp 2 contains the smaller ones. And you can kill them in three inch mesh net. They're beautiful fish. I like them. And they're right up over in that area. Along with Alaqtaq. And that was the reason I was opposing making a landing field for delivery of diesel on those lakes. If they destroy those fish and they don't live in any other area where we know them and we can't ever find them in any other place, then I don't want them destroyed. Also the natural habitat is being destroyed by natural erosion of the river and other areas where you can't protect anything when that happens. If the river breaks through, it breaks through those lakes containing some species of fish. Some with lake trout. (Utqiaġvik) (Brewster and George No Date)

I know these lakes, rivers and lakes, but I think this is the one that I heard so many times to be a subsistence spawning area. This little lake right here, [Chipp-Ikpikpuk Report, AB-19] it's a spawning ground for those fish, and they know it and when they spawn they go and pick up a lot of fish, you know? And they just go in there and get grayling and whitefish and all that spawning and they just mingle in there and get them. (Utqiaġvik) (Brewster and George No Date)

There are lots of fish in Qaababvik. At the mouth of it. We used to go there while traveling and needed a safe place to wait for good weather before crossing Dease Inlet. And we'd fish there. We'd get aanaakjiq [broad whitefish] and lots of iqalusaaq [least cisco]. (Utqiaġvik) (Brewster and George No Date)

The Chipp River is known for aanaakjiq, and also for burbot [tittaaliq] and iqalusaaq [least cisco] and those little humped whitefish - pikuktuuq. There are many in those areas where they seek burbot and grayling. They follow the spawning of aanaakjiq every year. Boy, you catch those with a hook, the pikuktuuq and the tittaaliq. They just follow the spawning run of the aanaakjiq. The Alaqtaq River is good for whitefish. It's good fishing in summer until July. By last part of July they're starting to disappear. We know they're moving someplace. So, all those lakes in there between Alaqtaq and Chipp River are mingled with those fish, with aanaakjiq. And they don't have to be deep, as long as they are about seven feet deep. (Utqiaġvik) (Brewster and George No Date)

The biggest fish I've seen are from Tasiqpak. The ones that are fat are right from this area. I think that some of these spots are fifty feet deep, and they contain big fish -- aanaakjiq. All of our nets were too small, when they got tangled up. But this guy had a very unusual net, made with three mesh deep. It was a big one. And he would make his own nets. And he'd get two fish, it was more than enough of a load for him to take home. The fish were big. And me and Tommy Jr. went up going through west Tasiqpak [showing on map] -- this way I guess. In this one lake. It was deep water. It was about fifty feet. And the aanaakjiq were big. And when we started to pull the net in it was moving like mad, but when we got it out, we got only two or three fish. Big ones. And five fish was pretty *near a sled load. There are big fish down there. The biggest aanaakjiq I know about came from the Mayuabiaq River. This was Elavgak's grandpa. Daniel Leavitt's mother's grandpa. He had one net. One fish was enough for him. He would drag it home like a seal. Put a rope through the mouth and pull it over his shoulder; you know just like dragging a seal home. It was that big. One fish filled the net.* (Utqiaġvik) (Brewster and George No Date)

Char and Other Freshwater Fish

Most of the lake trout I've seen outside of Tasiqpak are in deep lakes. They don't stay in the shallow lakes. Where lake trouts are found is usually an impossible area for the fish to get in. They don't escape to travel like aanaakjiq do. (Utqiaġvik) (Brewster and George No Date)

In Barrow, in August, the fish along the coast are coming from the east. One time I saw the water churning off the beach and it looked like Iqalukpik [dolly varden char]. They're good eating fish, so after I saw them I put a net in and got some. I put the net out in front of NARL [along Chukchi Sea coast]. People don't know this. They put their nets on the Elson Lagoon side for aanaakjiq, but the dolly varden are traveling out on the other side. I've seen them at Point Barrow, too. In Point Hope, they put a net out from the shore at a 45 degree angle and wait for the fish because they are traveling along the edge of the shore. So that's what I was doing. (Utqiaġvik) (Brewster and George No Date)

There are some underground rivers around the middle of Teshekpuk Lake. There's the shallow part and they have rivers through there. They call them rivers. That's where the fish travel. The big fish, the thirty-five pound lake trout, are in those deep channels. (Utqiaġvik) (Brewster and George No Date)

This certain place where they used to set up their nets is by where we put cabins in on the Tupaabruk River [Tupaabruk 2 area, see Figure 96]. There are three houses there, plus Mary Lou Leavitt set up a house across from our houses. We put the cabin there because it is a good fishing spot. We put the nets out around the bend and they catch all kinds of fish. Besides at night when we want some burbot, we can just go fishing. It's close by. (Utqiaġvik) (Brewster and George No Date)

Tittaliq [burbot], that's the Meade River, at Atqasuk. The real Atqasuk. That's what they call it, Atqasukiak. The real place, before they moved it to the village. Winter ice fishing. And we get the qaaktaq at the same time, and the humpback, the pikuktuuq. Right at this creek, right there [Usuktuk River]. A lot of burbot, big burbot. The biggest one I got was this long and this wide. (SRB&A Barrow Interview March 2006) (SRB&A 2010a)

And when I go up inland, go fishing, you start getting catfish. Those are unusual in our rivers up inland. You start getting these catfish. And those catfish are always on the ocean, not on rivers. Johnny Aiken. (Utqiaġvik) (MMS 1982)

Now, the Elders up here warned us about what happens to our food chain when they get -- it gets destroyed, and we look at -- you know, that sound down there, and the herring hasn't come back yet. And what is the herring? The basic food for most of the animals that are there. You destroy that kind of fish up here, my seals are gone, my walrus is gone. And if you destroy the lower part of the food chains, well, America, you will have finally achieved your goal, to destroy the Arctic whale. You tried it in the early 1800s by *overharvesting it. Now you are going to pollute it. George Edwardsen.* (Utqiaġvik) (MMS 2009a)

Salmon

I think all the estuaries are major spawning. I get a lot of salmon fish in the lagoon. I get coho, chum, pink, humpies, some [Arctic] char once in a while, and in August King salmon. I've had a net out right at Kokolik mouth, and I was getting Least Cisco in there one year, and I used a small net in the fall time, August and September. (Point Lay) (SRB&A 2011a)

Salmon, they never used to come up here. In summertime, by our cabin, I got a net. And it started getting some salmon. Dog [chum] salmon. Real big toothed ones. Not very many of them. We never used to get them, but now we do, so maybe they start moving from someplace. (Utqiaġvik) (Carothers et al. 2013)

Kukpowruk and Kokolik are our important spawning grounds [for] the salmon, the grayling. When I first came there was a lot of fish bones on the ground. Past Niklavik, [it is] just graylings. (Point Lay) (SRB&A 2014b)

I think our prevailing wind has changed to the south, southwest. It's been dominating the winds have been dominating from the south and southwest. It's warmer air and high tide in the lagoon and it's not favorable for salmon fishing. The current has to be going out when the salmon come in. (Point Lay) (SRB&A 2013a)

Fish Movement Patterns

Lakes and Rivers

And when I thought about that and I -- if you looked at a picture of the whole North Slope from the Canadian border to Point Hope, you look at where NPR-A is and the central part of the North Slope, there is thousands of lakes and lots of little creeks and rivers. That's where the majority of those lakes are. And what that tells us is that that habitat is so critical to fish. You know, you could see there, all those lakes that have fish in there, that's just a snapshot of fish that, you know, they identify as fish bearing lakes. But listening to elders in my family, even biologists who study fish on the North Slope, that these fish, they move from lake to lake through streams, through creeks that are seasonal. They might not be there year-round. And if you build roads in these areas that don't have a river, like a permanent river, but you're going to block their connection between these lakes, from moving from river to lake to ocean or whatever it may be. And I don't think there's been enough research to document that. So you need to seriously think about how that's going to impact the habitat of the fish on the -- in that area of the North Slope. (Utqiaġvik) (BLM 2004f)

Wind in Teshekpuk Lake affects the fish. When it's ufalaq [west wind] they never come. There are no fish there. When the wind is from nigiqpaq [the east], that's good. That river [Mayuabiaq] is so different when it's east wind. The water gets better. But when it's west wind the water is low. In our area around there, Mayuabiaq, when it should have lots of water at ufalaq, it's different. The water goes down. I think the wind pushes the water from Tasiqpak. (Utqiaġvik) (Brewster and George No Date)

Also we've mentioned before that we're now moving in to the heart of the broad white fish, the ahnalik center of distribution and population density, and these fish have a *complicated lifestyle that requires use of several types of habitats: lake habitat, deep river, spawning habitat, small ephemeral streams for accessing summer feeding areas - they go out in the near shore area - and all of those different habitats are used in different parts of their life cycle. So it's important when building gravel roads and structures not to impede even very small streams in order to retain healthy populations of this fish.* (Utqiaġvik) (BLM 2003a)

I notice that these fish we have, the white fish, have not migrated out into the ocean, they just migrated back into these lakes and stayed there for the winter, they are locked in for the winter when they get there. Some of these lakes that I named as the rearing ponds are also the wintering areas for these fish. (Utqiaġvik) (FEA 1976)

The area around the lake … is all flat tundra. Every spring, at break up … all the flat tundra around the lake is very grassy and when the water level rises, the low-lying areas with dips and hollows become flooded. That's when all the pike go all over those grassy pools. When people are short on food, they would go fishing for them. They are ideal for dog food (Arctic John Etalook, pers. comm. 1981) (Anaktuvuk Pass) (Spearman and Nageak 2005)

They are real resilient fish. They go up these streams [the Miluveach River and others off the Colville River] and right up the waterfall, and they feed off the waterfall. ... It depends on the season [what the fish eat]. Like late August, early September, they feed on beetles. … [Also,] we have little stickleback that graylings and the other fish eat. (Nuiqsut) (HDR Alaska 2015)

The big run for iqalusaaq is in the summer. In the wintertime, you can put a net out under the ice and get a lot of them. We'd go to Kuugaagruk [Inaru] River for that. We used to eat a lot of those iqalusaaq and then feed them to our dogs, too. (Utqiaġvik) (Brewster and George No Date)

There's usually two to three weeks of a fish run in the fall. Just when the ice is forming. Aanaakjiq, iqalusaaq and pikuktuuq they come together. And sulukpaugaq. They all run together. Our belief is that after the rivers begin to form ice, the fish are heading back in up towards the inland area into the lakes where they came from. (Utqiaġvik) (Brewster and George No Date)

The Alaqtaq River is good for whitefish. It's good fishing in summer until July. Last part of July, they're starting to disappear. We know they're moving someplace. They're heading up to Chipp River. We know exactly the route they are taking to go up there. They go through Tasiqpatchiaq. And go through Pittalugruaq one time. But the river has broken through to Chipp River and is flowing this way now. It still flows out, but the channel has built up [increased water flow] and it's deep water now. And there are those streams that flow into the Chipp River and other main rivers. There're some streams like Tittaaliq, Aumalik, Qaksrabavik and Qubafnaq and stuff, but those are up in the headwaters where the water is coming from. There has to be enough water up there that they continually flow in the summer without letting up. So the fish are going up there, too. Those little fingerlings are the ones that go through those, too. And there are some lakes up there we know where the grayling are found, where the fish will go. And then four or five years later the big ones that are ready for spawning. Male and female. They go down. And you are tagging them coming up. They go from Alaqtaq area and then go in there. Those that are spawning grade are going up. And in the fall, just before around freeze-up, they stampede back down to spawn in those qaglus. Same thing, going up or coming *down to spawning, I imagine those fish know where to go for spawning. Now, some of the things you didn't catch out. All the fingerlings don't go all the way here. Some get lost. The majority of them, they go into these bays. When the break-up pushes them all out, they have to go somewhere. They run around, probably escape predators. The only way they will reproduce is in these lakes.* (Utqiaġvik) (Brewster and George No Date)

Fish in the lakes, the small ones, are in the rearing ponds. As they grow into big fish, big enough to spawn, early in the spring they stampede out while it's high water. That's when we get some good fish. I like to be there to catch some of those. They already have roe. They are not prime, not ready to spawn out, but they are there. The eggs are glued together. You can't separate them easily, like you would at spawning time. During spawning time, you just squeeze the fish and the eggs pop out. Sometimes we have to clip the tail end to leave the eggs in there and then freeze them that way. All the fish [ones in rivers and ones that had been in lakes and moved to river through streams at high water] go to the headwaters of the Chipp River in the summer. They head up to the headwaters. How far up? I've never made it up to the very end of the Chipp River, but I have gone a ways up. Even tittaaliq and grayling go that way. In the fall, the fish are coming down the Chipp River for spawning to the deep water. There are deep water holes in the river where the fish spawn [qaglu]. Those fish know what they're doing. I think they know that during spawning they want to come down with a spawning group. If the run is good, the majority will go down towards the bay, and to qaglus where they spawn. (Utqiaġvik) (Brewster and George No Date)

Nalaakruk Lake has really good, tender fish. It was different. I think the oil companies used that water and it's really different now. The water looks different, they say. Our son [Billy] usually goes there for a few days in the fall and gets real good fish. They are different than the river fish. Aanaakjiq. (Utqiaġvik) (Brewster and George No Date)

In the 1930s, '40s and '50s, we usually ended up fishing on October 6. We started around September 23rd with a dog team traveling through snow and ice crossing small lakes that were already frozen enough and useful for traveling. We knew the fish run would start around September 25th or 26th. The fish don't miss that. We have to be there to catch them, otherwise after five or six days the run is over. And if you don't catch them then, you don't have much subsistence food to put away. Today, it runs all the way into October, 10th or 15th. (Utqiaġvik) (Brewster and George No Date)

Six days before spawning, seven days at the most, that's when I want to arrive at my fishing spot on the Chipp River. That's why I have to be there. You have to catch the fish run when it's happening. After the 10th of October, it makes no sense. The run is over. Right now, it's changed to the 10th. The run used to be from September 26th on down to October 1st. It's ten days difference now. I figure the change of climate or some measure of change has to do with it, because we have a late freeze-up today. In my younger years, I would go ice skating maybe on the 15th of September. And then the reindeer corralling time would be the last week of September. And the ice would be that thick and it was just right for making a huge ice corral. We put all the reindeer into that. So that's the difference today. I mean somewhere around October 8th or 10th, up to there. In those two areas, I would pull all my nets out. No matter which way you look at it, spawning has to take place. I don't know if the fish can hold off that long. (Utqiaġvik) (Brewster and George No Date)

Nearshore Marine

When the weather is warm, [there is an] overflow from ocean, in July. It changes the fish coming in. [I saw that] in [the] last few years. When the overflow from saltwater is coming in (from a west and southwest wind), it coincides with warm spell of the weather. (Nuiqsut) (ABR Inc. et al. 2007)

The Arctic cisco and broad whitefish always come in [on the eastern side of the mouth of the Colville River]. A lot of animals like bearded seal, [ringed] seal, and spotted seal begin coming into the river from the ocean during the time that it is continuously dark. Also at the mouth of the Nigliq [Channel] is where bearded seals increase in numbers in the darkest months of the year [early winter]. … We get seals, bearded seals, sea lions do come in there near the mouth of these channels to feed on fish. And they do hunt in those areas: Colville Delta region all the way to Nigliq and some are in Fish Creek area. They're abundant in August- September. That's when the fish start coming in.…Some do come in way inside somehow.…I got ugruk [bearded seal] by Kayuqtusiḷuk…It was around with a lot of spotted seals. (Nuiqsut) (HDR Alaska 2015)

It is noted of 28 species of fish that comes over winter and have them -- and half of those fishes winter in the Colville River. Like the Arctic cisco is a migration fish that spawn from the MacKenzie that has been pushed through the current until they are three-, four-year-old. By that time they are in our river system. But there is fishes that comes in the river. That's why we are worried what will happen. (Nuiqsut) (BOEM 2011)

I have fished most of my life and have noticed that the fish follow the currents. During the summer months we would never have to leave the shore to catch fish. I also remember that most of the Arctic cisco caught during the summer had eggs within them. Starting in July when it starts getting darker, they follow the salinity of the ocean. They never leave the shoreline in summer. The families used to fish where Helmerick put his cabin. Once the causeway was built, the seawater treatment plant, changes began to occur. These changes affected the size and abundance of fish. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

In older days, with a west wind [we] hardly caught any fish, but today we catch most fish [in a west wind]. In the past, the west wind used to push fish out, whereas today, we depend on the west wind to push the fish in. (Nuiqsut) (ABR Inc. et al. 2007)

In the beginning of August, the Arctic cisco turn around and start moving back into the river. Large fish seem to disperse a long way east and west from the Mackenzie River. Other white fish from the Mackenzie peter out at Herschel Island. Other fish from the Colville peter out at Flaxman Island. But Arctic cisco are found all the way along between the Colville and Mackenzie. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

The reason why I had my sons pull out all the fish nets in December was it was an unusually different weather pattern this year [December 2003 - February 2004]. It was hardly below zero until December. [On the rivers] the salt water will flake up, and there's flakey ice that looks like maybe the fresh water is coming out from the river or somewhere. It forms paper-thin, and is real sharp and then it moves. But in the salt water it is in a different form and it will collect easy on your net. And it will float the net no matter how much weight you put on it. It collects so fast through the current that I told them that happened to me more than once. So you might as well pull the nets out, because I think you're going to have a bad situation trying to pull them out later.

Because I know, I've done it before. I got caught in it. Got caught twice, it's enough. And then I remember it. (Utqiaġvik) (Brewster and George No Date)

Health and Physical Abnormalities

The fish we get, the cisco—it seems more contaminated—like chemicals are eating away at it, not that another fish had taken a bite out of it. There are big sores on fish, and some are deformed. You see this especially on the belly and tail. They have pale-colored meat, the color is reddish. You have to throw it away; you can't even feed it to the dogs. (Nuiqsut) (McBeath and Shepro 2007)

When I started seeing dark spots in the liver [of burbot], I, I mean I ask questions. 'Cause I know for a fact there's an old dump site just a few miles upriver and lot of it is toxic. So might have something to do with those dark spots showing up on those livers 'cause the liver of a burbot is our delicacy. I mean it's probably the best part of the fish that we go after. But then after start seeing that dark spots in the liver they might start shying away. Start telling my boys no more from that place. (Nuiqsut) (Brown et al. 2016)

They are smaller, skinnier fish now. I have a picture taken in 1973, when things were different. Fish are very small now in the channel compared to thirty years ago. Then people caught from two hundred to six hundred fish per net per day. Now we get one to thirty fish per net per day in the same area, on a good day. (Nuiqsut) (McBeath and Shepro 2007)

She said that she was raised here and she's been living here, and over the years she has personally consumed qaaqtaq, Arctic cisco. And the liver is a delicacy for her, but over the past couple of years there has been discoloration of the liver in Arctic cisco. Although the fat contents are still evident, there appears she hasn't had any liver from the qaaqtaq for the past two years because of the discoloration of the liver from its normal color to a darker, blackish color in some cases. Flora Ipalook, translated by Delbert Rexford. (Nuiqsut) (MMS 2007c)

In the 1970s [the] fish were healthy and you could cook all of those fish and [the] taste was good most the time; now, the fish has changed, the taste has changed; even the fresh fish they catch today tastes like it has been in the freezer for a long time, freezer burn. (Nuiqsut) (ABR Inc. et al. 2007)

Effects of Seismic on Fish

In the wintering years when ice gets thicker and the waters and the fishes are even more sensitive because the ice, the more ice there is the water becomes more dense, so much that it's -- any little sharp noise or bang of those effects can kill fish. And included one incident where when there was fishes site on a clear day you can see it clear, but under the water and - and for -- not for it to be lost, the ice is 10 to 14 inches and you can slap that with a -- like a bang and cause that fish either to die instantly and those are known types of things that have killed the fishes and especially when the ice is thick, because the pressure of the ice makes that water more dense and easy to kill the fishes. (Atqasuk) (BLM 2004b)

He said they were sounding along the river bank by Kuugagruk, and put up poles all the way by the river banks. And, they were sounding there ever since the fish were scarce. All the other rivers drain to the ocean, and when there's Spring breakup, then *all the debris and everything that's in the river goes out. But, Kuugagruk happened to be different than those other rivers, because it does not flow out to the ocean. And sometimes, the debris will collect in that river because the oil companies had been doing some testing there. After they did that, there was lot of dead fish along the along the river banks, like they were just a long line of wood that they gather from the bank of the river, sometimes. They said the river banks were just full of dead fish after those testing on that river. Noah Itta translated by Alice Solomon.* (Utqiaġvik) (MMS 1982)

And, as told in a comment made by an inland person earlier, he said his father would kill fish by hitting (the ice) from the top, and if there is ice-free water under there the fish would die. And then he would make some holes in the ice down-current for the dead fish to float up through. This, (his story) is also true. This is how the (people) that are drilling, using explosives on land during the winter near the lakes, kill the fish. And also in the ocean when they are using compressors, it is no different. A person saw this with his own eyes and knows that just by hitting the top of the ice the fish would be dead. A compressor which sends off a very loud noise (and vibrations) can also kill a lot of fish. (Utqiaġvik) (SRB&A 2003)

Due to the ships traveling about we didn't get any whitefish this year. Usually we get plenty. This year, with all the ships dragging seismic equipment, we didn't get any fish on our river. (Wainwright active harvester; Experience timeline: 2006; Experience location: Kuk River. SRB&A Interview 2007) (SRB&A 2009)

And he's more concerned about the east -- the lakes east of the Ikpikpuk because they are filled with fish, and he's very concerned about these for wintering and seismic because these are the Community of the Arctic Slope, Barrow, Atqasuk, Nuiqsut and Wainwright, they still rely heavily on the nutritional supplements from subsistence, and renewable resources especially in these fishes -- I mean, lakes where there are fishes. These are known, you know, for to supplement the dietary and nutritional needs. And they need to be heavily protected. There is not much more else that we can rely on other than our renewable resources that is just so sparse right now, but being on the whim of extinction, on especially in the advent of seismic and oil and gas exploration. (Atqasuk) (BLM 2004b)

During the course of early seismic testing during that oil exploration, the blasting of the dynamite gave a good recording. But they were destroying all of the fish. The only way we found out that we were destroying fish was in the springtime during break-up when it produced dead fish on the surface. Seagulls enjoyed them all, I think. But the seismic was responsible in them years by using dynamite. Today, they've got different methods. We made a report on that. I was fishing and working for the Navy. By testing dynamite in the river, I learned that I killed a whole bunch of fish. I was part of them, working for the Navy - and I didn't even know it until one guy mentioned that Tasibruaq Lake fish were gone, and there's so many fish on the edge of the lake. They blew one, two, three charges of that dynamite there in that lake. It had some effect too, probably even poisoned rainbows, killed them by concussion, I don't know. (Utqiaġvik) (Brewster and George No Date)

Noise bothers the fish. Seismic crews in the early days used dynamite on fish bearing lakes and rivers. Norman Leavitt said he saw lots of dead fish on the Kuugaagruk River [Inaru]. That's sad. The state allowed that to happen. We had no say. Now they've developed a vibrosis method for seismic surveying, shaking, that doesn't hurt anything because it's gradual not sudden. (Utqiaġvik) (Brewster and George No Date)

My next-door neighbor he mentioned at the time he was up in the fishing area near Alaktak that the dead fish were on the edge of the lake that the seismic had got to during the winter. They did tremendous damage, not only at the lakes that I pointed out but also some other lakes around the area - all these lakes that are ten feet, eight feet or more. There's - or was a tremendous amount of fish in these lakes - one lake has more than three species of fish. (Utqiaġvik) (FEA 1976)

A compressor which sends off a very loud noise (and vibrations) can also kill a lot of fish. An elder (made a comment) to stop (the drilling for five (5) years.) since we, ourselves are elders now. I will support his comment to stop (for five years) to see if the animals will return to(their habitats); I am glad to know that a person thinks in this way. If they are going to drill near the river, don't use the water in that river. The (abundance) of fish will change. (Utqiaġvik) (SRB&A 2003)

This year my husband went fishing. He only took home two whitefish. Not like years past. Ever since the seismic, anything that has to do with noise. They've done some sort of search up by our cabin on the Utukok River. We did not get very many fish. If they stop the seismic, maybe they will come back! (Wainwright active harvester; Experience timeline: 2006; Experience location: Utukok River. SRB&A Interview 2007) (SRB&A 2009)

We never see those fish anymore through here. I think I know why. One of these seismic people, they were sounding in this area, all the way up here. When they dynamited that down there, they blocked that road for the fish when they come up that way. We never get anymore. Last year, was the same way. It's been six or seven years now since we ever catch any. In the summer, sure, we get a little bit, but not too much. Sometimes ten, twelve fish in one net. But, we used to get a lot of them. We have to come out in here, where Noah Itta's place is. We can get our fish in the summer right there only. That's the only place in the river in this area that we can get fish. That's aanaakjiq. (Utqiaġvik) (Brewster and George No Date)

And he's concerned on fish in lakes and rivers over wintering areas and seismic. Sometime ago they had been involved with the -- working with seismics before and it has devastated known wintering areas near here and Ikpikpuk. And these were -- these are dynamite things and they know that this does kill and devastates fishes, stocks of fish, many of them and many known over wintering areas. And he's -- and perhaps on account of those that the setbacks, maybe that may be warranted to be even a little bit more to -- rather than relaxing them in all the ravines, including rivers. (Atqasuk) (BLM 2004b)

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Effects of Development on Fish

I believe that sediment studies along the DEW line should be looked at. Nowadays, the fish are skinny and not fat like they used to be. You should look at those problems from the past. Perhaps the fish have an altered migration path in order to avoid contaminated areas. Maybe they migrate out in the ocean farther. But there is something that is causing a change in their migration route. They are traveling longer distances and that *is evidenced by the fact that they are not as fat as usual.* (Nuiqsut) (MBC Applied Environmental Sciences 2004)

It is a lot of work to go out there and chisel ice and coming back the next day to check the nets and there is only one fish. It was really sad last year. I barely made a half a sack of fish. When we caught fish, we send some to Barrow. Last year we sent three fish to Barrow and two elders fought over them. This year they are happy with what we are catching. We are able to send more. I hope it gets better. I feel the decline in fish occurred when development began. It has really declined after three years of construction of the HDD (horizontal drilling under the river) near Putu. This year they drilled at Iqalliqpik (Fish Creek); we didn't catch many fish when that rig was there. Now that development is slowing down, we hopefully will see the fish counts increase. I believe noise and development are the cause for the decline in fish counts. Prior to development there were no complainants with the fish counts. First there was Alpine and then North Star. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

I am concerned with industry building more and more ice bridges every year. They build these ice bridges over the rivers of the Nigliq Channel as well as the Colville River. These ice bridges are used to enable rigs to travel over the river in order to reach the drilling site. These ice bridges are built in December and January. My theory is that late in the season, with the building of ice bridges, migration routes are being blocked. With ice bridges being built across rivers, it naturally forms ice underneath. By the time the ice road was done in April we found about 70 feet of ice formed beneath the bridges and only about five feet of open water left at the bottom for the fish to pass. That practically covers the whole river and prevents any wildlife or fish to pass the river at these areas where ice bridges have been built. I would like a study to be done to determine if these bridges are being grounded to the ground. I feel that the bridges affect the fish greatly as well as the community. Industry says no, we need the oil here, but further studies need to be done to do it right… This is a concern because the fish travel within a specific temperature of water and a specific depth. When the ice forms and blocks those specific areas they will turn around and go back or elsewhere. They probably will not go underneath and figure it out. A similar situation is seen among the caribou and the pipeline height. When the caribou encounter the pipeline they will turn away and go somewhere else. They will not stop and think that perhaps nearby there is a crossing path that could be used. With the forming of ice bridges I believe that the fish that encounter it will turn around and go back. I don't think they will go under it. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

The effect of outboard motors on the fish is the noise. Any time you create noise, it's going to effect the fish. That's why when you put out a seine net, you use a rowboat. Fish are closer by if you don't use an outboard. They scatter from the motor noise, but they come back. (Utqiaġvik) (Brewster and George No Date)

When there's noise from people walking on top of the ice or people traveling on top, fish like tittaaliq move away from where the people have made a trail. Now they don't stay around there when there's noise. When there's noise, they're more afraid than other fish. (Utqiaġvik) (Brewster and George No Date)

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Maybe [the change in quality] is related to the ice road. Maybe it's blocking wintering fish feeding grounds, blocking the freedom of movement for wintering fish; they are blocked from the ice road near Spy Island [a barrier island east of the Colville delta; Most [of the ice road] is grounded. (Nuiqsut) (ABR Inc. et al. 2007)

My theory is that late in the season, with the building of ice bridges, migration routes are being blocked. With ice bridges being built across rivers, it naturally forms ice underneath. By the time the ice road was done in April we found about 70 feet of ice formed beneath the bridges and only about five feet of open water left at the bottom for the fish to pass. That practically covers the whole river and prevents any wildlife or fish to pass the river at these areas where ice bridges have been built. I would like a study to be done to determine if these bridges are being grounded to the ground. I feel that the bridges affect the fish greatly as well as the community. Industry says no, we need the oil here, but further studies need to be done to do it right. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

Titaaliq, the burbot, just about every year I go ice fishing. Last year I caught one and it was yellow where it was supposed to be white. A few other times the liver was discolored and I am wondering if that is coming from Umiat or all that stuff they buried at Pivoqsook and all the erosion from the banks. (Nuiqsut active harvester; Experience timeline: 1992 and ongoing; Experience location: Tuiqauraq. SRB&A Interview 2007). (SRB&A 2009)

Dredging affects the turbidity of the water and in turn affects the Arctic cisco and their migration patterns. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

There are little fish that are good for qaaktaq that discharge out of the Colville River– ice bridges are blocking them in. (Nuiqsut) (ABR Inc. et al. 2007)

Our fish used to be a lot bigger. We have gone from 3-inch mesh net to 2.5 inch. One year they said the low catch in the Nigliq was because of the slush. After the first year of the crossing [HDD drilling under the river], there was a lot of drilling mud that was lost. Scientists and biologists believe that this mud has not affected or harmed the fish because the mud contains a lot of salt. Some people are skeptical; they feel that this didn't help the fish at all. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

We're already a living example of if you would eat contaminated animals or fish. Right now, our burbot is contaminated with PCP form the contaminants in Umiat. And we're - I'd say like 60 percent of the village used to harvest burbot. Now I'd say only 10 percent if even any 10 percent. (Nuiqsut) (MMS 2001b)

There are lots of fish within the area. The plant sucks in the yearling fish and also changes the salinity of the water within the area. The place where the most cisco are found is where Old Nuiqsut, currently Helmericks fishery, was located. Causeways could block the fish from traveling between the Mackenzie and Colville Rivers. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

They are extracting gravel from Napaung Lake. This will affect the Broadhead and Whitefish. The lake is very long. When they pump these lakes it takes away the food source *of the fish. At Oliktok, there is a large salt water intake. How big is the screen? Is it small enough that it doesn't suck in the food source for qaaktaq and other marine animals?* (Nuiqsut active harvester. SRB&A Interview 2007). (SRB&A 2009)

The changes are the burbot, that eat the fish. The burbot are more slimy in their skin, and the liver has changed; the taste of the liver has changed, the burbot liver. I don't know, maybe after that one big mud [discharge], when they drill and also when they are near Umiat, and there's a lot of debris in the Umiat area. We found out now that burbot, after they found out that they had PCP in the livers. The elders that have been eating those have died from cancer. (Nuiqsut) (SRB&A 2013c)

*Before development began the abundance of fish was higher and the fish were fatter. Since the development started there has been a low recruitment of fish and they have become skinnier over the years. (*Nuiqsut) (MBC Applied Environmental Sciences 2004)

There was a decrease of Arctic cisco in Colville after a few years of the HDD drilling. Since it is up and operating and drilling has stopped, it seems like the Arctic cisco run is getting better. Now the fish counts seem to be getting better, perhaps because there is less industry activity, less underwater drilling. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

We don't know how much, the ones that affect the areas where the fish travel on these rivers and the activities that are going on in the Colville [River] are the ones that really affect our area. Last spring we didn't get hardly any fish over at Chandler and Shainin Lake. Like the alpine development; that's really affecting us. Do fish migrate? The activities on the Colville River, those that drain in there, that affects us. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Not on a regular basis. A major oil company here on the North Slope was fined heavily for illegally dumping at Endicott, which is on the migration route of the Arctic cisco to the Colville. I feel that illegal dumping is a serious problem, whereas five kids playing in a swimming hole is probably not the problem that has wiped out the cisco. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

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3.3.5 Birds

Black brant, you can catch those up here [directly east of Barrow], and if you want to harvest large [amounts] you can go [here] [Wainwright area]. Black brant are not my favorite type of geese, but if I'm in the area and I can harvest them, I harvest them. When I go eider duck hunting over here [in the lagoon], the black brants sometimes fly back and forth where the eider ducks fly south. The black brants fly back and forth between feeding grounds. (Utqiaġvik) (SRB&A 2010a)

That's pretty much it except for on the spit, there's lots of eiders along the whole lagoon spit, lots of eiders. The whole thing; I've seen eider nests throughout the whole spit from *here to Icy Cape. They don't nest too far apart, from here to the wall and there'll be a whole pod of them.* (Point Lay) (SRB&A 2011a)

All those birds I tell you about, they go all along the coast. After they're born, first two weeks they stay around there, then we see big bunches of babies floating around the lagoon. Inside the lagoon. Hundreds and hundreds of birds. They raise them in the lagoon. All the way up to Icy Cape we always see babies bunched up. (Point Lay) (SRB&A 2011a)

Eider ducks, geese, swans, loons, and there's aahaaliqs [long tailed ducks], what you call it in English? Always see them raising their young all over the lagoon. They call them isas. (Point Lay) (SRB&A 2011a)

[The brants are] mainly inside the lagoon going south. We're always seeing them in the lagoon. They go from point to point (in the spring). They hit the points like this and fly this way and head over. But when there's open water they seem to fly over the open water a lot. (Point Lay) (SRB&A 2011a)

All along the coast, the whole spit is key habitat for the birds nesting, all over. Up Kukpowruk River, in all the lake areas [there are], loons, terns, everything, swans, cranes. I have never seen a crane egg but a swan egg. I saw a nest that was abandoned and they never came back. (Point Lay) (SRB&A 2014b)

There's an island at Kukpowruk. That's called Snow Goose Island, The big one. That's where there's a lot of snow goose end of June. Elders used to tell us where to go for that [egg harvesting]. If you want to get snow goose eggs, don't get too much. Plus [they nest] right from the village. I think it's this one [lake] here [near Point Lay]; it's got to be this one. That's where the Canadian geese go. There'll be hundreds of them end of June. Canadian geese. They're nesting there. Swampy area around that area, it must be their food. (Point Lay) (SRB&A 2011a)

There's some birds that don't normally come this far north, but they do nowadays. The weather warming up, they have more areas where they could raise their chicks and produce, reproduce. (Point Lay) (Braem et al. 2017)

Also at the mouth of Niglingaurat black brant used to nest there by the hundreds. There were so many that they looked like bowls from a distance filled with eggs. We could have hunted them if we chose to. When they flew away, it looked like there was a big, black cloud. But we do not hunt them. (Nuiqsut) (BLM 1998c)

When the thin ice near the mouth of the river breaks up, that is when they start duck hunting. We, the residents of Nuiqsut go there to hunt for ducks when they arrive. I do not know how the ducks that nest along the sea coast are doing because it has been so long since we lived there before we moved back to Nuiqsut. There is a very big nesting area along the sea coast though but since we moved here some time ago, we do not know whether it is still that way. (Nuiqsut) (BLM 1998c)

Back in, when I was beginning to be a boy, my parents, they owned a canoe. So we have to go down the coast when the, when they, after all the ice caved. We had to haul some driftwood for when, winter use, along the coastline. There used to be some, these stellar eiders just bunched up in one spot, another bunch, another bunch, in the summer months, after they nesting in the, in the, up inland. They stayed along this coastline in a big bunch, you know, in bunches, bunch, bunch. But for the last years that I have *known, have seen my, personally, I haven't seen any flock along this shoreline for the last few years. I don't know what, what became of those ducks. Kenneth Toovak* (Utqiaġvik) (MMS 1982)

Birds, migratory birds nest quite a bit around the delta...Also, quite a bit of goslings and nestingers (ph) from Iysuk (ph) by Cape Halkett along the Harrison Bay to Fish Creek near the Ocean on those swampy areas. (Nuiqsut) (BLM 1998c)

I'm not sure about what kind of studies were done on the National Petroleum Reserve or how many studies or how far those studies went because it is warming up here in the Arctic and we're kind of warming up at a rapid rate up here and you know we're starting to see new species of bugs, new species of birds traveling this way. (Point Lay) (BLM 2019b)

They're all over that flat [spit]. [There are] all kinds of eggs, even seagull eggs. The birds lay right in the flat area there. Eider ducks, seagull, aaqhaaliq [long-tailed duck], Arctic tern, geese, and all them birds, they always lay eggs right there. Always in June, they lay eggs. (Point Lay) (SRB&A 2014b)

Right here [mouth of Kukpowruk River] is where they feed, I guess, or rest. Probably both resting or feeding, last year me and my uncle saw maybe 1500 take off at once. They were all bunched up all in this area. When you look up to the sky you could see nothing but ducks. (Point Lay) (SRB&A 2014b)

Phalarope. There used to be millions. You don't hardly see them any more. The whole shoreline used to be covered every time in the fall. And you don't see them inland where they nest. (Utqiaġvik) (MMS 1982)

Same way with these, these little birds, snipes. Used to be in the fall, along the beach, just hundreds of it, along the beach, you know, in the ocean. But same, same thing. They're gone. Maybe you'll see one or two there, this and there, but not hundreds anymore. (Utqiaġvik) (MMS 1982)

I think [when] the weather changes, animals come early like the geese. We were trying to go by the calendar by how we used to hunt them and by the time we get there they have already gone north. (Anaktuvuk Pass) (SRB&A Unpublished-a)

That is where they all nest, all the way over here and on the channels. They go in the wetlands. We could see all of the nests over there, just hundreds of them. That's where all of the eiders and King Eiders and the Brants nest (by Oliktok Point)… (Nuiqsut) (SRB&A Unpublished-b)

There are different waterfowl that are coming up here; they cannot be named because they are new to the region. The sand hill cranes used to be much larger and there are stories that they killed people. We have them up here I have shot them before. I didn't know what to do with them when I shot them. The one mate started circling me and it kept going up and up and it disappeared… I buried the other sandhill crane. Some of these birds must have been huge to where they could kill people. (Nuiqsut) (SRB&A Unpublished-b)

Ravens too, they were gone for a while and now they are starting to pop up again. I saw a swan in October. We saw a lone swan after freeze up. It must have been lost, it looked *weak. Someone maybe shot the mate because if that happens then they die too.* (Nuiqsut) (SRB&A Unpublished-b)

Teshekpuk Lake Special Area

In addition, this is also Carroll's testimony, in addition the entire area around Teshekpuk Lake is an extremely important habitat for waterfowl nesting, molting, and feeding should be excluded from leasing, exploration, and development there for that reason. (Utqiaġvik) (BLM 2019a)

In addition to the area north of, this is the last page of Carroll's transcript, in the area of the lake it is extremely important for habitat of molting black _____ (01:30:35.85) and then Nesting White Footed Geese and the construction of a pipeline could be very detrimental on these populations. (Utqiaġvik) (BLM 2019a)

The area to the north and east of Teshekpuk Lake is vitally important for many molting geese. Up to 20 percent of the entire Pacific flyway population of black brant can molt in the Teshekpuk area at any one time. This is a great concern that molting birds are susceptible to disturbance and any activity in these areas has a potential to greatly reduce the population of brants and other geese. Also in the area there are relatively dense populations of king eiders which are very important again for subsistence and king eider populations have declined by about 50 percent in the last 20, 25 years. There are also many other species of waterfowl that are important in this area and we need to learn a great deal about them. (Utqiaġvik) (BLM 2003a)

Effects of Development on Birds

I'll go get your oil from your part up here and then when you look at this area up here this is the nesting ground of the migratory birds of this planet. This is where they go nest. We saw what happened to the Snow Geese in Prudhoe Bay. They were chased into Canada and once they got there they overpopulated. Now their nesting ground in Canada is destroyed. Where the Snow Geese going to plan for home now? And we're going to do that to all the other animals? Let's get our Secretary to do the work right and first take care of our private property we need and then two to look at our climate, how we're living in it. It's not important to go after oil and gas when you can save all the species that migrate and when you go to the ocean it gets scarier yet. (Utqiaġvik) (BLM 2019a)

I do have a few other wildlife issues and concerns and these mostly have to do with birds. The first is oilfield activity or the development of oilfields on the North Slope has most likely increased -- well certainly has increased some predator populations and has mostly likely led to the increase of other predator populations. And the predators I'm speaking of are foxes, ravens, and gulls. Part of the issue is garbage and that garbage has allowed -- has provided additional food sources for these predators. There's another issue that's out there, though, too, and that concerns mostly ravens, but foxes as well, and that's -- there are places where ravens can now build nests or foxes can den or take their young. And so those are some of the reasons that the predator populations have increased as well. The result of those increased predator populations has been a decrease in the productivity of many birds that nest within the oilfields and many of those birds are important for subsistence. (Utqiaġvik) (BLM 2003a)

These wildlife folk that see it—they've witnessed, I guess they are wildlife folks, that walk in the country and [are] looking at birds and things in the Colville River Delta, *maybe the east side, down by Ulumniak (ph), that's next to—not far from the old Nuiqsut site, they're monitoring these birds and go to and from these places with a chopper—upsets, disrupts, displaces—perhaps some of [our] only opportunity to go get…game, especially caribou, in the area are scared and may…run off because of these impediments that arrive [and] are not natural. Naturally, [we] would walk along the coast where they're at and be able to harvest…caribou.* (Ruth Nukapigak, as cited in USDOI, BLM, 1998, NE NPR-A Scoping, Nuiqsut). (MMS 2007a)

I have gone how many times to Inigok where there was some drilling that took place, and I have seen bones from birds that have been killed from the, from after they drill a hole, the stuff they leave behind, the fluids. I don't want to see that kind of thing happening where we see our wildlife and waterfowl dying from contaminants being left after having conducted drilling activity, I don't want to see that kind of thing. And leaving an area without having done some kind of thing to put it back into the shape it was before the drilling took place. (Atqasuk) (SRB&A 2003)

Now, let's look at what's going to happen after you discover the oil: you're going to have to lay roads, you're going to have to lay gathering systems, you're going to have to lay buildings, you're going to have to lay pipelines. And when you start laying pipelines, then you start harassing animals like spectacled eiders, steller eiders, snow geese, the peregrine falcon, those kind of animals are going to be bothered. When I, as a person, shoot one of those animals I can get fined up to $10,000 and put in jail up to five years. What does the industry get when they damage those animals? What do they get? Nothing. You might give them maybe a $10,000 fine, but heck, that's the price of developing, it's very affordable. But me, that live here, I go to jail...And when you start your development and you endanger those animals that are endangered -- that are on the threatened or endangered species list, when I do it I become a criminal. What are you when you allow it to be done? What is BLM? What is the State of Alaska? When they allow these threatened animals to be endangered you are a criminal too. And it becomes premeditated because you plan it ahead of time. (Utqiaġvik) (BLM 2004c)

3.3.6 Terrestrial Mammals

See traditional knowledge provided in the ACOUSTIC ENVIRONMENT and WATER RESOURCES sections for traditional knowledge that is also applicable to this section.

Caribou

Teshekpuk Lake Habitat

With all these possibilities we are likely to have ample oil revenues in the future. This greatly reduces the motivation to restore and develop the crucial wildlife habitat areas such as Teshekpuk Lake and the Western Arctic Special Area and the Colville River Special Area. We should continue to protect these areas. They are very important to wildlife and subsistence hunting. End of Carroll's transcript. (Nuiqsut) (BLM 2019e)

You also ask our opinions for areas where there should not be pipelines. Again, the area around Teshekpuk Lakes should be avoided, one of the worst places for a pipeline would be just north of the land. A pipeline running east and west would interfere with the ability for the caribou to travel towards the coast or encourage _____+ (01:29:51.86). It would also impact caribou moving south away from the insect relief area grazing areas where weather conditions are favorable and insect harassment is *reduced. This would have a negative nutritional effect especially in the years that conditions cause the trail to the insect relief areas and that back and forth multiple times. Every age _____ (01:30:16.45) through the herd uses that area so it would affect the entire herd.* (Nuiqsut) (BLM 2019e).

Please take notice that Teshekpuk Lake is the core habitat of what we subsist on. This area supports the caribou, fish and waterfowl habitats. If this area is disturbed, you have no idea what detrimental effects it will have on our resources in the long run. (Utqiaġvik) (BLM 2004c)

And our caribou always go down to that Teshekpuk Lake or for the -- they always come through in springtime to go down north to that Teshekpuk Lake. And then after they have their calves in the fall time they -- if somebody don't scare them off on their way coming this way, they usually come back in the fall right through our village and that's how we have our food gathered up for winter. (Anaktuvuk Pass) (BLM 1998b)

We need to be very careful there because this planning area is starting to get over into the calving area of the Teshekpuk Herd. There are very -- there are narrow migration corridors over in that area that the herd needs to move through and it's an important insect relief area. Insect relief areas are very important to a herd because during the summer when the bugs are driving them crazy, they need to be able to get out and get relief from the bugs and they also need to be able to get into feeding areas. So, you know, as work progresses in that direction, we need to be extremely careful not to hinder the movement of the caribou to their calving areas and their insect relief areas. (Utqiaġvik) (BLM 2003a)

The west side [of the proposed area of development] is getting over into the Kogru River area in the area that was originally excluded from leasing because it's extremely important for waterfowl, nesting, and molting, and it's also very important as a caribou calving area. This, of course, is getting over into the Teshekpuk region and our Teshekpuk Caribou Herd, which is the most important subsistence caribou herd for most of the villages on North Slope. For the villages of Barrow, Nuiqsut, Atqasak, Wainwright, this is the herd that we hunt and this is the one that we're very much dependent upon. (Utqiaġvik) (BLM 2003a)

The caribou migration and the Teshekpuk herd is the most important component of our wildlife here on the North Slope. They don't migrate as much so -- as essential caribou herd does, or porcupine over to the east. Teshekpuk caribou herds is always on the North Slope, they don't go no further than the foothills in the Brooks Range. (Nuiqsut) (BLM 2004d)

Nearly all of the parturient cows move north through the narrow corridor between Teshekpuk Lake and the Kogru River. It would be very difficult to have any development in this corridor without the risk of seriously affecting the population. However, this corridor is part of the area that BLM has proposed to open to leasing and development. (Utqiaġvik) (BLM 2004c)

The Teshekpuk Lake herd uses the planning area for calving, like the gentleman just explained to you, feeding, insect relief, and 19 percent of the time, for over wintering. (Utqiaġvik) (BLM 2003d)

Even the caribou know that their calves have a better chance of surviving if they can just get to the narrow corridor to the east of [Teshekpuk] Lake. The Teshekpuk caribou herd somehow gets enough sustenance from this area to winter in the North Slope, unlike other Arctic caribou herds that head south. It is from this herd that the Inupiat who live here get the majority of their year's supply of tuttu meat. (Utqiaġvik) (BLM 2004c)

The area to the southeast, the east and northeast of the lake, Teshekpuk Lake, which is critical caribou calving area. There are probably ten to fifteen thousand caribou that calve in that area each year. And also to the north of the lake, that entire area from the Beaufort Sea coast to along the northern edge of the lake and on over to the Ikpikpuk River area are all fairly crucial insect relief areas. The movements of this caribou herd during much of the year are somewhat erratic and unpredictable during the fall and the winter they go to many places, but what is predictable about this herd is that most of them show up in that area east of the lake and pass through that area between the Kogru River and Teshekpuk Lake every year, that's pretty consistent in that most of the herd will be seen north of the lake in the summer, usually up to twenty-six to twenty-seven thousand caribou can be counted in that area. It's pretty hard to imagine that any development could occur in some of these critical areas without being detrimental to that caribou here and incidentally this is the herd that most of the villages on the north slope harvest. It's the primary herd for harvest in Nuiqsut, in Barrow and Atqasuk, and many years it is in Wainwright. It's kind of split in Wainwright between the Western Arctic herd and the Teshekpuk herd. The Teshekpuk herd is smaller than some of the other herds but probably more important on a subsistence basis to the people of the North Slope. (Utqiaġvik) (BLM 1997a)

There used to be thousands of caribou in that area in the 70s. [For the] first time we see a little bit of herd this summer come from the east, because the migrations of the caribou has changed a lot. The Porcupine Herd comes from the east, that's along the coast, and the Teshekpuk Herd comes from the west; that's the western herd. The migration of the western herd has diverted southward. We used to see them coming in from the coastline, but now we see them coming from the south. Mainly [because of] too much traffic. Bow hunters and head hunters. I think they don't usually wait for the first herd to come by and then the second herd gets diverted. (Nuiqsut) (SRB&A 2015)

Other Important Caribou Habitat

Another place where there should be no leasing is the Western Arctic Herd special area in the southwest part of the NPRA. The area contains the calving area. For the Western Arctic Caribou Herd there are several important migration corridors. The trauma and activity in that area would be detrimental for the herd. The Western Arctic Herd is an extremely important subsistence resource for some North Slope villages and many villages in the northwest part of the state. (Utqiaġvik) (BLM 2019a)

That [caribou calving] would be in Kukpowruk area; in October when we are fishing they are all over, that is where they are calving, that whole area. They usually are there every October. For some reason they didn't make it there this year. (Point Lay) (SRB&A 2014b)

We get [one] herd coming from the south and [another] herd coming in from the north. We get the best of both of them. They're calving, giving birth. This whole area right here [south of Wainwright] because of all the vegetation. (Point Lay) (SRB&A 2014b)

They seem to be coming down behind Wainwright, and back behind us toward the mountains. When you see them along the coast, it's smaller groups of them. October, mainly. Sometimes they're right in our yard. They winter here. (Point Lay) (SRB&A 2014b)

We don't go south in July because all the caribous are out here [indicating an area from Anajuk Point northeastward to Qulvi], all the way, all the coast. … It's cool over here. We start feeling the ocean breeze around [Anajuk Point]. When we turn, right when we turn, you know, there's the breeze, … and that's where the caribous are, from right here [at Anajuk Point], you know, all along—where they should be. (Nuiqsut) (HDR Alaska 2015)

Other Caribou Observations

It's unusual to see our caribou in the dead of winter; they're mostly south at this time of year. The weather trends [are affecting the caribou]. (Nuiqsut) (SRB&A 2015)

Looking at your Alternatives A, B, C, and D, it's a --it's a real coin and the toss issue for me with our caribous being in that location right in October. Maybe there's global warming taking effect from past ten years up here. We used to get caribou migration during September. Last year I think they came in December. And we're in October, and there is no caribou migration. I -- I like Alternative A and also D, but I would also benefit from C -- B and C. With exploration being up there, it would be able to misplace the caribou herd, possibly changing those herd, sending them south -- southward bound toward Anaktuvuk. That's where we would also benefit. It -- it's exploration versus subsistence. That's the type of my -- my thinking that I've been thinking. All these alternatives are good. I've -- I really want to benefit. Maybe I'll -- I'll leave it up to the caribou herds. If there was full-scale exploration to move those herds southward, that's where we would benefit. If there is a lot of structures in that area, maybe we'll benefit year round up here. (Anaktuvuk Pass) (BLM 2007)

We're seeing the changes. The caribou have problems. Lesions on the liver with a bad cover. They have lesions on the joints and internal organs. We asked the North Slope Borough about testing, but they said they have no budget for that. Where do we turn to identify the problems? (Nuiqsut) (BLM 2003b)

When the caribou was in short supply we would travel to Tasiqpak knowing that we would find caribou and to the area close to Kuuguluk. Before we moved back to Nuiqsut I used to also do my hunting at Umiat. That area is a prime hunting ground… (Nuiqsut) (BLM 1998c)

Back in 80s and 90s... [caribou] used to go right up to village and turn that way and some of them would pass that creek we always go through, and some would pass that and go to Itkillik River and go back out, and not anymore. The closest caribou I ever caught was two and half miles [from the village]. (Nuiqsut) (SRB&A 2014a)

Normally they come through this oil field right around here and I have been doing a lot of hunting on this side and we haven't seen much caribou over here. Half of the caribou we catch are sick. Green, yellow. They have big pus bubbles the size of my fist. (Nuiqsut) (SRB&A Unpublished-b)

Yeah, it's different now, the migration. I know that years back it used to be end of June, July. Now I think it's later than July and the herds are smaller. There's smaller herds *down there. I think because of the pipeline over here. They say it's not affecting [the caribou], but it is. They're coming later and later. If you get an aerial thing [picture], you can pretty much see the footprints of the caribou, coming east-west like [local elder] was saying. Since they made the other pipeline going from the river crossing, it has changed, too.* (Nuiqsut) (SRB&A 2010a)

Porcupine Herd that comes to Kuparuk, they changed from there and some of these in Central and Teshekpuk are slightly changed in timing, July most of them are on the coastline. There were times in July that all the caribou were on the coastline until August-September. (Nuiqsut) (SRB&A 2010b)

I guess the caribou are more skittish nowadays. People are approaching them and they are gone. Before they used to just hang out and you could drive by them with the boat and they would just look at you. Now when they hear that outboard motor they are gone. They are more skittish nowadays. Maybe it is that aircraft activity. There is a lot of traffic out in that area. (Nuiqsut) (SRB&A 2014a)

This year we didn't get no caribou. What would BLM do that would help our community that was impacted by no caribou at all? No migration because of that infrastructure that are being built north of our community, and the activities that are going on no north of our community. And for 50 years we had— or more than 50 years we had depend on caribou. And every time we get no caribou, we don't get no disaster funding. We get help from Wainwright people. We get help from Barrow people, from Nuiqsut people. [unclear] 13-15 caribous at a time. But that's not BLM helping us. It's our own entity that's helping us. We're being impacted, but like the community that we are depending on caribou all our lives. What kind of impact funds that we have BLM would do for our community when this happens to our community in every year. To those sport hunters, activities going on up North and all that infrastructures that are being built. What kind of impact funds that would —anybody that would help our community. We tell you guys over and over we've been impacted for years. We never get any disaster funding. We get help from the other villages. Last year we got to help from Kenai. They sent us some fish. I really appreciate Kenai for helping us. They understood us. But for years, we told you guys over and over who are these people that are affecting us? We don't get any disaster funds. We don't get any help from BLM. Nobody except from North Slope Borough or the communities of Wainwright, the community of Nuiqsut, or the community of Barrow. If there was some kind impact fund, what would this kind of situation be reported? Because we're telling you, over and over, about our situation about the caribou. (Anaktuvuk Pass) (BLM 2018a)

Caribou is still important right now. From years and years from when I was a little boy [caribou has been important]. Guide hunters, well, they push the first caribou and [the caribou] turn around and go someplace else. And we wait and wait and wait [for the caribou]. [Traditionally] we wait until they pass the village, three miles down and then we start shooting them. They [the ones that pass] don't care, they [other caribou] just come by. (Anaktuvuk Pass) (SRB&A Unpublished-a)

In springtime we hunt the caribou in April, May. [They come] from the south. Sometimes [in] October [the caribou come] from the north. (Anaktuvuk Pass) (SRB&A Unpublished-a)

TAPs has a lot of negative impacts because the Dalton Highway is open to the public. Our caribou, the Central and Porcupine herds, go through the Sag. River and they are *diverted by bow hunters. These folks have access to it, they can come across the right-of-way but they are not allowed to walk along the road because that is private property. I have run into so many people looking for wounded caribou which they have shot and are looking for caribou. A lot of impacts from TAPs are happening today. Any of these still, if only ADF&G could put seasonal [restrictions] on these bow hunters then our caribou would be able to come across the Sag River and move westward. We do not see 1000s of caribous coming this way anymore. There have been a lot of impacts and what kind of programs have they done to us? Nothing, none. Even though we are impacted these programs were not given to the community. That is what I have seen and experienced.* (Nuiqsut) (SRB&A Unpublished-b)

Caribou Calving Sensitivity to Disturbances

The challenge is to decide where to draw the lines between where petroleum exploration and development occur and where wildlife and subsistence values are protected. In the past planning processes, we have come up with compromises where leases were available for much of the NPRA but the critical wildlife habitat areas were protected. You asked us to outline areas that should not be opened to leasing, exploration, and development. Teshekpuk Lake continues to be one of the most biological productive areas in the circle polar arctic that should be protected. The area just south of the lake is extremely important for caribou calving of the Teshekpuk Lake Herd. The area north of the lake is critical for insect relief. The areas east and west of the lake have narrow gaps of land that are important migration corridors. Most of the cows and calves migrate through this narrow gap between the lakes and ____ (Cogro? 01:27:10:42) Inlet to the east and cows and calves are particularly sensitive to roads and cows and calves are particularly sensitive to roads and industrial activity at the time of calving. (Utqiaġvik) (BLM 2019a)

The pipeline should not run within forty miles of the south side of the lake because of the caribou calving area. They should not be run through the narrow gap of land between the east side of the lake _____ (Cogro? 01:31:03.11) Inlet because it's a very restrictive and important caribou migration area for cows and youth calves to travel to get insect relief. Cows with calves are very sensitive to structures and activity and would be detrimentally affected by construction of the existence of the pipeline to that area. There should also be no pipelines running through the calving and insect relief areas of the Western Arctic Herd. There should no pipelines running along any of the major rivers because of the danger of a spill destroying a major subsistence fishery. Even pipes running across the main _____ (01:31:42.07) could result in major damage to a fishery. Pipes should not be run in areas where there are a lot of subsistence camps where people commonly come because it would lower the volume of those people's lives. (Utqiaġvik) (BLM 2019a)

The females have effects during calving. They're under a lot of stress. They lose a lot of little ones. (Wainwright) (SRB&A 2009)

...there is a narrow corridor of land between the east side of Teshekpuk Lake and the Kogru River, which nearly all of the parturient cows must travel through shortly before or after calving to get to insect relief areas. Cows with calves are very sensitive to disturbance, so we have the most important segment of the population passing through this corridor during the time of year when they are having calves and are most sensitive to disturbance. Development in this corridor and the calving area south of there could have a detrimental effect on the herd. (Utqiaġvik) (BLM 2004c)

Very important that the calving area right by Teshekpuk Lake there should be no allowed for oil drilling and disturbing the caribou herd there. Also caribou migrate route from that area through Anaktuvuk roads, Chandalar Lake area. During the fall migration, there shouldn't be no activities. Also spring migration from south, if they start going down to the -- towards north, there should be no activities in the way of travel north and south. (Anaktuvuk Pass) (BLM 2007)

It is very important for pregnant cows to get to and use the calving area, which is south, east, and north of Teshekpuk Lake. Over ninety percent of pregnant cows calve in this traditional calving area. During years when cows can't get back to the calving area, calving success has been much lower than years when most of the cows did get back. (Utqiaġvik) (BLM 2004c)

Effects of Development on Caribou

And I notice that game appears thicker along the pipeline corridor than it does in other areas and I believe that the phenomenon that the Mayor spoke to earlier about the pipeline deflecting the game is, in fact, a converse. I believe it is an attractant, it's luring, if you will, game away from areas which may have traditionally been used by subsistence hunters. So I think the effect that people are experiencing, a decrease, perhaps in game density is real but the effect that they are scribing to it is as a deflection is, in fact, incorrect, it's actually an attractant. And I attribute this to two phenomenon. I'm not a scientist, I'm an economist by training but I do observe these game patterns on an annual basis. First of all, the dust from the Dalton Highway spreads out and settles on the snow and then when the sun returns, that's the first areas that become snow free so the game then, rather than having to paw through the snow, the caribou especially and the ptarmigan, are attracted to this corridor and then the predators follow suit. So the best place, if you want to observe game is actually up and down the Dalton Corridor, especially in the spring. The second phenomena that I attribute this attractant phenomena to is the fact that it's something of a hunting sanctuary, you know, there's the 10 mile Dalton Highway Corridor which is limited to bow hunting only and the entire area around Prudhoe Bay is closed. And it doesn't take game long to figure where they're not persecuted. And as I think as you experience in other areas where there's a game refuge, that's where all the game is especially on opening day of hunting season. I think the caribou have figured out rather quickly that they're safer from hunting along the corridor and then the Prudhoe area and so tend to collect there. Mark Helmericks. (Utqiaġvik) (BLM 2002)

It will be about 12 to 15 that we average in that area. It was less than that. Too much air traffic. That is the main problem, is that during summer there is too much air traffic. The caribou is unable to come near this area. Conoco has an interest in this area too [Fish Creek.]. (Nuiqsut) (SRB&A 2010b)

Fish Creek towards Tingmeachsiovik [River], before they put the bridge on, [there] used to be caribous around there. They used to hang around there, but I don't know. Now [because of] that bridge they don't go over there. Used to be some, lots of caribou out that way [by]Atigaru [Point]. And [now] hardly any caribous. They used to go look for caribous around there. (Nuiqsut) (SRB&A 2015)

Only thing I could say is they're confused, because they get to this area where they usually go and they can't go there. They're trying to find any way to get to the west side. This one was about, I'd say more than a thousand, but one went a few miles and *crossed. [They're] lost. Migration where they've been going has changed. Where they're used to going they can't go anymore. They have the pipeline by CD3 they have to go farther. Same way with the pipeline that goes the other way. I'm surprised that they even go past that. Some will go. Ever since they put that up they only go through there the west side.* (Nuiqsut) (SRB&A 2015)

Ever since the pipeline came in from Alpine to 2L, the caribou migration's been different. When I came in in '93, we caught 12 caribou in by Nanuq, and since then I've never seen them come through that area. Since the pipeline came in, they don't go through the village any more. We caught like 12 bulls, and we never seen caribou in there again. And that's definitely an impact. (Nuiqsut) (SRB&A 2014a)

The pipeline, wish they could change it to make it more dull. They [the caribou] think it's ice, so they think they need to stop and go back from where they come from. Summer time I can see it from my house. Pipeline and helicopters [are] probably the two main distractions for caribou in this area. That pipeline needs to go. (Nuiqsut) (SRB&A 2014a)

The pipeline keeps them from crossing. Not like they were crossing [before], because the Western [Herd] and Porcupine [Herd], they normally come this way, but last two years they've been on Point Thomson side, Prudhoe side. I haven't seen a Porcupine herd in how many years? (Nuiqsut) (SRB&A 2014a)

[For the] first time we see a little bit of herd this summer come from the east, because the migrations of the caribou has changed a lot. The Porcupine Herd comes from the east, that's along the coast, and the Teshekpuk Herd comes from the west; that's the western herd. The migration of the western herd has diverted southward. We used to see them coming in from the coastline, but now we see them coming from the south. Mainly [because of] too much traffic. (Nuiqsut) (SRB&A 2015)

Fumes: When the caribou smell exhaust fumes, without even looking they will go. When they smell man or combustion, the noise, they go up straight inland. That's why you don't let them smell you when you're hunting. You have to get upwind. I think there are a lot of caribou around Prudhoe. When I worked there I noticed that somehow the smell doesn't bother them. But around here they're bothered. (Barrow active harvester; Experience timeline: since 1950 and ongoing; Experience location: Barrow area. SRB&A Interview 2007) (SRB&A 2009)

I've heard from other hunters complaining about caribou looking sick. I caught a couple maybe two or three years ago. It's possible. I think the caribou are getting sick because of the flares they are burning over at Alpine. You see this dirty air. And we have north winds a lot of the time when they burn that yellow smoke and it gets deposited on the tundra. That's why I think the caribou are getting sick. (Nuiqsut active harvester; Experience timeline: 2004; Experience location: Just up the river. SRB&A Interview 2007) (SRB&A 2009)

The caribou on the west side of the village, some are okay on the ocean side but the ones closer, the one I got was a sick [one.] I decided to not even bother to hunt [that type of] caribou because they're loners, and the loners are the ones who hang around [the developed areas]…they're protecting themselves from the bears and wolves and they're using the pipeline as coverage. They can get close to the Alpine or the village, and the wolves won't. They have peace away from the other carnivores. They're picking *up air quality damages or something. For us, when we ingest something wrong, we get heartburn or hiccups. I think they do that to, they get the same thing but it stays in them like cigarettes.* (Nuiqsut) (SRB&A 2011b)

Just the flares that are always going. I kind of think that's why they are getting sick. Flares are on 24/7, and I think that mercury is making them sick. The [pollutants are in the] air and drops down to the ground, and [gets on] the food that the caribou eat. (Nuiqsut) (SRB&A 2014a)

There's always caribous on this side of Itkillik and not too far from Itkillik-Pa…. I go up inland. There's always caribou there in August. Plus, there's always helicopter flying, doing their survey, and I don't get caribou just for, you know, the helicopter [to come] bother me. There was [a] helicopter doing their survey [over] Itkillik-Pa and on this side of Ocean Point. There's always caribous [there], but there's always helicopters disturbing [them]. That was in August. (Nuiqsut) (SRB&A 2014a)

In the beginning you were mentioning that the Secretary of the Interior had the authority over this NPRA, how it works. What's so hard about the Secretary of the Interior settling the ownership of the land inside the NRPA? What is holding him from doing that? And when you're looking at making roads and pipelines and wealth like that you know the structure of the North Slope. You have a calving area at Teshekpuk Lake. The caribou after they are born _____ (01:08:07.41), swing by Nuiqsut and head up toward Anaktuvik. Then after Anaktuvik they all head out west. This is their natural migratory path and we also know that when you lay a pipe in front of their path the caribou no longer uses that path. Knowing this you would endanger the ability of _____ (01:08:33.81), Nuiqsut, and Anaktuvik and probably up into Wainwright of the migration of one herd. We watched what the other herds have done over further east, east of Prudhoe Bay and in Prudhoe Bay. They don't follow their migratory paths anymore. We should have learned something from this but I don't know what's going on there when it comes to the learning part. The caribou will not cross a pipe, with have a pipeline right there or a gas line going to the east field over fifty, sixty years. The caribou still don't like to cross that piece of pipe right there. It's alive to them and it scares them and then we start laying pipelines all over the North Slope. The caribou is going to be the first animal to go. (Utqiaġvik) (BLM 2019a)

In those things we recognize some of the hurtles and we also recognize the current state of infrastructure on the Slope from North Star, from ENI _____ (01:33:57.79) Development to the Hooper Development using unstable areas on the North Slope that are um free from permafrost issues that's why they call it thaw stable areas and the pipelines that are buried in these areas are um part of the future dialog in the technical report of how change in dynamics of local climate change issues and, and other areas that BLM needs to consider about thaw stable areas along rivers being the Trans Alaska Pipeline, if you go down the highway there's about a forty mile section of that pipeline that's buried in the thaw stable section of the _____ (Sauanatuk? 01:34:58.76) River on the Snake River in that, in that river corridor where it's thaw stable. Those are some of the things that have not been highlighted and they are important features of development not just because they are out of sight and out of mind, because of the more important needs of the free movement of terrestrial animals. (Utqiaġvik) (BLM 2019a)

[My] biggest concern is the caribou migration, if the oil exploration would bring a pipeline. The migration passes through Wainwright almost every year. I've lived here since 1991. I get my yearly supply of caribou in September and October. I've heard

from people in Nuiqsut: once Alpine came in the caribou migration was affected. (Wainwright) (SRB&A 2009)

There used to be a lot more caribou, but it's getting to be a lot less going to that area. Because they're getting diverted in Meltwater. The pipelines from Meltwater to Kuparuk are so low and they can't cross the pipeline. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

Well, the pipeline is a problem. When you look at it, it is reflective. All that pipeline that comes to Alpine and goes to Kuparuk, it shines and it looks like ice out there. The caribou look at that and they are re-routed. If you come here in the summer time, and look, it looks like a glaring ice pack out there. And we told Conoco Phillips that the caribous that are coming from the east side and the west side, they need to do something about the pipeline. It goes all the way from Colville all the way to Kuparuk and where are the caribous? Some of them do migrate all the way through there. And once they see that pipeline, the caribous think that they are close to the ocean [that's why they reroute]. But on this side [west side] you don't have that yet. (Nuiqsut) (SRB&A 2010b)

He knows that Teshekpuk has never changed much, they still go on the migration of their past. Central Herd is same general area, but changed slightly, because low water happened and some pipeline in Meltwater. Can't come across it, and that's why it's up, caribou can't cross to the other side. They go around the pipeline. Some of them [pipelines] are real low. Make sure they are seven feet [tall]. The older ones are those ones deflecting the caribou [new pipes are better, taller]. (Nuiqsut) (SRB&A 2010b)

I never seen a real lot of caribou. Back then we used to have a lot. There'd be a lot more caribou in this area than compared to the west, Teshekpuk Herd. When they'd migrate there'd be more. In the 50s there's lots of caribou used to cross right down there, in the summer time. Never do that anymore, hardly. They start CD3 and Alpine, but that Tamayayak River used to have lots and lots of caribou but hardly any more. CD3, the people told Alpine, there's hardly any here. There used to be a lot of caribou that migrate right here, they don't do that anymore [by the coast]. (Nuiqsut) (SRB&A 2010b)

The Porcupine Herd that comes from Canada through here, when the pipeline, when it went all the way to the Meltwater, when they build that pipeline to Alpine, they stopped seeing them. Oliktok, to Meltwater. (Nuiqsut) (SRB&A 2010b)

They start to come in late, they used to come in early, now they start to come in late. Right now, there's nothing there and Teshekpuk stay around there most of the time. We can't get any caribou around here, there's the pipeline and Kuparuk [even if the caribou were there]. This is the caribou area. Nowadays they gonna get the caribou [south]. (Nuiqsut) (SRB&A 2010b)

One of the main caribou crossings on the Colville River delta. And then what I had never realized what Sara Koonalin (ph) had said was that during the migrations and when it's very hot in the summertime, the caribous like to go along the high banks of the rivers to stay cool when they're in mass amounts. And then I just wanted to point out, and then keep in mind that, you know, that we have to take care of our caribou and stuff like that, and then just wanted to point out that it hasn't been pointed out in a long time, when the caribou start migrating in low areas where there's swamp and stuff and they like to get on high banks when it's really hot and then that they like to travel through *there to try to cool off from the Arctic breeze and stuff. And that's the only thing that I was against, is that pipeline structure is a little too low and I'd like to see it like 10 or 12 feet high because most of our winds are from the east to the west and then, you know, they make -- with that pipeline there, they make an unnatural barrier for the caribous to cross.* (Nuiqsut) (BLM 2003b)

In the NPR-A Northwest draft, it says that there will be 150 flights a year. Well, Alpine, the model of a smaller footprint, had 1900 flights from Alpine in the summer of 2001. How was it expected we would not be impacted in a significant way with the subsistence harvest study that showed our village harvested there? They claim that the caribou herd is healthy with numbers, but the only caribou I got last year was bad. Twenty caribou were harvested in October when we could access areas not accessible by boat. Seventeen were sick. When I went camping last year, I waited three days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had overflights three times while trying to cut the harvest. It is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oilfield. It went right over us three times. The herd was right there and it put us at risk. I had my two young sons with me and it made me very angry. What am I to do when the activities that have been handed down for thousands of years to our people are being changed by the global need for energy? (Nuiqsut) (BLM 2003b)

The caribou haven't been coming about the last few years. There seems to be a border of where the caribou want to go. I don't know if they have realized that [they don't want to go to those areas] due to past activity. It has become like that ever since they started seismic explorations, probably five to 10 years. The seismic activity has been moving further west, all over. Every time we go to Umiat we experience exploration. They [oil industry] have been moving further and further west, and the caribou have been moving further and further west. Looks like a mini-town when you see it from a distance. You would find exploration activities but it would be further east, closer to Colville. The next year, it is further west, and that's where you find the end of the caribou. This year, where they last did seismic exploration, that's where you find the caribou. It seems like they've learned the exploration boundary, it seems like they're not crossing them [the boundaries] anymore. (Utqiaġvik) (SRB&A 2013c)

It varies whether we have a lot of activities going on. When there are a lot of activities going on, we hardly see any or they [caribou] change their migration route. Oil and gas, airplanes, helicopters, bird survey people—airplane, floatplanes. Either there are less caribou or they are changing migration with activities. I don't know which. (S.R. Braund and Assocs., 2003, Field Interviews, USDOI, BLM, 2004) (Nuiqsut) (MMS 2007a)

…I feel because of all the traffic between Fairbanks and Endicott, much more increased traffic, that caribou are hesitant to cross the main roads because of all the traffic. I feel that has something to do with the caribou migration as well, because of increased [air] traffic…not just ground, as well as…seismic operations happening all over. (Lampe, 1997, NE NPR-A Scoping, Nuiqsut, USDOI, BLM, 1998) (MMS 2007a)

We will have the same problem we did in the Prudhoe Bay and the Kuparuk area with our caribou. Right now I call our caribou that are existing around here that don't go nowhere our 'industrial dope addict caribou.' They already sick and nobody's doing anything about them. (USDOI, BLM, 2004) (Nuiqsut) (MMS 2007a)

Caribou displacement. You've heard of the Meltwater and Alpine. The caribou are displaced where they used to go to eat. Instead of caribou, we have vertical supports. If you put up a pipeline, you displace the wildlife. Before Alpine we'd see caribou every summer, every year. They came in the thousands every year. After the pipeline, we don't see them like we used to. We used to catch a lot of caribou from the Porcupine Herd. Not any more. (Nuiqsut active harvester; Experience timeline: 2002 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

The migration of the Eastern Herd that comes through the Colville River has really changed since Alpine with all the pipelines. It's deflected the Teshekpuk Herd from the east and south; because of the pipeline changing their migration route. (Nuiqsut active harvester; Experience timeline: Since 1977 and ongoing; Experience location: Colville River. SRB&A Interview 2007) (SRB&A 2009)

Before they started the [helicopter] activity, the caribou were in the area by the thousands. Now they migrate out and none come in. It is harder to find caribou every year. I grew up hunting caribou from Wainwright. Barrow used to be like Wainwright. The caribou are starting to winter further south. When you reach Wainwright they are everywhere. They are all around Pt Lay. You would always meet the caribou just before October, they were always here. They don't come up from the south anymore. They changed their migration route. From Wainwright they start heading to Barrow but at Peard Bay they turn around and head south. (Barrow active harvester; Experience timeline: since 1996 and ongoing; Experience Location: Alaktak. SRB&A Interview 2007) (SRB&A 2009)

Maybe it's over the last five to six years the caribou routes have dramatically changed since the oil and seismic going on. Like this summer, there were hardly any big herds coming through. You have to go way up for subsistence hunting. You have to go further and further. There were a lot of complaints this summer. All the helicopters flying around. Maybe they're chasing them away. (Atqasuk active harvester; Experience timeline: 2001 and ongoing; Experience location: We go way up. Sometimes 7-12 miles from our cabin. Sometimes we go out by Skull Cliffs. SRB&A Interview 2007) (SRB&A 2009)

Nothing has been done. They say caribou can go under [pipelines], but sometimes they turn back. We mention that to oil companies, to bury the pipeline half a mile away from the coast so caribou can get away from mosquitoes. They say they can go under, but I don't see them go under. Especially along the coast, crossing Sagavanirktok River, then they could go along the coast. (Nuiqsut active harvester. SRB&A Interview 2007) (SRB&A 2009)

Here in Nuiqsut I hardly get any caribou due to the pipeline diverting the caribou. I used to see five to six thousand caribou. I haven't seen a herd like that in years. It's like a rolling thunder when you see that many of them. But they're real sensitive. I don't see that here any more because of the pipeline. (Nuiqsut active harvester; Experience timeline: since 2000 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

Because of the pipeline and the choppers and aircrafts that were flying around. When we were way down by the Chandler area and there was air traffic going on over here at Umiat and that red and white plane of Alpine kept following the river and scaring the caribou like he is doing it on purpose. We have bright clothes on and he knew we *were there and he made a couple passes and made the caribou run further inland. That was wrong. Red and white plane. We had the caribou in our sight and plane comes and it took off and turned back around and did the same thing and same path and that [made us angry]*. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

You know, what I think about it, since they built that pipeline up, the Porcupine Herd doesn't want to come this way. I think that pipeline is diverting them. Because the Porcupine Herd that's coming in from the east usually travels along the shores. I think they come in from the shore and stay in this area around Beechey Point, because there's no way to go further westward. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

Mostly the caribou used to come from the west, back in the old days before that Alpine there was nothing around, we had caribou coming this way and that way. They mostly came right [through], the whole section of this from the eastern [direction]. Back in the old days, before that activity. Alpine, it started happening since they build that pipeline. Some [caribou] go further north coming in. Especially when they build that pipeline, they really divert that caribou that used to come straight across before Alpine was here. The pipeline's just right over here. All that pipeline goes there and the Western Herd, before the pipeline, they used to go straight there. They really divert that caribou. All those caribou used to come from the eastern herd and go right through. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

There used to be a lot more caribou, but it's getting to be a lot less going to that area. Because they're getting diverted in Meltwater. The pipelines from Meltwater to Kuparuk are so low and they can't cross the pipeline. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

That's where most of the Porcupine Herd usually comes, around here, due to that pad; that pipeline that goes from Alpine to Prudhoe has pretty much changed the route of the caribou migration. The only big herd that usually came around is the Teshekpuk Herd; they came around. None of the Porcupine Herd that usually comes around, they never really came around, [because of] that big pipeline and the pads that connect to Alpine. And that other pipeline that goes all the way to Kuparuk. And from the north pad, CD3, down to Alpine. And then it goes to Kuparuk. It's shiny and makes the caribou not want to go through. Those caribou are scared of the pipeline. Some stick around. Some go towards it and go back. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

It's mostly the pipeline that is affecting the caribou pattern. In the 70s when we first came, there would be 10,000 in a herd but now, due to the pipeline, it affects the people here and they have to go 30 miles out in all directions to hunt for caribou. It's too shiny. The coating is too shiny. More likely…when we were riding on the ice roads one time, we could see quite a few caribou crossing but maybe in the summertime, due to the reflection of the sun, they don't want to cross. They'll pass right under the pipeline [in the winter]. (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)

Also the pipeline is so reflective that sometimes the caribou thinks that is the edge of the ocean, the ice pack, so that is why they go and travel further south of us. Those pipelines are still shiny, it's not coated. All the way from Alpine, pretty much from CD north, all the way to Alpine, it's so shiny; all the way it looks white. And it's reflecting. We always address that with them, and they say they might change that but they didn't.

That always [is] a problem with their representative that comes to our meetings. (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)

When a caribou is going to run for safety, they jump six to seven feet and they have their racks on so they have to be able to get underneath the pipeline if they're going to cross freely…when it's running away if the pipeline's too low with its racks it could be running and hit the pipeline and then sheer off its horns and it could cause it permanent or lethal damage to itself. (Anaktuvuk Pass) (BLM 2003c)

And just last week when I was cruising through Prudhoe Bay area like from where the bridge crosses Miluveach and where you start hitting these orange drill sites, pads, and stuff and it just hit my mind that your infrastructure of your pipeline is so low that at times that while you're cruising from that area past that bridge all the way past KOC of Kuparuk that your pipeline is so low that even a caribou wouldn't even attempt to try go over or under, neither. And then your caribou crossing things are so far distance when you look at it, I think I only see three of them. And then on top of that, I just want to point out that the infrastructure like that are for where the pipeline is also they're like permanent unnatural snow fences where the caribou crossings and stuff are, and then that's one of the things that on the environmental side that you all have to be looking out and be aware. And then I really disagree of this five feet pipeline -- five feet high of the structure that you guys are proposing around our land and our area where the caribou migrations and stuff are. (Nuiqsut) (BLM 2003b)

Infrastructure: Atqasuk. When we travel we see roads and I'm pretty sure it makes the caribou go away from our village and closer to Atqasuk. We noticed when we went to get our new snow machine from Barrow. (Wainwright active harvester; Experience timeline: ongoing; Experience location: Barrow to Atqasuk to Wainwright. SRB&A Interview 2007) (SRB&A 2009)

Seems like they're sticking over by the pad, that one. They mainly stay around this area, don't move nowadays. I know that they spend a lot of time over by Alpine. They don't move once they get by over there. I guess just like at Prudhoe Bay. You even see herds go under the building, to cool off.. Because it's cool, there's a draft going under that building. I used to work in Prudhoe Bay for how many years, a technician, for their annual tests to see if there's anything leaching from their pads. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

That CD 5 and 6, that's going to divert my caribou farther south. [During] some winters there's too much air traffic and hardly any caribous come from the west. It's not like back in the old days before the Alpine was there, before the air traffic was there. Yeah, we were camping out and the activities, the caribous used to come over here [from Teshukpuk towards Nuiqsut] They never could come over this year. Mostly with choppers, and airplanes, and the flights to Alpine, that really affects the noise problem. [It affects me] when I'm up there in the summer. [And the] regular plane to Alpine. (SRB&A Nuiqsut Interview April 2010) (SRB&A 2010b)

The caribou migration has been changed rapidly because of the road or too many traffic (sic). Mostly the caribou with the collar don't have enough fat and the meat always taste different. I think if they took the collar off from the caribou I would be satisfied or if I see one I'll kill and leave the collar right there because I won't eat it, too skinny. The problem we got, they put too many collars. And some cows that come through here this fall, I saw two cows with a collar, I think they don't have fat. They were -- probably had *more worms than my dog had worms because of the collar. And besides it hurt the skin. You can see when it moves around right here, it rubs the fur. Gilbert Lincoln.* (Utqiaġvik) (BLM 1998a)

And another thing is, the pipelines, they need to be-- they need to have crossways for the caribou because the caribou I think will just follow the pipeline if they don't want to go under. I think that would be very important if they start development around that area. The caribou have to have a place to get down to the ocean in the summertime for --from the -- get away from the mosquitos. I've watched -- as a hunter, I've watched caribou when they're migrating. I've watched them cross my snowmachine trail, they don't have any problem with that. But if I walk across their trail, the caribou will immediately turn back, just from the scent of my feet. I've noticed that, I've watched that as -- just from being a hunter. I think the -- it will really impact my hunting; if the caribou move away from that area, I have to go somewhere else. So I would think that the caribou have to be taken care of, that's my main concern. (Utqiaġvik) (BLM 2004f)

Pipelines; we have seen caribou turn back from pipelines because they [caribou] see a flash from the pipeline. They used to go to Helmericks' in the thousands, not any more. Maybe two or three or less. Especially females with young used to go down there. Westside at Kugaruk, Harrison Bay, there are caribou there. You always see them. We had to go out to the ocean and to Kugaruk to catch them. (Wainwright active harvester; Experience timeline:1999 and is ongoing; Experience location: around Alpine, Meltwater and Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

There is so much activity going on it drives the caribou away from the insect relief areas. This makes them keep running, wearing off fat, not lying down. They want to do seismic testing there in the insect relief areas. This is one of my biggest concerns. (Barrow active harvester; Experience timeline: 2006 and ongoing; Experience location: The southern boundary of the North Slope; the mountain side, central and western parts. SRB&A Interview 2007). (SRB&A 2009)

We're getting to go further and further to catch caribou. Because their route has changed. They're not in our backyard. Now I have to go to other communities' backyards, like Anaktuvuk, Atqasuk and Barrow. Caribou you have to go out further because of seismic testing, helicopters, small aircraft. They'll be flying those choppers again. They'll be doing it soon when they gather information like when the ice goes out or when they haul their contractors out. This scares the caribou. What happens when the belt breaks on your snow machine? I walked 10 hours home once. (Nuiqsut active harvester; Experience timeline: since 2001 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

I've noticed that since they started making ice roads, the caribou are hardly out there anymore. The caribou are 30 to 40 miles out. Some people told me they go 60 miles out. That's the Village of Atqasuk. I called them once to see when there were caribou. (Barrow active harvester. SRB&A Interview 2007) (SRB&A 2009)

It's longer [until the caribou arrive], we have to wait for the caribou to cross the river. Sometimes they don't even cross the river. Yeah, ever since Alpine started, we are having to wait for caribou to cross the river. It seems like they're sticking over by the pad, that one. They mainly stay around this area, don't move nowadays. (SRB&A Nuiqsut Interview March 2009). (SRB&A 2010b)

If I'm able to hunt within 1,000 feet of the pipeline, then it isn't an issue. But a lot of areas between here and Deadhorse, the pipeline is just too low. The snow builds up and they aren't going to put their head down to go under. I saw a caribou blocked just the other day, by Deadhorse. One side of the pipeline is all bare, and the other side is all open land. (SRB&A Nuiqsut Interview March 2009). (SRB&A 2010b)

The caribou that we see at Fish Creek are so far away from the channels, and it's not that easy to harvest caribou and wait for the caribou. And sometimes we have to travel farther west. But a lot of us who go there, we have to wait and a lot of the caribou are diverted by the aircraft. They [aircraft] are counting fish and some caribous that have collars on them. (SRB&A Nuiqsut Interview March 2009). (SRB&A 2010b)

It is hard to say, you see helicopters flying around, you have things going out there that are not usually there, human activity. It is hard to say, with the Meltwater road. With the last couple years the caribou haven't been coming like they used to. I usually catch 20, 30 caribou for my mom and other people. [I have been harvesting] way less than usual. (SRB&A Nuiqsut Interview April 2009). (SRB&A 2010b)

The Prudhoe Bay spine road is like a gate: the caribou get corralled in the area by roads, traffic, pipeline reflections, and staging. They get confused. They are scared to cross the pipelines, they are as scary as a grizzly bear would be to the animals. Some caribou are driven south, others are driven to the coast. If more roads are built, then there will be more blockage of the caribou. They will get stuck in the oil fields like a corral. The ones stuck south stay south and get little insect relief, while those going north get to the beach and the coast and get relief (S.R. Braund and Assocs., 2003, Field Interviews, USDOI, BLM, 2004). (Nuiqsut) (MMS 2007a)

I think the pipeline in a big factor in the caribou migration being disturbed. Because when I first came to Nuiqsut in 1993, we would be at Nanuq downriver and the caribou would come straight across – Fish Creek, hundreds of caribou – and then the pipeline came and…. And that year – 1993 – I got 10 fat bulls in July. We got a whole bunch of caribou right about where they put that pipeline. After the pipeline the caribou don't go through there anymore. They either go, their route changed, go through Fish Creek and come this way. The pipeline definitely changed their route. (Nuiqsut) (SRB&A 2015)

Pipeline height is always an issue. Five feet minimum is inadequate. I mean you hear so much. You hear that it's a concern to the community. And the coating of the pipe, the outside layer, you know, it's just like a reflection especially during the summer hot months. I mean you could see that, you know, the pipe having reflection. I think they should put better, you know, coating or something that wouldn't reflect. I think that's where the problem -- maybe -- I don't know. Maybe that's one of the issues that needs to be addressed, that it's deferring the caribou. I mean there's some studies, I think, that needs to be done. (Nuiqsut) (BLM 2003b)

The pipelines, you know, maybe the caribous don't like to go through the pipeline even if they can go through, they hardly don't' do that anymore; they always have to go around somewhere. They always start to go up river and then up around Fish Creek. We can see tracks down by Ocean Point and then going up towards Fish Creek [circle around south and then back north toward Fish Creek]. There used to be big herds going through there almost every year. We would have lots of caribou in my area [before], they go by my house; bunch of caribou would be hanging around in that area and go *over towards Fish Creek. Those pipelines, some of them are not too high, and some of them there are places for them to go through alright, but they always be scared or something, I don't know.* (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)

With the five foot proposed pipeline height, it's a big concern to me. As you are aware of the studies that were done on this was for caribou during the summertimes and, as we all know, it snows during the winter and the snow drifts and builds up. It's a different case during the wintertime where caribou may have problems crossing pipeline during the winter months. So I would recommend a minimum height of seven foot instead of the five foot minimum. (Utqiaġvik) (BLM 2003a)

In addition to this 13-mile pipeline I'm talking about, with the new discoveries that already occurred south of the Kuparuk field, we have about another over 10-mile pipeline again, that that's three feet high. And then you look at the caribous when they - when they're trying to get to the ocean side, they're always migrating, keeping away from these bugs and everything. They stop right at Oliktok. They - we don't see those anymore, these thousands of migrating caribous. Now, at the same time, we're seeing hundreds. (Utqiaġvik) (MMS 2001a)

Look at Nuiqsut. Couple years ago they were finally able to catch caribou around their town because -- three years ago there was seismic being done around Teshekpuk Lake, and what they did was take that herd around Teshekpuk that used to come here to Barrow to feed us, they chased it all the way over to Nuiqsut. And that winter we caught nothing here. We had -- our hunters had to go above Atqasuk, above Wainwright to find caribous for themselves. You are talking traveling from 60 to 100 miles just to find something to feed your family. Did we get any assistance from anybody? Heck, no. And the federal government couldn't lease it fast enough. (Utqiaġvik) (MMS 2009a)

Seems like they're sticking over by the pad, that one. They mainly stay around this area, don't move nowadays. I know that they spend a lot of time over by Alpine. They don't move once they get by over there. I guess just like at Prudhoe Bay. You even see herds go under the building, to cool off. Because it's cool, there's a draft going under that building. I used to work in Prudhoe Bay for how many years, a technician, for their annual tests to see if there's anything leaching from their pads. (Nuiqsut) (SRB&A 2010b)

Actually, with the Meltwater road on there, the caribou are getting lost. They don't' know where the migration route is. We've got the Prudhoe roads over there, but the Meltwater comes farther down, and in the caribou's mind, where's the direction? We used to have the caribou coming into town, the migratory route [used to] come in, but now they don't do that anymore. (Nuiqsut) (SRB&A 2013b)

That migration pattern has gone southward. We hardly see the western herd this year. The Porcupine Herd, haven't seen them lately. We used to see thousands of Porcupine Herd coming through the villages, but we haven't seen those for a number of years and since that pipeline was built, that changed the pattern of the migration of the caribou. [We are] mostly harvesting caribou from Western or Central Herd. (Nuiqsut) (SRB&A 2014a)

Pipelines; we have seen caribou turn back from pipelines because they [caribou] see a flash from the pipeline. They used to go to Helmericks' in the thousands, not any more. Maybe two or three or less. Especially females with young used to go down there.

Westside at Kugaruk, Harrison Bay, there are caribou there. You always see them. We had to go out to the ocean and to Kugaruk to catch them. (Wainwright) (SRB&A 2009)

I don't think that has changed much, except we used to get the Porcupine Herd, but no more. After the pipeline, we don't see them anymore. (Anaktuvuk Pass) (SRB&A Unpublished-a)

There has been some adjustment time for the caribou from the Alaska pipeline, the oil pipeline. And I think they have adapted to that pipeline now. So this project might not have as much affect because it's along the one that's there. The road to Umiat will definitely affect the route of the migration, but that's another study. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Any activity that goes from north to south, [the elders] made the statement, north to south activity is not too harmful. It's not affecting the migration of the caribou that go north and south. They travel north and south, so that north to south activity doesn't have much of an effect on the migration of the caribou. So that's not a concern, and it's already going through completed project before. (Anaktuvuk Pass) (SRB&A Unpublished-a)

We live on caribou. I don't know what they changed, the haul road or who knows what now. [after road and pipeline we are] hardly catching caribou [in the] fall time. The [proposed road to Ambler], that's gonna make it worse. Cause that'd be in the winter [that it would be used for construction]. DOT [will] make an ice road, snow road. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Maybe on the seismic – it's always the most distracting, because there's a lot of wires, and you are crossing [over] wires. When they do the seismic, the caribou seem farther out. Even in wintertime, when we see lots of seismic activities going on. You could see it right there, just laying on the ground in the land area. They're bright orange and you can see them for miles and miles. (Nuiqsut) (SRB&A 2015)

Pretty much the caribou herd, what they always talk about. The migration route is a big concern to all of that. As long as I have been here we used to get the caribou herd run through town. When I was little. IT's been about 10-15 years or something. Since they actually came through town. They actually come into town, the caribou trails. You can see them come into town. And then there is a couple more, and on top of that hill around here, that hill has a caribou trail that has always been there and everything. (Nuiqsut) (SRB&A Unpublished-b)

Nigliq seems a little wider. The caribou don't really go. They used to go further into the pipeline and now they split into little groups. I remember when there used to be thousands. (Nuiqsut) (SRB&A Unpublished-b)

One of the concerns I have, I was about 13 years old when the porcupine caribou came through town. I don't see tutu come through town anymore. There are trails that are old caribou trails, they used to run strait through town but that was before Alpine. They go around now and stay away from the community. (Nuiqsut) (SRB&A Unpublished-b)

Yea, they will divert the migrations when they are in the middle of their construction because they will not stop for caribou pass by. The caribou were already affected by the TAPs. When those drill sites expanded that is when the caribou were diverted. They *were diverted eastwards instead of going through the village. The development is going to be a concern to the wildlife. It will actually be more difficult to go further to harvest caribou. If they open that Umiat road what will happen to Anaktuvuk Pass and Nuiqsut? They will cut off our access to the Central and Porcupine caribou herd. That is going to be an issue when they build this. How are the wildlife, and the caribou, be address under that APP project?* (Nuiqsut) (SRB&A Unpublished-b)

Undoubtedly for good the animals need a sanctuary. I have always joked and said that since I have worked the oil field for several years. Before that the closest I could get to a caribou was maybe 500 yards, but in the oil field you can get a whole heck of a lot closer. They know it is safe. (Nuiqsut) (SRB&A Unpublished-b)

Moose

The wolves are a major impact on the moose population. There has been industrial activity that takes place there more recently. I don't know if that's affecting the moose or not. You theorize activities there in winter time, it's so cold there, that any additional movement or pushing of the animals has an impact on their ability to survive the winter. They're using their fat reserves. Additional activity is going to burn that off quicker. One year they found a couple animals off the Umiat runway, they had pneumonia, a cow and a calf. If you run animals hard in the winter time you can frost their lungs. This is just my opinion, but the wolves probably pushed them hard enough to where that happened. (Utqiaġvik) (SRB&A 2013c)

And some people always run into moose that are – they say that some moose have a big lump on the side of their bodies and they don't really know what are causing the bumps in that area. We have learned back in the 1980s that there was a lot of seepage of battery acid from the Umiat site…. Maybe from the battery acid from that Umiat site. (Nuiqsut) (SRB&A 2013c)

There's two places that I know where there's always a lot of moose. Right by our camp [at Sentinel Hill] on the east side mainly, the majority of them. One year we saw maybe five to six calves in there. Two cows had calves. Then by the Uluksrak [Bluff]. The high country is on the west side, so we could go up there and then scan the area from the west side and look at the east side [for moose]. (Nuiqsut) (SRB&A 2013c)

Basically on the Colville, between Anaktuvuk Pass and 20 miles up from Umiat is where you find the most concentration. They usually tend to gather around Umiat area, in about a 10 mile radius of Umiat, but basically on the river. That's where you find the bulk of the moose herd. It's always been like that due to probably the highest concentration of willows in that area. (Utqiaġvik) (SRB&A 2013c)

Well, the first time they declined there were high incidence of brucellosis and leptospirosis. We thought that contributed to the decline. This time we're testing them, they don't seem to have their disease. They're dying of pneumonia, which is usually secondary to other diseases. We're in the midst of doing range studies there. The population isn't really high, but we're finding moose that starve to death. We sampled the willows and there was plenty of browse. Now we're sampling the quality. They're way up on the ragged edge of where moose ought to be. Maybe the plants don't pick up nutrients the moose need. And, to keep things more complicated, the snowshoe hares just moved into the area in the early '90s, before it didn't have rabbits. Just as the hares came in, the moose population fell. One thing that can happen with willows is if they're *being preyed upon heavily, they'll start producing toxins that make them less digestible.* (Utqiaġvik) (SRB&A 2013c)

Small Mammals

It should also be known that leasing in the Colville River Special Area, this oasis is a riparian habitat is very productive and supports wildlife populations such as moose, hares, lynx, that are not abundant on the rest of the North Slope. It's an important area were North Slope people can harvest meat and fur trapping, conduct fur trapping. (Nuiqsut) (BLM 2019e).

They're basically in the Umiat area, that's where you tend to see the most concentration of rabbits is Umiat area. Probably about same as moose, where the willows are the thickest. Up the Chandler and up the Anaktuvuk River, but more in the main river. I think they're about ready to crash. I don't know how many year cycle they have, but it's getting close. (Utqiaġvik) (SRB&A 2013c)

Trapping was abundant east of here. Now, we don't go over because of the oil field. Just recently, it is known that the foxes are very dirty, discolored and rabid in that area. Trapping is done elsewhere. We used to see grizzly bears around. Now, they are not around. Where's the caribou now? One summer when we used to walk miles looking for caribou, we came across two dead caribou for unknown reasons. The animals have faced a change. We have faced a change since activity began. If there is to be further activity, the fish and the sea mammals will suffer and we will suffer too. We depend on the fish, wildlife and the birds, still, today. Bessie Ericklok. (Nuiqsut) (MMS 1979b)

You don't see lynx anymore, at least up there. There were hardly any to begin with but my grandpa would get them all the time. I don't know why they aren't really around anymore. You just don't see them. (Nuiqsut) (SRB&A Unpublished-b)

Also there have been porcupines this far north. Camp robbers [birds] or chickadees are up here until January. (Nuiqsut) (SRB&A Unpublished-b)

3.3.7 Marine Mammals

Distribution of Marine Mammals in Nearshore Environment

Seals

When the river floods, near the mouth of Nigliq river it becomes filled with a hole or thin spot in sea ice that has melted as the river breaks up. When it reaches the sea that is the time that they begin to hunt for seals, through that thin spot in the sea ice that has melted. They hunt for bearded seals and other types of seals. (Nuiqsut) (BLM 1998c)

About a quarter mile off here, the brown water and the green water off of the shore. Off of the coast. [It looks] like there's already a line right there [on the map]. That color, that brown water and green. And then at the end of June those seals kind of eat on the outside of the brown water for some reason. I don't know why but maybe it's that muddy taste. I'd rather wait until the lagoon clears up and then start getting fish. Dirty water – the fish don't taste that good. They (seals) are on the green side of the water. (Point Lay) (SRB&A 2011a)

I know the ugruk season was kind of slow because the river water was kind of murky and as soon as it cleared up, they started showing up. I just got one. I think I was the only one that harvested one in June, and then the ice went out all of a sudden. It is every year [that the water is murky] and you don't see them until it clears up. You only have like a two week window for hunting ugruks and seals. (Point Lay) (SRB&A 2013a)

Utukok Pass. They go feed there for herring I think. That is a special place, there is like 50, 60 [seals] around there. I have never really seen them on the passes south of Five-Mile [Kukpowruk Pass]; I see them on Five-Mile Pass, Eleven-Mile [Akunik] Pass, Utukok Pass. The pups stay in the pass. All along the spit the pups are down there. There is quite a few of them. (Point Lay) (SRB&A 2014b)

Hardly any [bearded seals]. It seems like if we're not catching them, something's happening. I used to see lots of bearded seals on the ice but this year, like I said, I saw a pod of 100 seals on the ice but this year I didn't see that number. I saw like half of that number, maybe 30 when it should have been 100. I almost want to say this is my theory, because of our climate changing and the ice getting rotten farther, the seals have more of a chance of swimming away from the areas. When they have good ice these animals can't swim away. They have to stay in the area and keep that ice open. They have the freedom to go anywhere now. There's more rotten ice. (Point Lay) (SRB&A 2013a)

Well, the seals have been coming onshore onto the land more frequently than previous years. I think it's because of our ice. It hasn't been there. Same thing with the walruses too. They've been onshore here for almost a month now. I think they go out and feed and then come back to shore because there's no ice for them. Yeah, I guess our northern ice cap has been melting so all the ice that does form over the winter is mostly first year ice which melts over the summer. That's been the case here the last few years with our walruses and seals. They come to shore here near town because there's no ice for them to rest on. (Point Lay) (SRB&A 2013a)

It's earlier than usual. First of June we get that breakup, end of May. That was the weirdest point of the season. It goes right away, it don't stay anymore. We used to get that ice first two weeks of July but end of June is when the ice is going out. We used to hunt bearded seals. Nowadays we're lucky [to harvest a bearded seal]. Lot of animals like to stay up where the ice is. (Point Lay) (SRB&A 2011a)

Walrus

Point Lay seems to be a good habitat for walrus, lately! It's typical, but we've been seeing big haul-outs. We're seeing 1,000 [count] haul-outs. Right out here on the first point I was talking about. It seems to me like they've been hauling out right there for the last three or four years in the thousands. I see like 800 or more. Uh-huh, there's lots of haul-outs all the way to Icy Cape right now, a hundred, fifty, but for some reason they want to stop right here. Icy Cape would be another big group of haul-outs. They gather up there, right on the point. (Point Lay) (SRB&A 2011a)

We live on the mainland, but we have Kasegaluk Lagoon, which is an 80-mile stretch of lagoon that goes from the foothills down south about 30 miles from our village all the way up to near Wainwright, which is considered the longest lagoon in the world. And there are 11 inlets. And every year we have birds migrating from down south coming up and utilize that lagoon. The walrus use that lagoon to get out of storms that *happen in the ocean because I've witnessed it quite a few times during my 40 years. The belugas go in there and, you know, as well as, you know, ducks, geese. We have a wide variety of waterfowl that utilize that lagoon.* (Utqiaġvik) (BOEM and BSEE 2013)

Walrus are hauling out more and more in the fall. The ice is changing. During the fall time the ice is way too far for the walrus. They go haul out on the shore. They picked our barrier islands to do that. About the first of September, they start doing that. That's when the Fish and Wildlife do the walrus tagging with the crossbow. They say there's a lot of clams out there. They wanted one of us hunters to get one, just to see what they're eating. And they are full of clams. Sometimes there's a few… this one year they found 30 dead walruses out there that just beached and died with a lot of sores on their face and bodies. But these last two years, I never saw anything like that yet. (Point Lay) (Wolfe 2013)

That, you got it right there. Yeah, we do sometimes occasionally go past Cape Sabine. This is where we get the walrus over here…. Walrus , you'll see them here and there [adding a small use area to the existing one], maybe just a mile from shore. (Point Lay) (SRB&A 2011a)

Polar Bear

Now we see they use the islands and banks a lot more now. Even when ice floes are big enough to use, it is the time of the year when there is a lot of snow during November, December, and that is when we see a lot of snow come around. Even if the snow is not dropping, it is drifting. That snow is drifting into areas where they have to put a den. You could see hardly any snow in one area when you go outside, but snow has accumulated enough for use. We see a lot of that happening now. By March they know where to go when they come out of their dens. (SRB&A Utqiaġvik Workshop, January 2018) (Braund et al. 2018)

He indicates there are more bears starting to den using the land. Some bears are denning in low, flat areas where snow can build over time in that area. They are starting to look for other places to den other than mostly the ice. (SRB&A Wainwright Workshop, January 2018) (Braund et al. 2018)

When the young ice that we call siguliaq is older, young ice that has gotten thick over time, and it starts to ridge and it gets long and go for quite a ways. A lot of ringed and bearded seals look for that kind of condition so they can live in there year round. There is enough snow for a lair, so they do not have to move away so much. The bears are looking for that type of ice to hunt in. The puktaagruaq are large multi-year or large chunks of ridged up ice. Icebergs. Puktaaq. Single large piece of heavy ice. Bears like that area too. They like to be on the thin stuff too. Siguliaq [thin ice]. (SRB&A Wainwright Workshop, January 2018) (Braund et al. 2018)

Generally, bears start coming from the east when the lagoons are freezing. In September and October they come from north with ice then they get on the ice with the beach. In the winter time, with the west wind, they come onto the shore fast ice. In the spring time, they know where to go; they know it is whaling season and know they will have food to eat. You see that pattern with almost all of the whaling villages; they know how to learn when it is time to go whaling and go to those places. The seals are moving too with the seasonal migration happening and belugas and walruses with the floating *ice. The timing is important for animals migrating and with those migrations are going to be the predators* (SRB&A Utqiaġvik Workshop, January 2018) (Braund et al. 2018)

When a polar bear is really hungry it does not matter how big or small it is. When there is that factor the bear will not stop. There is that source of seal skins, rendered oil or food in the community. It has been like that for many, many generations that he has seen and these communities know that when an animal is starving when he smell something, he will not stop at a gun or person or dog. He will be determined to get that source of food. (SRB&A Wainwright Workshop, January 2018) (Braund et al. 2018)

Participant 1: You have to scare them so they will not come back; not just shoo them away. You scare them. Gun shots and shoot near them on the ice if not going to take them. It reduces them coming back.
Participant 2: Chase them out with snowmachine. I think we need to chase them farther rather than just a little bit out of town so they will not come back.
Participant 3: When they first come around, you shoo them away, but they go out and you think they not going to come back. When they do come back, the bear hunter will chase the bear out until it knows [Name] that it is not welcome in the town. Chase him really hard. Chase him until the point they are tired, and that will reduce that bears chance of coming back. It knows it will get tired. That has been taught to whalers and community members. That sort of action. It is in our bear patrol. We try to teach the same kind of tactics that were used through generations. We put that part in our bear deterrent program.
Participant 1: Cracker shells and bean bags.
Participant 3: Hard chasing been around a long, long time. (SRB&A Wainwright Workshop, January 2018) (Braund et al. 2018)

I would like to mention our polar bear as well. I know that I didn't mention them. Lupita for the record. I know that there is polar bear calving. The polar bears do come up into our mountains and they calve up here. Be aware that they are calving. I know that there's special consideration for our polar bear right now, especially with that new treaty that's being issued so there's some protection for our polar bears that Fish and Wildlife already put into place in some of these areas so I would like to make mention of that to take a look at that. That way when we, when we come back with another scoping you have a projected map with those markings on there. That way we could see it because I mean it does say River Uplands Special Area but it doesn't really say what it's protecting, why it's protecting… (Point Lay) (BLM 2019b)

[Point Lay resident] will attest that they'll den close to the old village. And you can find polar bears almost anywhere. All they need is a snow drift to den in and they do. We'll find them along the barrier island. They're not in the numbers that you might see in Kaktovik and Point Hope. (Point Lay) (SRB&A 2011a)

She said they have lived subsistence living as their forefathers did also. They traveled with animals. They survived on animals. And she stated that once…the polar bears, they live on ice, but the females, when they tend to their young, they don't live on ice. They go towards the land and the rivers. Go towards the rivers to tend to their young. The fish travel towards land when there's no ice, when it's easier. And then they out out to the ocean when it starts freezing up. And she states that animals know fish go towards ocean underneath the ice. Sarah Kunaknana through translator. (Nuiqsut) (MMS 1979b)

Whales

In the past we have -- we have seen a lot of ice making it difficult for us to go out to the main open water. Now you don't see that. In recent years, once the ice goes out, you don't see it. It don't come back. Now that will change the pattern of the migration of bowhead whales. They will be traveling closer to the shore, closer to these barrier islands in the 30-meter mark, and that's where these marine vessels like to travel from. And that has been their pattern since the ice pack had gone further north, 100, 200 miles north of us. And since then, all these bowhead whales have been traveling a lot closer, and some are traveling inside the islands. And now they migrate -- they use these islands as more of, like ice because they are shallow. Thirty-meter mark is real shallow. And if we cannot -- like Archie Ahkiviana said, we had a successful season in the past couple years because the whales were closer to the islands and we did not have to go further out, no more than eight miles out to -- to catch our harvest. And a lot of times we may be weathered in because of the weather, high seas. Edward Nukapigak. (Nuiqsut) (MMS 2009b)

Seventy-five percent of our food comes from the ocean. We get some of our food from the land, but the ocean is our garden. Whales, beluga, walrus and seals are all foods we need. OCS is something people are concerned about because it can contaminate our garden. We know about Prudhoe Bay. The tundra is fragile and if you scar it, then it will last for years. We have seen that with oil development. But, if you spill oil in our garden, the scar will be forever. (Utqiaġvik) (EDAW Inc. et al. 2008)

[We hunt in] June, July, but it has been earlier these past few years; it used to be July but you can say June now. All the animals come early, even the bowhead. They used to hunt them in May and now they do it in April. Animals don't have a calendar. Maybe it is the climate that lets them move back and forth. Whales have been coming earlier. (Point Lay) (SRB&A 2014b)

If we don't have any down there [Cape Sabine], we'll come up and scout around there. We've herded them more down there more often than we've herded them from up north. We go out here, and then we go this way [toward shore]. We don't want to cut them off and scare them back to where they're so far away and we have to wait…it's safe to say five miles [offshore is the furthest they go when beluga hunting]. I think we've gone as far as Eleven-Mile [Akunik Pass] to turn them around. Those are reference points, so you might go a little further than that…[you go to] whatever inlet you're nearby. You can lose the beluga real quick out there. You herd them in through the closest inlet. (Point Lay) (SRB&A 2014b)

Health and Quality

The bearded seals used to be fatter. They're not fat at all. They travel more, we hardly see them, that's why there's a short time [when they are] around. I bet that's the problem with the beluga, too. They're not as big as [they were] a long time ago. (Point Lay) (SRB&A 2011a)

A lot of sick seals, [ringed seal]. Couple of bearded seals me and my crew got their hair wasn't all there. They were already molted, the big ones anyway. I found maybe five or six eider ducks dead. [More than usual]. It was, I think it's the heat. Yeah. There's a lot of sick walruses, seals, a few I saw bearded seals, ducks, eider ducks. From Eleven-Mile north that's where I saw most of the sick animals. (Point Lay) (SRB&A 2013a)

I have been butchering seals for more than 20 years now. I can safely say in the last five years I have had six seals uneatable, unusable to where I had to just throw them out, throw them back into the ocean. One of the -- I did have them tested, and it did come back malignant with cancer. So another thing to be watching out for, too, for these ships that are going is the waste that they are putting in the waters because it is affectic -- it is affecting all these -- the bearded seal, we hunt that for kiniqtug and misigaq. And that's one of the things that is important, too for our well-being. Take a teaspoon of misigaq, and that's better than Dimetapp. It really is. You know, you -- it may sound funny, but -- beluga oil, you rub it on your chest for a chest cold. We use it more for than just food. Roberta Leavitt (Utqiaġvik) (MMS 2007b)

Climate Change

Animals were only available during very narrow opportunities because of the weather, the sea state conditions, and the early warming. We not only lost our ocean ice early, we also lost all our beach cover early as well as [losing] all the ice in the inlets early. [There was] no way to really go any farther than 20 miles without dragging a boat with you. But yet the lagoon ice was very thick and did not go out until the middle of July so we couldn't use the boat ramp to launch our heavy boats. All the weather conditions worked against us. We have to adapt to it; it's normal. (Wainwright) (SRB&A 2013a)

If you look at everybody else's data, there's a one week period in August that everyone got bearded seals. That was it; that's not normal. We usually get them all the time. It's because there's no ice; it was all blown out to sea. Not having no ice. We had no ice, open water for about 200 miles all summer long. It was pretty hard to use the ocean because it was too dangerous. There was that one week period that they had gotten those seals. After that, nothing. When that opening happened I wasn't home so my boat didn't even go out in the ocean. (Wainwright) SRB&A 2013 (SRB&A 2013a)

The seals typically come the middle of June, and we're here, we're waiting, people are struggling to get their boats launched because of the soft sand and there's no seals. Wide open water. The conditions were a little choppy, and then one day toward the end of June about the same time I started getting hits on the fish finder then the seals come, and we had—it was an amazing hunting window. Almost two weeks of perfect weather. (Wainwright) (SRB&A 2013a)

The ice conditions; I noticed the ice isn't thick as it used to be 10 years ago, 15 years ago. Even last year, too, wasn't as thick as we'd like to see it. They're probably going further north just to find good hunting grounds because there's hardly any ice. (Point Lay) (SRB&A 2014b)

I've noticed that the shorefast ice has come closer and the lead opens up closer than it used to when I first moved down here. I went out seal hunting one time and my speedometer said 15 miles and I just looked down, and I said 'Hey boys, we're going back; this is way too far for me.' We didn't even reach it [the lead]; we had two miles to go. Nowadays, it opens up two to three miles out…. I think it made it easier for our subsistence activities to have an open lead closer. We would have to go north, you know, to find closer open leads. (Point Lay) (SRB&A 2011a)

Effects of Development on Marine Mammals

...there are other persistent organic pollutants that are concentrating in our animals. There are studies of the polar bears that are showing these concerns. These pollutions from industry developed elsewhere are coming to our lands with the way the air currents are and the precipitation, they are coming to our lands and we did not have to identify the issues, but we have to deal with it. This adds to what is coming from the fields of Prudhoe Bay, Alpine, and Kuparuk. There are changes to the animals which are our resources for survival, the fish, the caribou, the whale, and others. (Nuiqsut) (BLM 2003b)

People that use the ice road leave trash, and animals eat that trash. Caribou and polar bears—have trash inside of them. Seals—plastic pop rings. Within the last 5 years, on the ice road, [I] see a lot of trash all over (S.R. Braund and Assocs., 2003, Field Interviews, USDOI, BLM, 2004). (Nuiqsut) (MMS 2007a)

3.4 SOCIAL SYSTEMS

3.4.1 Landownership and Uses

See traditional knowledge provided in the SUBSISTENCE USES AND RESOURCES section for traditional knowledge that is also applicable to this section.

On the issue of the Haul Road. The direct environmental impacts of the pipeline has been limited and manageable. Issues associated with the Dalton Highways or the Haul Road and their relationship to the pipeline issues complicate matters. Clearly, the Haul Road and the pipeline are related and the management of the two assets must be a coordinated undertaking. The State of Alaska, over the strong objections of the North Slope Borough opened the Haul Road to public traffic. The ongoing and potentially serious impacts associated with the Haul Road must be considered together with the pipeline for purposes of impact assessment. Originally a restricted industrial supply route to the oil fields, the Haul Road is promoted in a lot of travel magazines as one of the America's great frontier driving experiences. This attracts more and more travelers every year to a road that was not designed for public use and is not adequately maintained for public travel. There is a critical shortage of sanitary waste, emergency facilities, including toilets, waste receptacles, roadside pullouts and call boxes. Drivers of 18-wheelers feel they have a priority on that road, just drive it one time and you'll see it, as was the intention and the case since the highway was first constructed. Slow-moving or stranded passengers vehicles can create dangerous situations out there. It is, of course, the North Slope Borough which must respond to emergencies on that very road within our boundaries. This is an added expense to us, to our local government and diverts limited response equipment and personnel from potential needs in our communities. George Ahmaogak, Sr. (Utqiaġvik) (BLM 2002).

The eastern bank of the Colville River is virtually not a subsistence area anymore. And that's probably -- you know, if your research people look at that, that's an overwhelming fact that it has happened. Although, in the comprehensive planning in Prudhoe Bay, the industry, State of Alaska had assured us that they would not restrict hunting, they have barred and restricted hunting from the eastern bank of the Colville River to the Sagavanirktok River already. (Utqiaġvik) (BLM 2004f)

My major concern is access to areas we've been using that may be developed and possibly we'll be prohibited from going in there. That's a major thing I've seen with *what's happened in Prudhoe bay and the Kuparuk area. You go through Deadhorse to Barrow and a number of times I've been denied the ability to go off the road system. A snow machine on the road is a bad idea. I went from Deadhorse to Aluktak and had to hire a trailer and truck to carry my snow machine.* (Barrow active harvester; Experience timeline: 1995 and ongoing; Experience location: Prudhoe Bay, Deadhorse, Aluktak. SRB&A Interview 2007) (SRB&A 2009)

All the western side of the Colville River and the rivers that they used to harvest game, to harvest fish, waterfowl and to use as camping areas because traditionally, these areas have been used by their forefathers. They continue to try and do this but what do they do? They are blocked completely by the industry. Even though that it's written, it's black and white on paper, Native people could subside in these areas, you try and do that, you get jailed. (Nuiqsut) (BLM 1998c)

3.4.2 Cultural Resources

We have not been able to have access to our traditional hunting grounds that we were raised with…The Inupiat have a close relationship with the land and animals. It changed the spiritual need between the Inupiat people and their traditional hunting grounds because they had a very close relationship between land and animals. Jonah Leavitt. (Utqiaġvik) (Worl and Smythe 1986)

To understand our culture is to understand the correlations of history, archaeology, socio economic factors, land and wildlife factors to a livelihood of subsistence patterns of the Inupiat people. The relationships of history and culture cannot be separated. The same is true for subsistence resources and the human food web process, including organisms of the smallest regime. The total regime of sea mammals, fish, land animals, birds, and caribou is all interrelated and dependent upon each other. To destroy one small part of the regime is to endanger the other parts. One begins to wonder if the hierarchy of State and Federal Governments understand these inter relationships of the total ecosystem as a whole. The total ecosystem provides the network for the continuation of a subsistence lifestyle. Flossie Hopson. (Utqiaġvik) (MMS 1979a)

Cultural resources along the Beaufort Sea coast are not defined in terms of architecture or buildings alone. Beyond such static material categories is a whole panoply of dynamic resources. Spiritual associations with places and activities shared by local residents, subsistence hunting, fishing and gathering pursuits. John Carnahan (Utqiaġvik) (MMS 1979a)

Cully Hill is the original graveyard for Point Lay, and we started another one by the freshwater lake. There's been people lost up and down the rivers and you occasionally find skulls. These are old war grounds. You'll find places where they made spearheads. This is where Point Hope and Barrow used to fight. You'll read a lot about the war grounds. Kukpowruk, at the base of Igloo Mountain, there's a lot of stones there. One story, that [a local resident's] parents told was that they were taking dog team down there and suddenly it started snowing red, and that sounds like fallout to me. These are two well-seasoned travelers. You have to wonder what was going on….There's a couple of sod houses at Kuchiak, just south of the mouth. Every river is significant. Pigmiaq River, at one time when Point Lay had only one man here, he was born at the mouth of Pigmiaq River, and there's sod houses there. Just south of it. And the coastline is encroaching, so at some point those are going to erode away. Cape Sabine, we used to *go there all the time. When Point Lay was unemployed, Cape Sabine was a common place for people to go there.* (Point Lay) (SRB&A 2014b)

The old village, right across [from the community]. Where the plane is on the landing strip [on the map]. We have old sod houses and graves. The second one is across the river. We lived on an island. That [on the river] used to be the second village. [The first village] was an island. The houses were lined up. All the houses would get buried. This is the third site. (Point Lay) (SRB&A 2014b)

So, I know that this area right here like Jane was saying, the Kasegaluk Special Area that is protected right here, well there's the Tuniluk River right here and there's the Tuniluk Lake and these are all historical spots where our people were, a large amount of our people and it's in our record. So, I just want to point that out that I would like to have this site right here protected. (Point Lay) (BLM 2019d)

The main one is up here [at Icy Cape]. There is a well-known Native village there. I want to see it [designated] as a historic site. One time my dad would say there used to be a thousand people there. (Point Lay) (SRB&A 2014b)

I'd just like to emphasize the importance of the Chipp, Ikpikpuk and the Colville River areas historically and still today. (Utqiaġvik) (BLM 1997b)

My mother is from Oliktok. When they were developing Alpine, the "rollagon" almost stepped on my mother's sister's grave: the industry never apologized to her. That would be my strongest point. (Barrow active harvester; Experience timeline: 1999; Experience location: Oliktok area by the mouth of the Colville River. SRB&A Interview 2007) (SRB&A 2009)

The Haul Road was built right over my grandfather's mother's grave. My father brought up the concern. The answer was given as "It was the other company's fault." Gravesites and campsites should be documented. No mitigation was done. It might not have been the only grave there. (Barrow active harvester; Experience timeline: 1976; Experience location: Dalton Haul Road. SRB&A Interview 2007) (SRB&A 2009)

Narrow view of sites. We got grave markers and burials. In the winter we have markers, but they're buried by snow. You get oil companies driving all over the area. That's not right to do. We are Iñupiat. We respect our elders. (Barrow active harvester. SRB&A Interview 2007) (SRB&A 2009)

We went seal hunting during May and in June, before breakup, we had to land again. The islands are used heavily for nesting and molting ducks, geese and pintails. The islands are important and have historical and cultural significance. There are whale bones and old ruins at Pingkok Island. The lands and its wildlife, fish, have changed today. For example, Putu used to have a free flowing channel. Now, last year, it had to be physically channeled. Two years ago, my brother Paul went to fish at Itkillikpaat where he ordinarily fished. He came back with no fish. We used to catch fish anytime we put a hook in. The Itkillik River is now rusty colored. There are even a bridge at Puviksuk. This river used to be glassy clear, as I have known it. These are the effects of past activity. Bessie Ericklok. (Nuiqsut) (MMS 1979b)

Our family stayed at Prudhoe Bay until the late 1930's. Our old sod house is still standing today. When I visited last summer, I saw the pingos we used for duck blinds was a burning pit. Our place is a barge landing place instead of a fishing camp site. I *guess people that are aware of Prudhoe Bay know that old shack on the east dock. That's where her house is still in position. That's the one she's talking about. There are a lot of old sites, camping sites, fishing sites along the coast line. The are there and are being threatened by development. Sarah Kunaknana.* (Nuiqsut) (MMS 1979b)

The oil companies travel doing seismic and surveys outside right now with snow vehicles. They should watch what they are doing. They don't know what they are stepping on. There are some graves out there they are running over. I see a lot like that. There is a graveyard southwest maybe 20 miles from here and some survey people don't care what they are doing. Do they have a monitor? Do they hear what Native people say, not to step on or run over [a grave] - a dead person might be under it. Don't just ignore the stakeholders. Watch what you are doing. There is a graveyard out there. It was there before you were there. They did not dig down far in permafrost. Not just one graveyard out there, there are more. (Nuiqsut active harvester; Experience timeline: 1999; Experience location: Fish Creek; Judy Creek. SRB&A Interview 2007) (SRB&A 2009)

They are still recognizable if you know what you are looking for. I think it was AARCO at the time who contracted an archaeologist on west side of the Colville. Settlements about 3-400 years old over there. Still some remains there that people were living there. He was showing me the old bones with cut marks, the fire pits, the sod depressions. I would say that happened within a decade. When HDE was first coming on before the project. It was either AARCO or the state or both that contracted him to look for sites on both sides of the river. And he has found several more not just in the crossing but going east. (Nuiqsut) (SRB&A Unpublished-b)

There are a lot of unmarked trails up there. A lot of history actually. A long time ago before development when they were living in sod houses and dancing there was a lot of trade in caribou and muktuk. That is how they would do it. They would do a lot of trading in the winter and do a lot of hunting in the summer time. (Nuiqsut) (SRB&A Unpublished-b)

Not so much on the ocean coast, but [I have spent time] on the rivers. Last year when I was working for Umiat, they didn't tell me but Umiat became a historical site and you can't take anything off of the ground. I found an arrowhead and I put it in my pocket. I showed everybody and they were like "No". They freaked out about that. I got kind of mad at them because I was like "Go ahead and put it back then or are you going to keep it". I found a pair of old metal binoculars. I had to leave them though. (Nuiqsut) (SRB&A Unpublished-b)

At Oliktok there are old grave sites. I think they have been covered by the gravel. It is a desecration. My grandfather was born and raised there. I am sure one of his parents or both are over there. (Nuiqsut) (SRB&A Unpublished-b)

Yeah, I say that now because of Alpine we have had some displacement of camping sites, fishing sites. Some families have abandoned because of the development. The impact of noise and traffic and the infrastructure itself the roads and facilities. They tell us we can use our camping grounds to hunt and fish but it's just not… And besides that with the fire arms these days the industry is wary of that. (Nuiqsut) (SRB&A Unpublished-b)

Yeah, that has a lot of history there. That was a route that the Barrow folks used when they went to the trade fair (unclear) site at the Nigliq Channel. So that, as well as that being a very sensitive area for the calving areas for the caribou, apparently, that's more or less overlooked because you're already talking of having a number of drill -- drill pads with 50 wells on them. (Anaktuvuk Pass) (BLM 2018b)

So we have on record, of people that resided there well before Nuiqsut was even there from -- from our people. It's on state record, also, of who was there. They have names and people and they're -- they're our direct kinfolk because they were our last names; people with our last names and our immediate kinfolks… I'm just asking, because we have kinfolk that are buried around that area there. (Anaktuvuk Pass) (BLM 2018b)

There used to be some people in Itkillik; there were allotments in Itkillik Lake. (Anaktuvuk Pass) (SRB&A Unpublished-a)

The nomadic lifestyle would have some activities over [in the project area]; there might be some grave sites in that area. The Inupiaq people would travel there, and when a loved one died they would bury them in that area. So the Alyeska pipeline might have affected some of that. (Anaktuvuk Pass) (SRB&A Unpublished-a)

We would find some old graves. A real long time ago, people would build [graves]. And they would start drilling and [find] some old bones. I said "2,000 years ago the last one was buried". There was caribou skin right there by the camp fire. I know over there in this area [gestures broadly to the map], it might be the same. They lived here a long time ago. This [TAPS] pipeline goes through the graves. During the starvation my wife's dad was three years old. He was three years old when he was starving there. People were right by the river and it overflowed in the winter. And that's where they found them [dead]. [speaking about the graves or bones by the rivers]. (Anaktuvuk Pass) (SRB&A Unpublished-a)

[Important places?] All the elders know, nobody else [knows about the burial sites]. People died in that area right there [west of TAPS]. When the person died, they called that area that person's name. [When a] person died there they called that place his name. [Do people still use those names?] More people [are] traveling over here because more animals are over here. Down, up, the mountains, and up and down. (Anaktuvuk Pass) (SRB&A Unpublished-a)

I travel all over place, what it is. [I] travel to the ocean from here. [I travel to the] Colville River. People from here and people from north they go right there [to the Colville River]. They make something down here they make something there, [and] they go and trade [these items]. That's how they used to be. There was no store here, it's a long way to the store. [We had a] dog team [in the] winter for groceries [laughs]. They know what month they [are supposed to] go to meet, [in the] springtime. They know where to find each other. Mostly the people live right here live here most of the time [in Anaktuvuk Pass]. People over there leave from Porcupine [to travel to Galbraith Lake]. It used to start a war, a long time ago. [If an] Eskimo find an Indian he [would] kill him. A very long time ago, [there was a] big war. Down south was the last time they had war. Only whites went back to Arctic Village. They made a story on a tape recorder. They said, "talk Eskimo so that they couldn't understand Eskimo". (Anaktuvuk Pass) (SRB&A Unpublished-a)

It’s the same thing that can happen when the pipeline is open to the public; we know people have no sentimental value [when they visit] up here. But for us [this area] has a great sentimental value. (Anaktuvuk Pass) (SRB&A Unpublished-a)

3.4.3 Subsistence Uses and Resources

Key Subsistence Harvesting Uses and Locations

First of all I'm aware that Nuiqsut is greatly affected by these development proposals, but as he just showed caribou that migrate through Anaktuvuk Pass also travel up north to these areas and these herds are what our lifestyle here in Anaktuvuk is based on. And for thousands of years the animals that migrate north have followed their routes every year. These areas are summer home to the caribou, among other wildlife. The caribou that traveled north are the main source of subsistence for our people. Mike Morry. (Anaktuvuk Pass) (BLM 1998d)

Please stay away from the water. I don't know how many times we have to say it. These are the subsistence highways. Stay off the rivers and the big lakes because these are important areas for fish habitat that Craig just mentioned, and for waterfowl. Oil industry and water essentially don't mix. (Utqiaġvik) (BLM 2003d)

We rely on fishes from Teshekpuk Lake quite heavily. The amount of fish that is caught from Miuliak (ph) River as it goes to the Ikpikpuk River is very popular. I've been in the area most of my life and these in the summer months. When I'm hunting in the area besides Chipp River. (Utqiaġvik) (BLM 1998a)

That Anaktuvuk River, which is part of the, if that…lets take the Colville River, even west of the pipeline. Some of the project [components] get way up in here, and that effects the fish and the habitats for the animals that we eat here; the birds, the geese, and those kinds of things. Lakes sometimes are further up from the river, and human activity, I’ve heard this, that if the lake is kinda stationary and the river is not then that lake starts draining out, and human activities can do that. (Anaktuvuk Pass) (SRB&A Unpublished-a)

I use the general area around the Ikpikpuk up to Navy Creek for the last 15 years I hunted caribou and reindeer, there’s a lot of reindeer up in that area. Fishers in the area catch reindeer annually. (Utqiaġvik) (BLM 1997b)

My favorite spot would probably be right in here [12-18 mile radius around Atqasuk]. If there’s hardly any caribou up here, I head out there. That’s when I need caribou. That’s a go-to place. My favorite hunting spot. The caribou are the fattest right there. (Utqiaġvik) (SRB&A 2010a)

Wainwright, around Wainwright, the caribou seem to be fatter, less stressed. [I go there] in the fall time. Along the coast line all the way from Barrow, that’s the one I prefer to hunt, the caribou seem to be fatter and less stressed because they come from the south, the ones that come from the east are bugged out. (Utqiaġvik) (SRB&A 2010a)

We utilize that lagoon every year. We go all the way up to Icy Cape, sometimes even all the way to Wainwright. You know, it's sort of like a somewhat safe trail in case the ocean is too rough to travel. We utilize that lagoon to harvest caribou along the mainland shore. We harvest off of the barrier island that is there. We harvest eggs, *which is going on right now this time of year. You know, we don't have to go to the store to buy eggs. You know, there is a wide variety of seagulls, geese, ducks, terns.* (Utqiaġvik) (BOEM and BSEE 2013)

It's really more a way of life. As you know, subsistence is an unfortunate term, it's really a lifestyle. And gathering wild foods and that sort of thing, is, is super important in a lot of cultures, but definitely here. And you know you hear the cliché that whaling brings the community together. It's true, it really is true. It's amazing. People that have been campaigning against each other, all this kind of rough stuff, when a whale is caught all that goes away and food is shared. And that sharing hasn't changed. In fact, that is probably the single most impressive, or important, let's say, aspect of the way things are done here. Is that it's, it's sort of communal hunting. And the way people distribute food is really amazing. And you can tell it's absolutely genuine. (Utqiaġvik) (Brown et al. 2016)

People fish in Chipp River in the fall time. The fish spawn just before October, early October. Or maybe more like the end of September. The bloated fish with eggs all come together and you get lots of them. Then all of a sudden the fish get lean. They've dropped their eggs and they get skinny. I catch aanaakjiq in lakes in the fall and they have suvak. One time I got two that were just big and round with eggs. I was holding the fish and that suvak was just draining out of it. The lakes are connected during high water of break-up, but then the water drops and the lakes get land-locked. The fish end up land-locked, too. (Utqiaġvik) (Brewster and George No Date)

When you catch reindeer near Peard Bay, that's part of Wainwright's herd. When you go over here to Admiralty [Barrow], that's part of the Barrow herd. The reindeer Nuiqsut gets, that's part of Teshekpuk herd over there. (Utqiaġvik) (Mager 2012)

With hunters from seven villages taking animals from the Teshekpuk Lake caribou herd, it remains the most important herd on the North Slope from a subsistence standpoint. (Utqiaġvik) (BLM 2003d)

I hunt seals every summer. Eleven-Mile [Akunik Pass], and Five-Mile [Kukpowruk Pass]…around that area. We get ugruks outside Eleven [Mile], and here too; both places. Usually they hang around on the outside. When there's ice out here, they're all over. We go all over when there's ice. That area over there [Utukok Pass], and about this far [Neakok cabin], all the way up and down for ugruk. Outside [the lagoon]. About three or four miles [offshore]. (Point Lay) (SRB&A 2014b)

I got three of them [wolverines] and four wolves. When the caribou are close by the town, I usually come around here and here [Kokolik] and here [Kukpowruk]. You get them along the rivers, mostly. Just up in here [foothills around rivers]. Deadfall Creek, around the hills. Last time I was chasing a wolf, it was a three and a half hour chase; we chased it from the coast to the river. Probably here where the foothills meet the flat land. They're right in the foothills near the flatlands, up to Utukok. (Point Lay) (SRB&A 2014b)

Kukpowruk is the main river there. You can go all the way up to fish camp. I'm gonna guess it's…gotta be this one. Kokolik, just for fish. Those are the two good areas. Everybody makes holes for fishes between that area and this area. (Point Lay) (SRB&A 2011a)

[We harvest fish] in Kukpowruk at the cabin, and we go to the school cabin and to other cabins. We start at the cabin there. We do that river and the Kokolik River. You can keep going up and then up to the coal mine. [We harvest] grayling, trout, during the whole month of October. At the same time we hunt caribou, wolves, and wolverine. (Point Lay) (SRB&A 2014b)

[We go] pretty much all the way from here [Cape Beaufort] all the way up to Icy Cape. [I go by] snowmachine and boat. [I hunt] black brant, emperors, white-fronted geese, king eiders, common eiders, Canada, snow geese…there's one good spot up here, right here [inland on the Kukpowruk], for Canada geese. There's a whole bunch of migration routes that they follow [crossing the rivers]. Inside the six mile, 12 mile boundary, too, for eiders. (Point Lay) (SRB&A 2014b)

[The migration pattern changes] only when helicopters [disturb them] or young people get too anxious to get them. Usually they can pass right between the snow fences right there. If we leave them, the first bunch goes through. If we leave those alone, the caribou will follow the scent of the first. But some young people like to get too anxious for caribou and go after the first bunch, changing the migration route. We try to tell them [not to hunt this way]. (Point Lay) (SRB&A 2014b)

When they come up, we herd them to shore. We stay close to shore, not even a mile out. One time we did that from Utukok Pass. We herd them from there. Usually when we hunt them from the south, we take them through Kukpowruk Inlet, and when we bring them from Icy Cape we bring them in here [Akunik Pass]. One time we herded them from the ocean, eight, nine miles out. That was not that long ago. Usually we spot them from the village and hunt them from there. We used to use airplanes, the last few years we haven't but it is good to use the airplanes because they spook easy with outboard motors. (Point Lay) (SRB&A 2014b)

This past summer I spent most of the time in Fish Creek Bay. And also on the west fork [of Fish Creek], the one that comes in on the bay side. From here I took about 10 to 12 miles in [to Fish Creek]…. Caribou are out here [along the coast], but this bay is too shallow [so you can't reach them]…. But there were caribous around here, but you don't have access to go to them because the majority of this area is too shallow…. But I focused my camping out here [Fish Creek area]. Teshekpuk herd tastes better. I've seen caribou when I've gone to Oliktok, when I go to pick up my supplies, from Pisiktaġvik coming down. On the east side, we have caribou but it seems like they want to stay away from the shoreline [because] we have so much activities going on. Here I only got a few caribou because in summer we have so many activities going on…. Majority of the caribou were on this side [west] of Fish Creek…. [I went] about maybe four or five times out on Fish Creek. I focus on Fish Creek a lot because I know that caribous on this side are being disturbed by industry. That way you don't have a lot of choppers flying every day. (Nuiqsut) (SRB&A 2016)

…in the summer when it is time to fish for large, round-nosed whitefish the place called Tillabruaq gets filled with them as well as the entrance to Itqiliq. Nigliq river gets filled with nets all the way to the point where it begins. We do not go to Kuukpiluk in the summer months. Then we enter Fish creek and that is where hunting sites and cabins have been built. That is where they build racks for drying fish and for drying caribou meat. (Nuiqsut) (BLM 1998c)

That Fish Creek area is most popular fishing for Nuiqsut for the fall time. Summer time around Nigliq Channel. So it's most popular fishing. So if that's happened, if the oil -- if that bridge pipeline broke up, there will be more devastation on our fish out there, especially the seal on the mouth of the rivers. There's all kinds of seals out there, there's all kinds of birds. So if there's an oil pipeline break up on that bridge, boy, you're going to have -- devastate our wildlife out there. (Utqiaġvik) (BLM 2003a)

The reason I was disagreeing on the numbers is I have a campsite near the mouth of Fish Creek and I take my family there every summer, every spring, summer and fall. We geese hunt down there in the spring. We set nets in the summer. We hang fish to dry. All the time, we go caribou hunting for the prime caribou in the fall, the one that's -- that's the best time to get them, but during all those three seasons, I'm still hunting caribou, taking my family down. Now I've got my grandchildren I'm taking down this summer and we were down there a couple of years ago. A nice herd came through. We got a couple of nice bulls and I didn't see you down there and I'm just -- all these assumptions and these good numbers you're getting from a collar or two in the area, I just -- I just have to disagree with that. (Nuiqsut) (BLM 2014c)

The residents of Nuiqsut use Fish Creek in their subsistence activities. In addition Nigliq area is used extensively where they do their fishing and in the summer months when the fish enter it, fish nets can be seen all the way down. (Nuiqsut) (BLM 1998c)

We go here near the Kuparuk River and here along the Kikiakrorak and Kogosukruk rivers. That’s where we go for furbearer hunting. If we don’t see anything we’ll go to White Hills. (SRB&A Nuiqsut Interview November 2005) (SRB&A 2010a)

[Speaking about the rivers he uses for subsistence hunting and fishing]: The principle one, of course, west of Colville that I used to pursue subsistence resources are Uglooktok (ph) River, Judy Creek and Fish Creek. Judy Creek. (Nuiqsut) (BLM 1998c)

What they said about fishing for whitefish at Kuukpik is true. While that is true, it is most true that another place where they fish for whitefish is Nuiqsaoruaq. You also know that from here all the way to the end of (?) those fishing for whitefish would fish from the frozen waters. (Nuiqsut) (BLM 1998c)

They'll go boating down towards the mouth of the river out to the delta at far as an hour out to the sea to get seals and things that are with animals or birds that are prevalent down there, but not old squaw ducks and those other little birds that were mentioned earlier. And sometimes when the route is good, they'll go to the Fish Creek and around -- and especially through the Nugaluk (ph) Channel for these things. (Nuiqsut) (BLM 1998c)

[The Teshekpuk area] has been used by subsistence hunters ever since he could remember. It's the area that when other areas within the close area of the villages like in Barrow, there's no game of any type, people usually go to the Teshekpuk area to harvest game that they don't have in the close proximity of various village. (Nuiqsut) (BLM 1998c)

Kowalski, Nageak, Obie (ph) all stated in the EIS that the Village of Nuiqsut hunt for fish and game at the Colville River. That is completely wrong because when the fish are there, all the way from where the boats are docking, that's down here. All the way down to the mouth of Nagaluk (ph) they put their nets. It's true that during the summer, that

(Inupiaq), they put nets there, yes, but for whitefish, this is -- this Nagaluk (ph) River is what they use the most. And then if they cannot do it there when the bay opens up, they go through the fish screen and use that area also for fishing. The Ulutuooh River which is really close from here and it bends like crazy like a snake, there's no fishing there. They don't I fish there. It's the Fish Creek area is what they use so everything that has been stated in that EIS is completely wrong. (Nuiqsut) (BLM 1998c)

Another thing that we have been given as the point that we can hunt for moose is the area at the mouth of Anaqtuuq. We have been told that we cannot hunt for moose past it. We cannot hunt past it, we've been told. When the residents of Nuiqsut begin hunting for moose, they are not able to get a moose right away and very often get a moose right at the end of the moose hunting season. The village of Nuiqsut is not like Barrow. When you live on the coast, like Barrow, there is a lot of game to catch. You don't have to travel very far either to catch it. That includes the geese, and seals, etc. But when you live inland, like Nuiqsut, you have to travel quite a distance to the coast to hunt...The hunting grounds extend all the way to Fish Creek. (Nuiqsut) (BLM 1998c)

For some reason our caribou on the west side didn't come. They wintered, summered, and wintered again in Wainwright. So the pattern is changing, maybe because of the industry is expanding and that's how we look at it. Because all this west side is undeveloped so why is that when you're supposed to be there, why aren't they? (Nuiqsut) (SRB&A 2014a)

To set our nets we have a tool that is a 15 –20 foot stick with a hook on the end. We cut through the first hole and then drop the hook with a weight attached. We move to the second hole and pull the rope using the tool in that hole; then move to next hole and pull the rope again, until all the holes have the rope connecting them. The net then gets pulled into the water and lies under the ice. Everyday we have to cut through the ice by hand to check the net; the thickness of ice is about 2 to 3 inches. This is all done in the cold, no tents and no warm-up shack. It takes one person 1 to 1.5 hours to perform this activity. The nets must be checked every day that takes about 20-40 minutes. Fifteen to 18 miles at 40 below and then finding one or two fish. It isn't fun after a while.

You can see the frustration; frustrated not only with industry, but the State and agencies, because, "How could this be happening to us?" We used to be a thriving fishing community. Now all of a sudden we get two to three cisco. It is very frustrating to an individual and as a family as well. You spend time and effort and money. The average family will set two nets, sometimes three nets to try to make up the loss of one net. It takes a lot of money to fish; prepare the snowmobile, buy gas and nets and you have to spend time away from your family and home. Our diet consists of 30-60% Arctic cisco. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

I just wanted to add in the 25 years I've been going to Fish Creek with my family and seen the caribous come and go, I've gone up the river all the way up to Judy Creek seeing caribou. I even got a couple of reindeer one summer and all these groups, even small groups, two or three, even larger ones, I've not once seen a collar on any one of them in the 25 years I've been hunting in that area and it scares me to think that the next generations with this GMT1 going up, are not going to be able to experience the good hunting that we have in the Fish Creek/Judy Creek area and I just wanted to say that now while I have a chance before this thing is over and I just hope you folks take that to heart if you have children or grandchildren, I would hope that you will listen to what's coming in the future. (Nuiqsut) (BLM 2014c)

Noise, Traffic, and Human Activity

They're too far out, too far from the rivers. Gotta be lucky [to get them] when they're migrating, but they never came through last year. Now they're over toward Atqasuk. There's none over there. People gone to Umiat and back around. Like I said they were at the dump for months. Traffic, when they start putting in all those ice roads, constantly going back and forth. The roads and stuff scare them off, the congestion and we have to go further to get caribou. Three years ago people were going 75 miles just to get caribou and that's ridiculous. Just the oil companies, the ice roads. I heard that's what's been keeping them away from town. Go back and forth on the ice roads, it's putting a hamper on it. Once the ice road gets built there's equipment and congestion, seems like they go further [the caribou]. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

Well, the wildlife, I think it's just the timing of the studies, the month of the studies has an impact. In the summer. Even the wildfowl notice, starting in May that's when they're really active doing their studies and that's a prime time when our local folks are trying to harvest their meat and they're being interfered by their summer activities. That's what it is. Just the changing of the pattern of their studies. (Nuiqsut) (SRB&A 2010b)

When I went camping last year, I waited 3 days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had overflights three times while trying to cut the harvest. It is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oil field. It went right over us three times. The herd was right there, and it put us at risk. I had my two young sons with me, and it made me very angry. What am I to do when the activities that have been handed down for thousands of years to our people are being changed by the global need for energy? (Mayor Rosemary Ahtuangaruak, USDOI, BLM, 2004) (Nuiqsut) (MMS 2007a)

That would be a lot of people if they built the road, like the haul road. The haul road [was] not supposed to be open but for commercial drivers. But now it's open for everybody. Every year they go back and forth. Trucks, cars, everything. [There are] more guide hunters. (Nuiqsut) (SRB&A Unpublished-b)

We experienced four years of no caribou with -- because of aircraft noise, mostly with helicopters and our migration - Western Arctic Herd that came from the south was diverted inland to where for four years, we had basically no caribou and the caribou that we had were… Real skinny, no fat caribou and it was four years, you know, even -- even we got so desperate for caribou meat, we had -- some people went up to Icy Cape, even myself, and also we went up to Wainwright just to harvest caribou. (Point Lay) (BLM 2014a)

*Caribou hunting I see a lot of helicopters going back and forth and might change the migration of the caribou. Last year I was out hunting for two weeks and only got four caribou because of them. I don't know what they were doing. I didn't make them out but all the caribou were gone. (*Barrow active harvester; Experience timeline: 2006; Experience location: by Meade River. SRB&A Interview 2007) (SRB&A 2009)

They claim that the caribou herd is healthy with numbers, but the only caribou I got last year was bad. Twenty caribou were harvested in October when we could access *areas not accessible by boat. Seventeen were sick. When I went camping last year, I waited three days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had overflights three times while trying to cut the harvest. It is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oilfield. It went right over us three times. The herd was right there and it put us at risk.* (Nuiqsut) (SRB&A 2003)

Last winter, nobody caught any caribou within 100 miles of this town because they were doing exploration on both sides of Teshekpuk and on the east side of Ikpikpuk. Last year, not a single one came through. They were all herded from the Ikpikpuk to Teshekpuk area toward Nuiqsut and Nuiqsut hunted them all winter. In Prudhoe Bay there was a union agreement that they could hunt wherever they used to - Nuiqsut - I'm using Nuiqsut as an example because they're right smack in the middle. This pristine land has been their hunting grounds. It starts from onshore and goes off. My dad was at Beechey Point. He was born there and grew up there. They used to pull up flounder and sole. The last time they tried that, 10 years ago, they hardly pulled up anything and they were very scarred and skinny. (Barrow active harvester; Experience timeline: 1996-2006; Experience location: Teshekpuk, Ikpikpuk, Wainwright, Atqasuk. SRB&A Interview 2007) (SRB&A 2009*)*

Don't follow the river. Because that is what they are doing. That is where the hunters are. That plane I wish and the chopper I wish they would reroute instead of following the river from Umiat. (Nuiqsut) (SRB&A 2010b)

It comes back to my whaling experience. Be quiet on the ice. No drilling on the ocean. It will affect us as hunter-gatherers. The noise drives the animals away. (Wainwright) (SRB&A 2009)

I heard they are always counting the caribou through helicopters. One time before Alpine had happened, they did a lot of caribou stuff by Piniqtuk and they noticed they used chopper and planes to scoot them away from the area where they planned to build Alpine. Then they say helicopters don't interfere with the migration. I think they always be together when they start coming in, the main herd that stay together. Then one lone caribou [makes it near Nuiqsut]. We always wait long time for caribou. Then July we're hungry because we got one in June, waiting for August. How we gonna get the meat from the store, it's expensive? $16 a steak. (Nuiqsut) (SRB&A 2010b)

[I] believe all of our caribou migration routes during the time that they are in their seasonal migration turn that those, those drill sites need to be turned off to allow our people to go out after them. Sometimes when you have too much loud noise during the caribou, they'll change their migration route and looking at the area of impact that our caribou are running through all that area I believe our caribou migration route should be protected. It needs to be logged and protected because of the decline in caribou. That's a resource that we use here every day on a yearly, we are every day, all year, 24/7. (Point Lay) (BLM 2019d)

Well the planes do come, but it don't scare them. No, the helicopters are the ones that scare the caribous. (Nuiqsut) (SRB&A 2015)

Hunting caribou; when we hunt caribou on the tundra where there are no trees, you've got to be very unobtrusive, there's nothing to hide behind. We were up at our camp, and *this has happened many times, were sneaking up on the caribou, and over a hill, bingo, there comes a helicopter; there goes the caribou. Same place, different time we went up there. There are signs all around that the caribou were there, but then there are ruts, deep tracked ruts in the ground where there have been vehicles, tracked vehicles. Caribou don't go where they've been chased out of. Over a couple of years, they change their activities. Same area, they have restrictions on activities, and some drivers didn't follow there where they were supposed to, and some broke through the river and spilled oil and left various foreign objects and never cleaned it up. That's part of why there's no fish there. About this time of year we'll take off on our snow machines and go wolverine and wolf hunting. Where do we go hunting? We go right here at Cape Simpson but there aren't going to be any out there. And what about all the money and time it takes to do this? I'm debating if it's even worthwhile.* (Barrow active harvester; Experience timeline: Since 2000 and ongoing; Experience location: Chipp 6. SRB&A Interview 2007) (SRB&A 2009)

These caribou been so far out, so I started using four-wheeler [to hunt]. All these caribou start being away from the river. Last year, every time there's caribou, [they are]
away from the Colville River, about five to six miles. Some are close to the river sometimes....We got a cabin down here and caribou are way, way out here instead of close to the river. There's too much traffic. Airborne [traffic] is one of the problems we had. That really affects our hunting. (Nuiqsut) (SRB&A 2010b)

[I caught] less [caribou compared to the previous year], same thing – [it was difficult to hunt] with the helicopters and low flying planes. And there's actually rolligons that go, when we go up and Puviksuk there's one really big hill and we could see a whole bunch of rolligon trails. There were hardly any [caribou] up there. (Nuiqsut) (SRB&A 2014a)

Where the hunters are going out 30 miles to get caribou and a chopper that's doing study of the area tested by the industry, that industry will not take terms or responsibility for that impact. The State of Alaska, same thing, as well as the federal government. There are no mitigation impacts to these hunters, so therefore, you have a diverted caribou as well very interfered and upset hunters. It's been like this for many years. (Nuiqsut) (BLM 2004d)

Like I said I wasn't having any luck in this area [near Fish Creek]. I think it is because they were looking at GMT1 [surveying the area]. I got satellite collar imagery, and it is really familiar to – the caribou avoided the GMT1 area. They went around, it is because they are doing a lot of surveys over there. Helicopters. I've seen a lot of choppers inside Fish Creek. I ran into BLM out there. [The exploration around] GMT1 and Fish Creek are diverting the herd around their proposed development. The caribou are going south. A lot more activity this year, close to 1,100 Conoco Phillips helicopter flights. If you take a look a Cassin 6 and Cassin 1, those are wells, there is a big resemblance as to how and where the caribous are going. It has gotten worse. I can see with the caribou are not coming into this area. During the summer Conoco did a lot of studies over there. The wells, hydrology, UAF [University of Alaska – Fairbanks] is down there at Fish Creek, studying the fish. (Nuiqsut) (SRB&A 2015)

It was sort of like different from last year, for some reason they decided to go towards west side Harrison Bay area. That's what happens when they were being crowded by planes and helicopters. I think they [industry] are starting to understand that during *the migration of caribou, they're staying away [from those areas]. That was some difference we finally saw. Maybe that's the reason they [caribou] start coming through town.* (Nuiqsut) (SRB&A 2015)

Also the helicopters – they are scaring off the caribou. We had to call the people around here and tell them to hold off the flight. They are always flying their helicopters around here [west of Nigliq, around the CDs]. I don't know [what they are doing] but they are from Alpine. Always out there from – well, out there year round. Well, summer time is the worst. They get water samples and stuff, and when it comes June for breakup, they always want to get water samples rushing from the rivers. It's already broken up and too much water. They always try and let the residents make money by guiding [them to those areas] but there is no way to get out there [poor conditions]. Planes weren't the issue this year for me, just helicopters. It was really affecting other hunters. (Nuiqsut) (SRB&A 2015)

Helicopter traffic. There was a herd that was coming from the east side going west and we were at our cabin on Nigliq Channel and when the caribou were coming in [closer to the cabin], a chopper flew over them and turned them around. At that time we were hunting for the blanket toss. Just when they were coming towards us, a chopper flew up and went straight towards the caribou. It was a blue and white one. My uncle was angry; he called them. He was so upset. It went right straight towards the caribou and it turned them around. That was in June. Just mostly helicopters. This year there was a lot of them. My uncle was sure mad when those got diverted. That chopper pilot knew it too. No they didn't care. No regards. A lot of people talk about that. Town folk say a lot that the chopper activity was really bad. (Nuiqsut) (SRB&A 2015)

They [oil company personnel] are all on this side of the river. If they put CD5 there it would be a big problem. That is right around the area that we hunt. (Nuiqsut) (SRB&A 2015)

I didn't notice at Fish Creek actually surveyors but they were walking. And they were just being picked up by helicopter at the end of the day those surveyors walk a good 30 miles a day. I see some people walking over there. A lot continuously all summer. (Nuiqsut) (SRB&A 2015)

A lot [of traffic] continuously – all summer long. It's the surveyors. They're surveyors out there. I don't know who they are, but all summer long they're just there. I think they're the ones – I don't remember the color – but I think it's the same helicopter that takes off and lands at Alpine all the time, but they're dropping off these equipment for surveying and bridge planning – whatever they're planning – to make these bridges for these roads. Basically at Miluveach, they're really utilizing that area to drop [supplies] off. They just so happen to utilize the area where the caribou are. Wherever they're setting their camps and drill sites is the best route [for the caribou]. When these animals travel, they travel on the lowest slopes possible and the most level, and where these people want to drill just so happen to be on a [migration] route. Right at the creek, and this is a flat area. You can see clearly for at least four miles; it's so flat, you can see as far as you want – but they basically use these two mounds for grazing areas; they're the feeding grounds, and when the disturbance comes they force them to go to Pisiktagvik and then Alpine. The helicopters are flying from Northstar to there. And from Oliktok to Northstar Island, the offshore drill rig. Every time that helicopter came in they just scare them around and the caribou move to where they left. (Nuiqsut) (SRB&A 2015)

I grew up as a hunter. I knew, back in the mid-40s there was not that much game at that time. In the late 40s the caribou showed up, so that's what we hunted. In Pt. Lay we did not hunt whales. The caribou would be real close, two to three miles. They'd come from the south and go north. Throughout the 50s it was good. People didn't have to worry. Going into the 70s and 80s, that's when we noticed the pattern of the caribou had changed. They came from the North. They went further inland. It wasn't just oil, but more snow machines. I think a lot of it is our own fault. We were always told not to shoot the first group that came through. Any disturbance to the first herd, whether it's hunting, snow machines, or any kind of activities, the first part of the herd determines where they go. I know this. We cannot force the animals to change their path. Not just the caribou. We hunt beluga by Pt. Lay. If we make too much noise, my dad says we should wait for them, instead of looking for them. The outboards will change their path until they get by Icy Pt. I strongly believe any kind of disturbance will change the animals' ways. The animals know when they travel year after year, where to avoid. The beluga, caribou, ugruk. If you disturb the first bunch, you can bet there will be hardly any ugruk. When the barges go through, they make a lot of noise. When the DEW lines first came in there were a lot of barges. We couldn't hunt beluga there. We had to go 30 miles south. We know now if there's no disturbance we should just wait for them. (Wainwright) (SRB&A 2009)

Now for the trapping people that are here -- where they make their livelihood -- they're going to not be able to trap at all in those areas that are designated for exploration. We know this for a fact because we're not able to trap around Prudhoe or any areas now being explored. Raymond Neakok. (Utqiaġvik) (BLM 1982)

It takes a long time for the tundra to grow all the way back. It will leave a mark. That is why they invented the rollogons to try and avoid the tundra damage. The rollogons will leave a mark in the tundra after the snow melts. (Nuiqsut) (SRB&A Unpublished-b)

I would say so [that TAPS has made subsistence more difficult], I have heard it mentioned from other elders and my grandparents. The people and the wildlife being displaces. Historically the Kuukpik people were nomadic along the coastlines. From the Brooks Range to the coast and east to west. We are settled now. We are here. We have the village here. Some of the campsites. I have heard of a couple of elders who were born in the Prudhoe Bay area. They grew up there and were raised there and tried to get allotments and somehow there was trouble with them doing that. Staking claim to those areas. I know that there is at least a family to two that tried that. I don't know if they were successful. Here I mean people aren't used to staking claims for their area. Game was everywhere. There would be 100 families who would harvest. You didn't need permission from my neighbor. You could camp and fish where you wanted. It was shared land, shared waters. Now we have to stake claim and tell people when they are trespassing. We still do that today; a lot of our campsites are shared. No one is ever really denied. (Nuiqsut) (SRB&A Unpublished-b)

Infrastructure

Pipeline has really changed our caribou hunting because Porcupine Herd used to cross the river, cross the road this way and come out to our Anaktuvuk and Anaktuvuk Valley from east, it doesn't happen no more. Once they build a road up here from -- from Alpine area to -- all the way across to NPR-A, once they build a road it's going to change the *subsistence just like every one of those coastal villages, if they build a road that's going to change their subsistence.* (Anaktuvuk Pass) (BLM 2003c)

Pipelines; we have seen caribou turn back from pipelines because they [caribou] see a flash from the pipeline. They used to go to Helmericks' in the thousands, not any more. Maybe two or three or less. Especially females with young used to go down there. Westside at Kugaruk, Harrison Bay, there are caribou there. You always see them. We had to go out to the ocean and to Kugaruk to catch them. (Wainwright) (SRB&A 2009)

That migration pattern has gone southward. We hardly see the western herd this year. The Porcupine Herd, haven't seen them lately. We used to see thousands of Porcupine Herd coming through the villages, but we haven't seen those for a number of years and since that pipeline was built, that changed the pattern of the migration of the caribou. [We are] mostly harvesting caribou from Western or Central Herd. (Point Lay) (SRB&A 2014b)

The impact I would say would be the infrastructure. Caribou they like the pads because it is a sanctuary. They know they are not getting shot or hunted there. We spent a whole day just waiting on them to [cross over]. Right in Nanuq area. Some scattered caribou and wasn't large or significant. Three there, four there, one there, what have you. (Nuiqsut) (SRB&A 2014a)

I want to elaborate on ice roads that are used to connect ice pads. There were two pads that blocked the route to Kuupik from Oliktok to Amoniktuk through July. Usually these pads are completely melted and we can hunt seals. Generally we can take our boats and go across our hunting grounds but with this big iceberg in our way, we had to work our way around. Usually we have complete boat access at the beginning of July. Also when the cost of gas was $4.00, we used to go by 4x4 in order to travel to Oliktok to buy cheaper gas. When construction was taking place, they would push the snow into the roads that we traveled making it more difficult to travel. Within the Nigliq Channel we had to follow 7 to 11 miles of ice when we went out seal hunting. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

You present the socioeconomic aspects and the connection to subsistence, which they really understand and which I dealt with during my terms as mayor here sometime back. So I think, no question, helicopters, air traffic is the biggest disruption. So it seems almost like a no-brainer to be in support of the road project there and by the way, that spur road for Nuiqsut that Kuukpik had been -- their company had been working on was just permitted here a day or two ago. So that's what the community wants and I just want to echo and support their desire to be able to live off the land, considering development is all around them. (Utqiaġvik) (BLM 2014b)

Before I would go east of here but there is so much activity going on that I don't hunt that way anymore. Occasionally if I miss one I don't want a stray [bullet] going that way. We are allowed but most people don't hunt up there. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

While I -- you know, there could be impacts on wildlife through the area. I kind of repeat that the major impact will probably be on people. As you can look at the map, Nuiqsut is nearly completely -- will be completely nearly boxed in with the completion of this project. There's a huge area to the east that they don't use to hunt in any more because of all the development over there. The Alpine development interferes with people going *north. The first two satellites that will be put in will only make this worse; it will further interfere with people trying to go to the north and the later developments will kind of block them off to the west. So that doesn't leave them many more options, particularly if there are, you know, more satellite fields out there after these ones are developed.* (Nuiqsut) (BLM 2003b)

...it's to look at what happened in Ukudu (ph) Bay in Kuparuk because that is a cumulative impact. The people of Nuiqsut don't use that area like they did in the past. And, you know, there is research that shows that. And what's happened there is going to happen here. So the people who use that area are fearful of that. So that is going to be an impact to all of us. You know, whether industry is very -- you know, you try to do it the right way, people aren't going to want to go hunting there. You might have access or the right to go hunting there but it's not -- you know, it's not going to be a favorable place because you let -- how many people from Nuiqsut want to go back and hunt in Kuparuk with all the pipeline, the roads, or go fishing near Alpine? You know, it's not a preferred place to go. And that's exactly what's going to happen in this area as well as -- the more it moves to the left, it's going to happen. And people are nervous about that, you know? People are. I hear people say, you know, I'm going to go out now before industry comes and enjoy it as much as they can before it comes to our area. So that, you know, I see that as something I want to have on record. (Utqiaġvik) (BLM 2004f)

We're getting to go further and further to catch caribou. Because their route has changed. They're not in our backyard. Now I have to go to other communities' backyards, like Anaktuvuk, Atqasuk and Barrow. Caribou you have to go out further because of seismic testing, helicopters, small aircraft. They'll be flying those choppers again. They'll be doing it soon when they gather information like when the ice goes out or when they haul their contractors out. This scares the caribou. What happens when the belt breaks on your snow machine? I walked 10 hours home once. (Nuiqsut active harvester; Experience timeline: since 2001 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009*)*

Yeah, we can't go near the pipeline. You can't shoot near the pipeline. That's restrictive to the hunters. They always warn us not to shoot toward the pipeline or cross under the pipeline. So if the caribou are on the other side, they don't want us to go near it. You have to get permission from Conoco Phillips to go there. (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)

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The pipeline. They say we can’t hunt near the pipeline; most of the caribou are near the pipeline. We can’t hunt with a certain miles of the pipeline. I think it’s around here. We went through but they say if we catch caribou in there and get caught they’d give us a fine. (Nuiqsut) (SRB&A 2010b)

If they start making pipelines on land, we have to go twice as far. It's scary. It's an obstacle to us. (Barrow active harvester; Experience timeline: 2006; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

They're too far out, too far from the rivers. Gotta be lucky [to get them] when they're migrating, but they never came through last year. Now they're over toward Atqasuk. There's none over there. People gone to Umiat and back around. Like I said they were at the dump for months. Traffic, when they start putting in all those ice roads, constantly going back and forth. The roads and stuff scare them off, the congestion and we have to go further to get caribou. Three years ago people were going 75 miles just to get caribou and that's ridiculous. Just the oil companies, the ice roads. I heard that's what's been keeping them away from town. Go back and forth on the ice roads, it's putting a hamper on it. Once the ice road gets built there's equipment and congestion, seems like they go further [the caribou]. (Nuiqsut) (SRB&A 2010b)

Actually, with the Meltwater road on there, the caribou are getting lost. They don't know where the migration route is. We've got the Prudhoe roads over there, but the Meltwater comes farther down, and in the caribou's mind, where's the direction? We used to have the caribou coming into town, the migratory route [used to] come in, but now they don't do that anymore. (Nuiqsut) (SRB&A 2014a)

Although we will benefit for our economics, but we will benefit very little for our subsistence because of the pipeline and because it will up affect the caribou migration, it will displace -- may displace some of the nesting areas of the waterfowl, shoreline birds, that she mentioned from Cape Halkett around the Harrison Bay to Fish Creek and the Colville River delta. (Nuiqsut) (BLM 1998c)

Another area that is no longer accessible is Uuliktuq. Last fall because ARCO made Uuliktuq inaccessible, it took over one week to haul two whales back at Cross Island. That has made things very difficult for us. As a result they were brought back through a big aircraft. Uuliktuq had always been a place where our people left their boats after whaling because of the ice that usually formed making it impossible to return by boat. That is why they left their boats at Uuliktuq. Last fall they did bring their boats back. Where are they going to leave their boats from now on if they are not permitted to use Uuliktuq which had always been used? Right now the way it is, they cannot leave their boats at Uuliktuq. (Nuiqsut) (BLM 1998c)

I've traveled the haul road in the fall time the last three years, and I see more and more outside hunters. When I say outside I mean non-North Slope residents. The caribou seem to be less since that's happening. (Nuiqsut) (SRB&A 2013c)

With the ice road and the diesel, when they make a road, it goes through the land. I know they try to be careful, but the land is ruined. (Barrow active harvester; Experience timeline: since 2000 and ongoing; Experience location: Around Barrow area; Ualiqpaa. SRB&A Interview 2007) (SRB&A 2009)

Within the city of Nuiqsut you see all the activity of Alpine. The caribou migration has really changed over the last two decades. Our subsistence users have to go further for waterfowl and caribou. We've experienced this both on and offshore. Development really affects our wildlife. Our subsistence users have really had to change the last two decades. Much further to go for harvest. (Nuiqsut active harvester; Experience timeline: 1987 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

And the ice road does. When they melt and all the snow is gone you will see the grass and it is dead and flat. I have no idea why… Probably no oxygen getting to the ground *because of the ice… I think it must be from the weight of the ice too. It is heavier than snow and the trucks add pressure to the ground.* (Nuiqsut) (SRB&A Unpublished-b)

… I think the gravel they have added on the tundra causes early thawing. But it is insulated by the gravel. At some point the gravel can sink and during the summer when it is hotter. She can only talk about Beechey point. She is going to give the young men a chance to talk about these topics. (Nuiqsut) (SRB&A Unpublished-b)

Contamination

They can leak and you don't see that until summer. The caribou then eats the moss. You won't know they're sick until you eat them and they taste funny. I tried to go caribou hunting and there was a pipeline. I had to use twice as much gas to go around it. (Barrow active harvester; Experience timeline: 2006; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

On- and offshore development are different. Onshore there is less chance for contamination because they can control it. We can live with it onshore and work around its effects on our seasonal activities. Offshore it is a hostile environment with moving ice and heavy seasons. It is very risky. If they invade our hunting grounds, that is not acceptable to us because of the risk. (Utqiaġvik) (EDAW Inc. et al. 2008)

I try not to hunt on Nigliq because a couple of them [caribou] hanging around CD4 have been sick – got pussy lungs and liver. They're abnormal. [Used to hunt near CD4] and every time I made my catch between here and Nigliq it was a sick one. (Nuiqsut) (SRB&A 2015)

Yeah, all of the caribou migrated through there. When I was a young man, I would wait for them there [near Fish Creek] with my uncle. Uncle used to say you go right at that point meaning at Nigliq. Used to be they migrated… even to Teshekpuk Lake. You know the caribou calving grounds, north of Teshekpuk… caribou kind of roam, up to the Brooks Range, up to Wainwright, this is the western herd…This is something else too. My own personal view is it because of the lights from the structures, the oil field infrastructure, and the smell. The smell from Prudhoe Bay, you notice with the haze that comes in. Those caribou have a good sense of smell. (Nuiqsut) (SRB&A 2015)

With the ice road and the diesel. When they make a road, it goes through the land. I know they try to be careful, but the land is ruined. The tundra is affected which affects the wildlife. When I've hunted caribou and am skinning them, I've noticed the meat is yellow. I've had to leave it there. It was due to the mosquitoes or to contamination. Sometimes the mosquitoes are so bad there are nests under the skin of the caribou which turns the meat yellow. (Barrow active harvester; Experience timeline: since 2000 and ongoing; Experience location: Around Barrow area; Ualiqpaa (Walakpa). SRB&A Interview 2007) (SRB&A 2009)

And the only biggest problem I have with that is you have 3 million gallons of gray water you dump on the ground now. And when you look at 3 million gallons of, you know, sewage and dish wash water, and you leave it on the ground, it gets pretty dangerous for the fish. The ground is very flat. We live in a flat ground and all the water that is put on top of the surface goes to the rivers. It works its way to the rivers and to the lakes. When I was young and being taught how to fish by my uncle up at the Chipp River, one time one of us washed our hands in the dish wash basin with soapy water *and we went down to the river and rinsed our hands in the river and for 24 hours we never got fish in our nets that day just from rinsing our hands in the river. That's how sensitive that Aanaaklliq that we catch, that white fish we eat. And you're looking at dumping 3 million gallons of gray water on the ground?* (Utqiaġvik) (BLM 2004c)

As you all know we've had pollution that's been identified and that needs to be cleaned up, in part of the NPR-A I here's a rare potential pollution contaminating material that were buried by the Air Force, needs to be considered looking at too, the possibility of me whole Colville, cause of that possible of effecting all of our species, there's been some areas, you probably heard a couple, last year, they had found pretty close to over 30 moose carcasses that were unknown causes of death. And I'm kind of wondering if it's coming from that contaminated site. And these are some of the issues that need to be clarified before the proposed NPR-A lease. (Nuiqsut) (BLM 1997b)

The first cat train in the 1940s, from Barrow to Oliktok, they did not open drums with a bung wrench but with an axe; they pumped what they needed and just left them in the river or lake. That was how they worked when they first came here. (Nuiqsut) (ABR Inc. et al. 2007)

The ice trail they have is only one mile from our cabin and it goes over the river we fish in. That might be an impact for the summer. Lots of trash and traffic. We know which way the trail goes. We see it while we go for caribou. We see more trash on their trail. I've written to the Borough and BLM about it. Their rollagon trail from Barrow. In the summer it leaves marks even though they say it doesn't. After the snow melts you can see where they've been. They say there's no impact, but there is. (Barrow active harvester; Experience timeline: current; Experience location: Ice road from Barrow. SRB&A Interview 2007) (SRB&A 2009)

There are small creeks that tend to develop from an area where there's development. It gets higher, and from that high area, the small creeks tend to go toward the bigger river. And from the bigger river, out into the ocean. And one of the things he's concerned with -- that the water that the animals drink, the caribou and the foxes, the wolves, those that are on land -- if that water is polluted, the effect on the animals would be such that it would affect the lifestyle of the North Slope people. (Utqiaġvik) (BLM 1982)

And, this waste material that has accumulated, is quite a bit. We've seen too many caribous that have wires on their antlers. Some of them just die because they just happen to have a couple of them right around their feet our their legs, and a doggone leg drops off. I mean, these are the waste materials that we would like to be protected from as human beings and also for our animals which can not protect themselves. (Utqiaġvik) (BLM 1982)

One drum diesel, five gallon motor gas, they were floating down the river. Some changes in the 40s and 50s, there were lots [of changes]from the Navy explorations. Some of the buoys were left behind before they clean up that area. The caribou changed, and everything changed with the caribou. Notice that, I trace changes back to that. That's what I know happened. From Umiat. I think it was 15 years ago [drums floating down the river]. They been cleaning up slowly, but they're still out there. (Nuiqsut) (SRB&A 2010b)

I don't know how many more sites inside the NPRA that you guys have but if you're going to be doing any kind of oil and gas those sites need to be cleaned so that they can *be used later because those were original migration routes and this happened what, maybe seventy, seventy years ago, fifty to seventy years ago and they are still not cleaned up. There's still nothing done there. Um, when I traveled out that way maybe 2012, 2013 or 2012 there was a like a rut from barrels that were dumped there. I know that we're not part of the National Petroleum Reserve and we are looking for a water source. We cannot use these. This being one that we have because it had old metal and stuff dumped into it. I know that our waterways run all the way into this reserve and so Lapita is right. We need to be able to have these lakes open and protected for the water source.* (Point Lay) (BLM 2019b)

In a sense, they feel like the oil companies are coming freely without rules or regulations guiding them, in a sense. These are things that were happening in state lands and one of the things that they saw the change in the environment was the development when they started going up toward Umiat to do their hunting in the summer and the fall time, they noticed that there was a lot of drums along the shoreline of the river that were floating down and sometimes, if they -- they found drums of fuel, diesel, white gas, gallons of -- one gallon and five gallons and this wasn't happening in just one season. It was a lot of things that were floating down and they think it was from Umiat because they started falling into the river from the oil -- whatever they did back in Umiat and I think they did a lot of things within that area. (Nuiqsut) (BLM 2014c)

Bilge water, that's a concern. We're totally against [drilling fluids]. Deck drainages, we're not that concerned about that. Blowout preventer fluid. When they were doing the Louisiana thing, it was a mud that thickened. All of this is alien to the area. I've heard horror stories about bilge water because it has other life in it. (Point Lay) (SRB&A 2011a)

That's going to be a massive problem, what they're putting back in the water after it's treated. Chlorine and caustic soda. They say it won't affect the water, but they don't know that. It removes the oxygen. What it does it kills the oxygen in the water, in the bottom. (Point Lay) (SRB&A 2011a)

If they're discharging, then let them look around first. There's always ugruks and seals that are curious and pop up to see what you're doing. A couple of ugruks keep popping up around us down at Omalik just to see what we're up to. We had four of them come up right next to the boat. I heard breathing and they went down. (Point Lay) (SRB&A 2011a)

Through krill and other small species, then to work their way up to larger species over time. Well the main thing I'm worried about is the krill and the small species. I'm not sure if that mud is going to be killing them off or poisoning them. Maybe they'll start feeding on the small particles on the mud that's being discharged. (Point Lay) (SRB&A 2011a)

We will have meetings and it doesn't change anything. Like at Umiat, they assumed 40 years ago that what we didn't know wouldn't hurt us but now it is all spilling out of the ground. (Nuiqsut) (SRB&A Unpublished-b)

Non-Oil and Gas Impacts

Fish and Game regulations don't help us. Moose season is too late so we can't get our boats upriver before freezeup. Guides and sport hunters from Fairbanks can fly in and *get the moose we need for meat, especially now that we can't get enough caribou.* (Nuiqsut) (Brown 1979)

Once in a while we get these private planes or…other people from the other major hubs flying up here and taking the scenery route, doing something, taking pictures I guess. Those ones we can't stop. They don't get out, because they're, they're just somebody who owns their own Cub and just go take a joy ride up here. But we try to tell the airlines and everybody in North Slope Borough to help us printing those ads, just like to the airplanes or the helicopters. They need to start honoring that no fly zone. (Point Lay) (Braem et al. 2017)

[There is] less of a migration every year, because of those guide folks over there. I think there are two or three guide folks, and they are starting to [hunt] over toward the Galbraith [Lake] area, and sometimes [they go] to Shainin Lake with float planes. So if the caribou are coming from the pipeline area, as soon as they come down the hill they shoot them, and send [the second group] over in another direction. A few might come [toward the village], but most end up in the western area. Some [caribou] might [make it to the village], but there are less than eight years ago when we had assistance from Wainwright and Nuiqsut. The North Slope Borough chartered an airplane to get caribou down here; we had maybe 30 caribou for the whole community. Some years it gets to be that way…. Sometimes it would be super smoky, you can't see the mountains, and it plugs up the area. When [the smoke] gets just above the mountains caribou don't like [it]; I don't blame it all on guide folks. When there's forest fire smoke [the caribou] go [somewhere else]. It's always been smoky here. (Anaktuvuk Pass) (SRB&A 2013c)

Sportshunters. As a hunter we're already there to harvest game. Caribou may be coming toward us, and helicopters or small planes with sport hunters fly in and divert the caribou from their normal routes. They use our cabins; help themselves; then they hunt the caribou and don't take the meat or the skin - only the trophy rack they want. It's going to have an impact over time if they keep it up. If they were limited to maybe 10 a year (now they're taking 40 to 50 [total] caribou a year) it would be devastating! I provide for a lot of families, elders and widows, etc. Since the state allowed sport hunting we're fighting for our rights. We need bag limits to keep below the harvest threshold. We need to set a certain limit -- do drawings on caribou hunts like they do on bears. With sports hunters it's an attitude of have at it -- sport hunters don't have to deal with our extreme environment and over harvest resources we've preserved for thousands of years. (Barrow active harvester; Experience timeline: 1997 and ongoing; Experience location: Hunting areas on the North Slope. SRB&A Interview 2007) (SRB&A 2009)

You know, that's— but that Haul Road is open to public, so there's so much hunters over there. Now the caribou herd comes straight from over there and I don't see them. Like Porcupine Herd that used to cross, now they make separate herd, Western Herd. We depend on Western Herd and Central Herd through fall time. Western Herd we depend on, but I heard they are decreasing now. 400,000 to 200,000. We are not the only hunters. There are so many hunters to the north of us. It is open to the public. But we can't control it anyway. But we do depend on the fall caribou herds. They used to come right through our valleys. I hardly see them anymore. Now they go 30 miles west of us, maybe same distance on pipeline over there. Anyway, I wanted to bring that up. I subsisted hunt all my life. We still depend on caribou herds, but when I say that, it also—airlines, there is no road here, only airlines come through here. So everything comes through the air. Very expensive. I save too much time at meetings... If you had to *pay, that's what I witness. I have to pay $10 or more a gallon for gas, $21 for a quart of oil. Some young people or some people don't have a job. They can't afford it. White gas, $11-$15 a gallon. People don't have no job. It is hard for them. You know, I just want to bring that up. I witness that.* (Anaktuvuk Pass) (BLM 2018a)

Sportshunters. As a hunter we're already there to harvest game. Caribou may be coming toward us, and helicopters or small planes with sport hunters fly in and divert the caribou from their normal routes. They use our cabins; help themselves; then they hunt the caribou and don't take the meat or the skin - only the trophy rack they want. It's going to have an impact over time if they keep it up. If they were limited to maybe 10 a year (now they're taking 40 to 50 [total] caribou a year) it would be devastating! I provide for a lot of families, elders and widows, etc. Since the state allowed sport hunting we're fighting for our rights. We need bag limits to keep below the harvest threshold. We need to set a certain limit -- do drawings on caribou hunts like they do on bears. With sports hunters it's an attitude of "have at it" -- sport hunters don't have to deal with our extreme environment and over harvest resources we've preserved for thousands of years. (Barrow active harvester; Experience timeline: 1997 and ongoing; Experience location: Hunting areas on the North Slope. SRB&A Interview 2007) (SRB&A 2009)

What I've noticed over the years, you know, we were taught by our elders to let the first herd go, the first bunch needs to go to make the path. Nowadays, once they hear about caribou, boats go out and they shoot whatever comes through. So we're kind of losing our -- what our elders have taught us to do. Some of our young hunters aren't allowing the herds to go through like they're supposed to and we can't force them. We can only tell them. (Nuiqsut) (BLM 2014c)

[I noticed] campers out there – other people, not local. Most people seen them with their loud jet boats and stuff. It was upriver somewhere, past Ocean Point, by Chandler. Like, I don't know how many miles, but somewhere around there, because when we were camping they were right there. Lot of noise, you could see caribou out there scouting on the hills, so they could hear the noise. The jet motor was loud as heck, definitely scared like three caribous away. (Nuiqsut) (SRB&A 2014a)

[There are] more activities. Planes [travel]back and forth [in the] springtime and summertime. That's when the people are hunting from the plane. [They come] from [the] Bettles area. [There is an] airstrip about 25 miles [away] and [people illegally] catch [caribou] down [near] Bettles. I called down Bettles and said "watch out for that plane, it's got [illegally caught] caribou". [There are] more guide hunters down there now, about 15, 20 miles towards Galbraith[Lake]. It's a long time [that they've been doing it]. They gave them permission to do it down there. We hate them though. They give out permits to make money. What do we get? Nothing. (Anaktuvuk Pass) (SRB&A Unpublished-a)

Legal or Regulatory Barriers

My concern is stray bullets. When I'm out subsistence hunting, I'm used to having a 50 mile area to myself. If there are 10 to 15 people in that area, that is crowded. I don't want to accidentally shoot someone. What if there are people on the other side of the hill and I don't see them? (Barrow active harvester; Experience timeline: 1990s; Experience location: Chipp River area. SRB&A Interview 2007) (SRB&A 2009)

Winter time we'd go toward the west side, because the caribou are coming in from the west, so over by Fish Creek. We'd be on the west side. All the way back to Fish Creek. The caribou come in from the west. The caribous are coming west from the coast to here and out in the Fish Creek, CD5 area. Caribou hunting in this area is tough, because most of these areas [north and west] are closed. You have to have a permit to go on CD4, Alpine area, so we go more on the west side. [We start hunting by snowmachine] winter time, somewhere around November. (Nuiqsut) (SRB&A 2016)

In addition, despite the relatively benign impact of the TAPS itself, there have been negative impacts that are not associated with TAPS operations along the Right of Way such as stressed public services and sport hunting pressure. The Borough is saddled with some of the TAPS corridor public services and the Mayor went into great length in describing these. Providing these services in a remote area that is devoid of permanent Borough residents is costly and difficult in times of shrinking Borough revenues. And when it succeeds in delivering these services, it seems only that it increases the influx of outside visitors traveling along the Haul Road who need even more support. So this is an undesirable feedback, effect, the more support we give to the Haul Road corridor, the more people use it, the more people who use it the more support they need. In addition, some visitors use the Dalton Highway and the associated airstrips to exert sportshunting pressure and produce other negative impacts that are not associated with TAPS operations. (Utqiaġvik) (BLM 2002)

We were able to hunt where the pipelines are and stuff. But now it's all built around there and our hunting lands is being diminished because of the pipeline then the oil field productions that are being up. And now I can't even go hunting over there 'cause I don't want to get in trouble for hunting near pipelines or where people are working. And even though there's caribou or animals around there, which I know I can go get, I don't go around those areas. (Nuiqsut) (Brown et al. 2016)

Beyond the dangers associated with the Haul Road travel are impacts to subsistence can be linked to that highway. While by comparison under normal operating conditions, the pipeline's impact are somewhat constant and manageable. The impacts of the Haul Road are largely dependent on traffic levels. More traffic generally means more impact on wildlife and to the North Slope residents. Since the opening of the Haul Road to the public subsistence hunters in Anaktuvuk Pass and Nuiqsut have noticed a decrease in the availability of caribou near their villages. Sport hunters and game guides using aircraft and off road vehicles cache supplies and use the road as a jumping off point to reach vast areas of the North Slope traditionally utilized only for subsistence by these and other communities. Competition for resources, disruption of subsistence activities and non-subsistence hunting practices which deflect animals from traditional subsistence harvest areas are a major concern. Without mitigation, these impacts will sure increase with the increasing traffic on that road. This is a very serious concern for those residents and more focus should be placed on scientific study and mitigation measures to address the village concerns. The village concerns of Nuiqsut and Anaktuvuk Pass. (Utqiaġvik) (BLM 2002)

Another big concern I have about any of the Plans is, if you build an industrial road within NPR-A, people are going to find a way to use it. You look at the Dalton Highway; when that was first built that was an industrial road and it was only going to be used for industrial purposes. Today it's a public road. And we have issues there where people -- we have competition for resources: sport hunters, recreational people, tourism, all that stuff is happening. And they want to even make it more accessible for people to *hunt from that road. And if you build a road into NPR-A, people are going to come. Whether they say it's an NPR-A -- or an industrial- only, it's going to change. I just know it is because that's what happened in the past with the Dalton Highway.* (Utqiaġvik) (BLM 2004a)

Yeah right now it is difficult to go to Alpine because they have a buffer zone in that area where we can't enter within two miles of buffer zone and that impact the hunters too. Most of the time they used to be a lot of caribou towards Alpine but that has changed a lot. Too many [regulations]. (Nuiqsut) (SRB&A 2014a)

Safety/Security Concerns

Yes, [ice road activity] affects me. It makes me nervous at the same time. I don't like to shoot my rifle towards this. There's an ice road southwest toward CD5; that makes me nervous. I know there's traffic out there. I don't like to shoot my rifle toward southwest and even if I try to shoot that caribou, pointing my rifle toward southwest there's traffic, caribous, tracks, rolligons, you name it, it's out there. That scares me, makes me nervous. I always thinking about shooting my rifle northeast because there's less traffic. More traffic going southwest. On facing southwest there's more traffic. That make me nervous, super. There's people out there just traveling. They're walking sometimes, doing seismic. October, November, December. Rolligon, cat train. I look with my binoculars and see people walking. (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)

And a lot of caribou this year was towards the Alpine side so I couldn't shoot or anything because the drill rigs and the pipeline there were very few on this side….I just don't shoot towards the pipeline. I'm not taking that kind of risk. (Nuiqsut) (SRB&A 2010b)

We don't go down that way to caribou hunt because of the pipeline in there; it is a big obstruction. A lot of times they [caribou] are on the pipeline side and we don't shoot. They [industry] tell us it is OK to shoot, but common sense says not to shoot into pipeline! (S.R. Braund and Assocs., 2003, Field Interviews, USDOI, BLM, 2004) (Nuiqsut) (MMS 2007a)

Yeah right now it is difficult to go to Alpine because they have a buffer zone in that area where we can't enter within two miles of buffer zone and that impact the hunters too. Most of the time they used to be a lot of caribou towards Alpine but that has changed a lot. Too many [regulations]. (Nuiqsut) (SRB&A 2014a)

We get these fliers in the mail about Alpine safety and it talks about using firearms around pipelines and all that other stuff. ConocoPhillips is always stressing that, so it kind of scares us off a little bit. I don't go over there [toward Alpine]. (Nuiqsut) (SRB&A 2014a)

My concern is stray bullets. When I'm out subsistence hunting, I'm used to having a 50 mile area to myself. If there are 10 to 15 people in that area, that is crowded. I don't want to accidentally shoot someone. What if there are people on the other side of the hill and I don't see them? (Barrow active harvester; Experience timeline: 1990s; Experience location: Chipp River area. SRB&A Interview 2007) (SRB&A 2009)

Yeah, we can't go near the pipeline. You can't shoot near the pipeline. That's restrictive to the hunters. They always warn us not to shoot toward the pipeline or cross under the *pipeline. So if the caribou are on the other side, they don't want us to go near it. You have to get permission from Conoco Phillips to go there.* (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010a)

Yes, [ice road activity] affects me. It makes me nervous at the same time. I don't like to shoot my rifle towards this. There's an ice road southwest toward CD5; that makes me nervous. I know there's traffic out there. I don't like to shoot my rifle toward southwest and even if I try to shoot that caribou, pointing my rifle toward southwest there's traffic, caribous, tracks, rolligons, you name it, it's out there. That scares me, makes me nervous. I always thinking about shooting my rifle northeast because there's less traffic. More traffic going southwest. On facing southwest there's more traffic. That make me nervous, super. There's people out there just traveling. They're walking sometimes, doing seismic. October, November, December. Rolligon, cat train. I look with my binoculars and see people walking. (Nuiqsut) (SRB&A 2010b)

General Resource Availability

And hearing that this impact is going to be more and more and more each year and each time is telling me I have to try 100% more harder to get food on my table. And I just keep wondering, how am I going to survive if these animals are being impacted? What is it going to take for me to make a supper? What is it going to take to find something to eat? And the animals that I depend on are being impacted and these are things that I depend on daily. And I just want you guys to know that subsistence is a big thing in my life and that's what I depend on each day to survive. (Nuiqsut) (BLM 1998c)

Go out further to get caribou. Gas costs more, when we first got here, we could walk across the river and get caribou. In summer we used to get lots, now only ones that come in are from the West side. (Nuiqsut active harvester; Experience timeline: Since 1998 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009*)*

So I have lived there and I'd like to know -- this is about the hunting area or fishing around Nuiqsut, especially on Fish Creek area. There's a lot of fish out there, especially Nuiqsut residents had used that for subsistence for more than thousands of years. Also around the east portion on this land where the Arctic ciscos are coming in through all the creeks over here. I fished with my mother for -- ever since I was a little boy. So there's hardly any Arctic cisco nowadays that used to be like 30 years ago. So ever since all this activity start happening around Alpine, the Nuiqsut have been impacted so much, by 100 percent, because all the birds that are around this area, they're nesting all over because I had experienced that before. I used to get a lot of Arctic cisco when I lived -- was a little kid with my mother, by hundreds and hundreds, and right now what my mother have been telling me, there's hardly any Arctic cisco nowadays ever since the Alpine has started about a few years ago. (Nuiqsut) (BLM 2003b)

We have to protect all of the moose as well. There's a lot of moose that come in and out of the National Petroleum Reserve all over and we're starting to see change in patterns of migrations and birds and in caribou and in moose. We've seen owls that never came this way, now they are migrating this way more and more and I know some of that might be due to the fire that they had down in the Brooks Range on the other side but we know that our animals are always coming this way for protection, same with your muskrat and our large squirrels. Our (Chikshukpuk? 37:24.19) is what we call them. They are starting to move and change their routes where they usually be. They are starting to *spread out. Where people used to never see them now, they are seeing them. So, any, any of those, any of our subsistence resource that we go off of I believe that they need to watch out for in the migration pattern of those species.* (Point Lay) (BLM 2019d)

The caribou herds used to migrate through our village and now they migrate away from us. Last summer only three houses hung caribou. There are over 100 houses and most houses went hunting last summer. The offshore developments have caused problems with our fish. They are not coming. It's been eight years now. I know one family that hunted all summer, 80 days, and not one caribou. Where is the help for us when we go without? (Nuiqsut) (BLM 2003b)

3.4.4 Sociocultural Systems

Social Issues and Change Resulting from Development

Right after the oil boom. This is when I noticed the change. When I grew up people might have a drink or two, but not get drunk. Now we hear about meth, cocaine, and the small villages first. Our Barrow is the hub, then it spreads to the little villages. (Wainwright active harvester; Experience timeline: since 1972 and ongoing; Experience location: Barrow and North Slope villages. SRB&A Interview 2007) (SRB&A 2009)

I think about it a lot. I teach our history and when you understand what's happened in our past and what's happening today, it's cause for wonder. Socioeconomically, we've gone from a barter society to a borough that has been able to tax industry, until recently, when the life of the industry [has] now degenerated. It's had a lot of economic implications. When we go back to a traditional social framework that we loved 60 years ago, there's an increasing concern with dependence on government welfare. There's a lot of social implications associated with development that have been neglected. We've spent a lot of time, a lot of resources finding out what's been going on with the caribou, the whales, but not with what's been going on with our people. (Barrow active harvester; Experience timeline: 1945 and ongoing; Experience location: Barrow and all over the North Slope. SRB&A Interview 2007) (SRB&A 2009)

We have also spoken before about another less obvious category of impacts, these are the social and the cultural impacts associated with North Slope oil and gas activities that continue to affect our communities. They are not always specific to a single project or incidents, but can certainly be heightened by individual events. More continuously, these impacts reflect the cumulative level of industrialization that makes people worry and feel threatened by the effects of change. Over a relatively short three decade period of time our people have experienced changes, felt over perhaps 200 years by the greater American society. Despite the clear benefits with oil and gas development on the North Slope has generated, industrialization has also created the conditions for a whole range of anti-social responses to a deeply felt sense of loss. The stress and anxiety and the depression associated with dramatic change is evident in individuals, in families, and in the broader North Slope communities. George Ahmaogak, Sr. (Utqiaġvik) (BLM 2002)

Not long after that, we had another bad season when one of our whaling captains was killed. We sent supplies to Prudhoe Bay because if you do not bring it to the island, you go without. When the captain went to pick them up, the weather turned bad. The captain was lost after a conflict with the manager at the camp there did not know about our *lifestyle and us. The whalers were unwelcome at the camp and tried to return to the island, but they struck an iceberg and took on water. They called for help and they came with a helicopter to rescue them, but that captain was lost. The helicopter was not designed for the rescue. All the whalers came back to bury their fellow captain. The weather did not allow them to return to finish the season. Both seasons caused us to lose out on subsistence resources. The people were hurting. They had no jobs and they had no food in the ice cellars. They were suffering as seismic activity continued around our land and resources had gone with them. No alternatives; no income to buy from the store. I saw the effects of alcohol or drug abuse, domestic violence, suicide attempts and successes, conflict amongst the people with only a few jobs and every house had bills, but many houses had only one member working and most were seasonal short-term jobs. When the sun goes down in the north, the subsistence resources go with it. They may take many months to come back. The people suffered waiting for the sun to return and the subsistence resources with it. Some lost hope and they could not wait.* (Nuiqsut) (BLM 2003b)

I guess I would have to say the urbanization of the Arctic. By that I mean, proliferation of roads, loss of language, TV worries me a lot. I've seen a huge change in community activities. Nobody walks; people are staying at home. The wildlife impact is more nebulous; my greatest concern is the impact to people. For example: When [I was] mushing from Barrow to Nuiqsut, I encountered a seismic crew on Teshekpuk Lake and they freaked out and said we had to divert 10 miles. That was a wake-up call. (Barrow active harvester; Experience timeline: 1993; Experience location: Teshekpuk Lake. SRB&A Interview 2007) (SRB&A 2009)

The communities are pretty much like a big family. When there's not much subsistence, when there are young men who can't go out with others, it affects them. They socialize the wrong way. (Barrow active harvester; Experience timeline: ongoing; Experience location: Barrow and other North Slope communities. SRB&A Interview 2007) (SRB&A 2009)

They're not here yet, but when they [oil companies] do [come], it'll be like Nuiqsut. There'll be roads to bigger cities. Then the wrong kind of things will come in like drugs and alcohol. It's starting now, even though we're not impacted. Once something gets started in town, we'll need more public safety officers. We used to get by with people hired by the city. Now we need training by public safety officers. (Wainwright active harvester. SRB&A Interview 2007) (SRB&A 2009)

With tourists videotaping us every time we go out. With the ice so close nowadays, I mean like three-quarters of a mile out with all that global warming or whatever. Now we're right off shore and they walk out there and videotape us. I don't like that. What if they twist it around and make us look like bad people? (Barrow active harvester; Experience timeline: 1978 and ongoing; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

My son's first harvest impacted by change, the loss of sharing that harvest within the family and the community, the joy of sharing a meal within the community, the joy of being recognized by the elders of our community. Those are losses that occur to our families. And these are things that are occurring on a daily basis. Rosemary Ahtunagaruk. (Nuiqsut) (MMS 2009b)

You see it. When there is an influx of money locally, there is rising consumption of alcohol and drugs. Where there is development, gold rush in Fairbanks, just like Nuiqsut, alcohol and drugs are readily available in the bigger picture of things. Who will be the people in power to solve [the problems]? Who will bend more backwards to oil development or subsistence? If there's lots of money, drugs and alcohol follow behind. Whether there is a conspiracy to bring in drugs and get them drunk up, who knows? That's in the back of my mind. How come it's so easy for drugs and alcohol to come in? Big money means drugs and alcohol. (Barrow active harvester; Experience timeline: since 1971 and ongoing; Experience location: Villages, Barrow, Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

Drugs and alcohol, that's the worst part of it. It's expensive; $300 for a quart [of alcohol]. They made money bootlegging. When the pipeline started I guess, everything came from there. (Anaktuvuk Pass) (SRB&A Unpublished-a)

We were living in Bethel. We moved back to Wainwright. This is when I noticed problems. When there was lots of construction [and] we began to see drugs and alcohol abuse. The NSB has grants for suicide and drug abuse [treatment], but you have to be a real bad guy to get help. Lots of our young people do not know how to deal with these problems. Since the 1980s people have started showing disrespect. That's alcohol abuse. If we stay strong to our Iñupiat values. I do not want drugs and alcohol to overrun us. Our young people have to deal with peer pressure. The in-crowd. Listen to your heart, like I was raised. You may become a loner, but deal with it. We do not have professionals to deal with our problems. (Wainwright active harvester; Experience timeline: ongoing; Experience location: Wainwright. SRB&A Interview 2007) (SRB&A 2009)

The staging and mobilization for ice road building, the housing of drilling and construction crews in Nuiqsut, and general oil development and exploration creates multiple interrelated and cumulative impacts to our community. These impacts include more trucks on the community streets and more planes landing and taking off at the airport, pressure on the community's water and sewer systems, landfill, fuel storage capacities, and local clinic. The demand on the local services will increase as the five proposed satellite projects take place. Additionally, the supporting documentation for Alpine Satellite Development Program, production and project description, September 2002, mentions a very real possibility of ten future satellite projects within 30 miles of Alpine. The community disruption from oil and gas exploration and development leads to sociocultural impacts in the areas of our health, economic well-being, recreational activities, and the social and cultural structure of our community which deserves mitigating measures. (Nuiqsut) (BLM 2003b)

I've noticed a lot of people who have worked for Prudhoe Bay or in the oil fields have moved to Fairbanks or Anchorage. It's easier for them to transit. Easier for them to spend their money. The ones who go to college get job offers to work in Anchorage. I'm afraid they will not come back. We have a brain drain. (Barrow active harvester; Experience timeline: since 1995 and ongoing; Experience location: North Slope. SRB&A Interview 2007) (SRB&A 2009)

Younger generations are leaving: They have no chance of making it, to build their own house and raise a family because costs are so high [here]. Anchorage is the place they are moving because it costs less. There is no way in hell I can live in Anchorage. I can take it about 10 days at the most. It's too fast paced. Younger kids won't really make it *here.* (Barrow active harvester; Experience timeline: beginning in 2000 and ongoing; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

We're losing the younger generation and the traditional ways. The oil company jobs are good, but it takes them away from traditional ways. (Atqasuk active harvester; Experience timeline: 2004-2005; Experience location: Atqasuk. SRB&A Interview 2007) (SRB&A 2009)

The ills of alcohol and drugs. It comes into Nuiqsut through the Haul Road and through Alpine. It will hurt us even more if they build a road and start driving in. (Wainwright active harvester; Experience timeline: since 2005 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

My only concern is the impact of people that are going to be coming again. Not only will this public route be more impact for our situation, I think it's going to create more impact. I don t know that, but we will see. We know what the impacts are, socially it has had a great impact. Not only do we have a different outlook, but other things were created and we have to deal with it. You know, more drugs will probably be on the road. Use to be it was just alcohol, but not anymore. The drugs are light and not visible. I think that will create more problems in the long run. That's me observing. We've had the impact of animals, we say, the stopping of the porcupine herd, we don't see them ever. We only deal with the Teshekpuk herd, and occasionally the western herd, we get that, but not always. The one we are really concerned [about] is the Teshekpuk. It will be a real big impact if they are stopped. Like I said, at Nuiqsut you could see three oil rigs right from the village. Three oil rigs and one blew up about a month ago and people were sick for about a week. I don't know if we want that for ourselves. They were sick for a whole week. Whenever the wind blew from the north they got the fumes, maybe it reached us here, I don't know. It's natural gas, maybe we should worry about that. (Anaktuvuk Pass) (SRB&A Unpublished-a)

in 1973… when we first got here in 1973 social and economic was different we never experienced anything like that. Since Prudhoe Bay started expanding westward we see a lot of changes today. The changes have to do with the environment but it has also changed the pattern of the animals and the vegetation. To socio-economics has impacted the village. By the time they got to Colville Delta… we never had any social problems or economic problems when we got here in the early 70s but today we are experiencing lots of impacts from development gradually coming westward acre by acre and soon they are here and they are right there and we don't know how it will affect us when they open the west one. (Nuiqsut) (SRB&A Unpublished-b)

My grandparents would talk about displacement, hunting routes, campsites and things. I was heavily involved with Alpine as cultural Guardian for the city. Before that the Borough gave our permits and ASRC and the State did the same to the companies without talking to the village. They didn't even consider coming to a place like Nuiqsut until we changed it. Now it's a requirement. I know for a fact that since then and along the way the North Slope Borough had to change the ordinances and plan for that. (Nuiqsut) (SRB&A Unpublished-b)

There is a lot of anger in the community because of the pipeline. (Nuiqsut) (SRB&A Unpublished-b)

It is hard to compare, back then [when TAPS first came] they had cocaine, alcohol and marijuana. There are a ton of other things now including methamphetamines. I have had to take care of friends that were one it. It is not a good drug to get into. I smoke marijuana, but that's natural stuff and I don't have a problem with it. It's not like it was made with chemicals in the bathroom. (Nuiqsut) (SRB&A Unpublished-b)

It just got worse [as development increased]. When they first started [building the pipeline] it [the drug and alcohol problem] was ok but after the pipeline started working it just got worse and worse. These people are ok when they are sober but later on like sometimes like a year or so everything turns around and they go to alcohol instead of trying to get away from it. That is what they done so… it has been up ever since. There is no way of stopping it. (Nuiqsut) (SRB&A Unpublished-b)

when we first got here in 1973 people all pulled together happiness as here there was no alcohol. There were times when we had lots of activities going on when we were a tent city. We all worked together. We didn't worry about alcohol. People were subsistence and living together, working together. We had outdoor sports and people gathered together and had activities. It was going on for quite some time until one day all of this illegal stuff came in and the happiness was going down. We were rising and the happiness was on top and gradually it was going down. All of those activities that we used to have are not there anymore. We have no evening or weekend activities with our people. We don't have something to show to our younger generations or grandchildren. (Nuiqsut) (SRB&A Unpublished-b)

There is a big increase in the people using the area. There isn't a lot of housing around here and when one comes on the market it is too expensive for the local people, but the industry can afford it so they buy them and change them into offices. It bothers me a lot. (Nuiqsut) (SRB&A Unpublished-b)

There are big families all crowded into one house. There will be multiple families. They have money; they should just build their own buildings (the industry). (Nuiqsut) (SRB&A Unpublished-b)

Social Organization

Prudhoe Bay has drastically changed the political atmosphere of Barrow. Back when they were exploring, there was not political impact. The Inupiat pretty well had the governing, had the last say on political activities. But when oil was discovered in Prudhoe Bay, then everything changed in the governing scope in a short period of time. And everything that has materialized today is because of oil in Prudoe Bay. The Prudhoe Bay area was a haven for hunting in the past. Since the oil industry has become active, the traditional hunting grounds have not been available to the Inupiat people. This is the most impact it has had on our cooperative sharing. Jonah Leavitt. (Utqiaġvik) (Worl and Smythe 1986)

When they first started moving from Barrow, one of the things that a lot of the old people, and we heard this story before, but I'm going to retell it, that the elders that had moved away from there wanting to go back, back to their homelands because we remember that they told them that if the children didn't come -- take them to Barrow for education, that they would take them away. That's one of the reasons why all the people that lived down in this area went to Barrow back in the 1940's, 1930's, somewhere in there when a school started in Barrow and then when the Native Claims Settlement Act *started, they started their -- a lot of the elders that were taken -- to be home, wanting to go back home because they felt like this is their land and they don't want to lose their land and that's why Nuiqsut was restarted for the people that are wanting to go home and that -- those were the years that they stayed in tents for a year or many years.. and there was plenty of animals when they first moved because hardly -- the oil companies hadn't gone this far west and they were mostly out on the Prudhoe Bay area and there was a lot of caribou and the fish were fat in the Colville River. Then when we're talking about this -- the elders that have lived the subsistence way of life and not depended on store-bought food, they always prefer subsistence food, like the caribou, the fat caribou (speaking Inupiaq) that were available around here and things have changed and she talked about the glass - another thing that came from the gravel pit preparing for expansion of the industry and it was interruptions like then with the industry coming closer to Nuiqsut and now, come closer, they're catching fewer caribou. For her family, 10 caribou is good for the winter, but they couldn't catch any when they were flying planes all the time. They only got about two this year. When they (indiscernible)look back when the industry was getting closer and there were a lot of meetings like these, well, in a sense, not going to those meetings might have caused a lot of things to happen.* (Nuiqsut) (BLM 2014c, 2014d)

Mixed Cash/Subsistence Economy

Impact mitigation funds from Pioneer and Conoco Phillips. That helps because if the helicopters scare our caribou further from here, like to Fish Creek, then that helps to go out there. We can get fuel vouchers from that impact fund, and once or twice a year they will give out a small check to the household, but you have to be an active subsistence household, not just any household; like the elders aren't active, but they have people hunt for them. (Nuiqsut) (SRB&A 2010b)

Subsistence lifestyle is priceless. There is no price to it, period. It's our livelihood, part of our culture. That has been passed on to us for thousands of years. (Nuiqsut) (BOEM 2011)

Having to adapt to a cash economy. Living in a capitalist world, you can't live without income. I've seen this more over the last 23 years. You hardly see anyone camped out all season like the summer gathering time like you used to when I was growing up. The whole family would spend the time out there. Making seal oil, drying meat, preparing for winter. Now most folks spend two weeks or a month at the most. We've had to find more full time jobs with less time to hunt. It's a gradual change. I guess it's normal for any society. (Barrow active harvester; Experience timeline: 1982 and ongoing; Experience location: North Slope. SRB&A Interview 2007) (SRB&A 2009)

The gas prices are what really get us, we have to wait to get a paycheck. Some people would rather use their boat and wait for a later time, and us we don't own a boat, so we borrow one or go with somebody. (Nuiqsut) (SRB&A 2015)

It's just, the cost of living, high cost of gas, high cost of ammo, high cost of maintaining your snowmachine or boat…and it adds up…So, you spend $3- to $4,000 on grub, gas, and whatnot to go out for 10 days or 2 weeks to harvest caribou before the long winters and yet, you know, there's no caribou. You come home empty. Sometimes you just get a couple due to a lot of activities happening up here. (Utqiaġvik) (Brown et al. 2016)

It costs more to do subsistence activities now than in the past. So, in that regard, for an adequate comfort level to cover your costs, you work longer and take shorter time with your families. (Barrow active harvester; Experience timeline: 1995 and ongoing; Experience location: Barrow area. SRB&A Interview 2007) (SRB&A 2009)

The way I hunt now is much different. I need a snowmachine, four-wheeler, outboard. I used to need a dog sled and boat with a sail. If you don't have these things, you have to buy meat from your neighbor. Now hunters are more independent with fewer helpers. I used to take out five to nine people. Families and hunters are trying to be independent. You rarely see people out unless they are related to the boat owner. Wainwright and Pt. Lay are very lucky. Oil development is not here yet. Like Nuiqsut and Barrow, we've had meetings with oil companies. They're coming on our land and ocean. They did seismic testing last year. I did not see much effect on ugruk, but I did not see any beluga. (Wainwright active harvester; Experience timeline: 1954 and ongoing; Experience location: Wainwright, Pt. Lay. SRB&A Interview 2007) (SRB&A 2009)

These are some of the diets, our customary diet that we depend on, not just whales, but whales are one of the main species that we really depend on, and it's been known over 10,000 years, known that we have been whaling. It's been passed down from generation to generation. My brothers and I came from a big whaling family. As a matter of fact, came from a real subsistence economic. Our parents are gone now. Had raised 12 -- 12 children with no cash economic. It's been all subsistence, living off the land, living off the sea. And we are -- and they are gone now. And now it's our responsibility to continue keeping the tradition alive, and we are passing it on to our kids. That's how the chain -- the chain of -- the chain link occurs. When we are gone, they will still be here, even when the oil is gone, been extracted out. (Nuiqsut) (BOEM 2011)

There are people with no job, there are people that are with jobs, and it's just hard for people, you know people think of their families, of themselves, but they have their family take care of them. People that are working aren't there to fish and it just work both ways you could say. I'm a fisherman that goes out there and whenever I get the chance to go out there and fish, and I give it to people—to whoever needs. (Point Lay) (Braem et al. 2017)

Our subsistence is food on our table; if we start having to pay for licenses like it's starting to happen, then we'll need more money. I don't think it's right for somebody out of state to tell us that you need to have a license to hunt where you were before we were even born. I don't think it's fair for them to say that if you break that law, you'll be put in jail. We want our kids to have the freedom that we had. It seems like our freedom is being limited and we can't go back to what we had. Fuel is so expensive and you need a lot to do the hunting you need to do. And a lot of my relatives have a lot of kids and they need to put food on the table. (Point Lay) (SRB&A 2014b)

My grandfather sued the oil industry for trespassing on his Native Allotment. Many others of his generation had the same adversarial attitude. So people who looked up to my grandfather thought that this was the right attitude to have. So a whole generation of leaders grew up fighting industry, which was in some ways justified. There's a small group of people that were quiet and worked in the industry. Now our job is to put these young people to work and they're used to this adversarial attitude, it's hard. You ask if I know someone, whether it's a personal concern, it's everyone. Kids should be able to learn that they can work a rotational schedule, do subsistence, get benefits, and still be proud of their heritage and background. That's what industry should represent for us.

(Barrow active harvester; Experience timeline: 1920 and ongoing; Experience location: North Slope. SRB&A Interview 2007) (SRB&A 2009)

When construction began on the NARL, there was a very definite change in the attitude of the people due to the introduction of employment to the community. You could really see a change in the cooperative sharing. [Illustrations?] Right after employment was introduced, everyone sort of abandoned the fur trading as a means of bartering for making ends meet. When everyone got jobs, things became easier. People began building wood frame homes, build some boats, outboard motors, etc. As things got a little easier, people started to stick to themselves around their immediate families since everyone was now in a position of self-reliance. So, at that time it became a little easier for everyone to look after themselves. (Utqiaġvik) (Worl and Smythe 1986)

[You have to make a choice between] having to stay home and going to work. Because you've got to have money to get your fuel and you've got to have money to get your food. In the old days, everything you depended on was out in mother nature. But now you've got to have money in your pocket. It's starting to change a lot. (Point Lay) (SRB&A 2014b)

The (indiscernible) Lakes, Pik Dunes, and those hills, we call them the Blue Hills up past the Kogohokruk River, are our prime areas that our young men go for wolverine, wolf hunting and trapping. And this is there for our traditional clothing, for our -- because this sustains our natural warmth in our body, when we have our traditional clothing. So it's for our tradition and culture. We do not want to -- if those become restricted and -- you know, we will lose our traditional way of life. You know, you start to make -- knit a sweater and you loosen one -- and now you're pulling it out from the seams. And now it's -- you know, we can't be bare naked in the Arctic Slope. (Utqiaġvik) (BLM 2004f)

There's people who have traplines, and it's just a matter of going out there in this cold because right now [February] it's the time of the year…it's the coldest time of the year and there's a very few people who go out and do it, because you have to travel miles and you have to go out and get these predators, wolverines and wolves. And it's just, you know, the excitement of getting them and bringing them home, actually getting these predators out there, that stuff we use to make our warm clothing, that's how it's been for years…you look back in the history and we had no stores, we had no way to buy up our clothing, it was out there for us to hunt, to make our clothing. (Point Lay) (Braem et al. 2017)

It is important to me because it was my wife and my kids' heritage. I tried to get in on as many activities as I could that involved that sort of traditional thing. [My son] is one of the better hunters and trappers in this community. And I was all for it, go with them, live with them, travel with them (his grandparents). It's the reason why people were here and it's a reason to stay here. (Point Lay) (SRB&A 2014b)

The person who is willing to work every day and passes his UA is willing to work every day. He wants to work every day. If he wants stuff he will work more. Alcohol and drugs will not help him make more money. The more money they want to make, there is a whole bunch of these kids I don't like, they make money all year long selling drugs and alcohol. They don't think of other people they only think of themselves and their own money. Why do you want to make more money, if you had a chance to do that why would you do that? I don't want to be like that, I want to make good money but not through *selling drugs. I kind of wonder about these drug and alcohol dealers. They make more money and more profit but they are causing problems. Everyone has got to work and make a living.* (Nuiqsut) (SRB&A Unpublished-b)

You will hardly see anybody doing seal pokes 'cause the weather warmed up too much, it won't let the seal oil render right—the way it's just traditionally been worked 'cause when it get too warm it gets rancid, strong. This cold weather we was brought up in the early '50s…I miss that a lot. 'Cause that food was staying fresher longer. Even our ice cellars held the food fresh longer. Nowadays we don't have ice cellars anymore 'cause they all melted. There's water and water gets in them and they get rotten and gaseous. People been known to have died from going in the cellars because of the gas that's produced like methane or whatever from the foods that rotted…we had to resort to electric freezers and walk in freezers. Temperature-controlled climate, however they might put it. (Point Lay) (Braem et al. 2017)

3.4.5 Environmental Justice

See traditional knowledge provided in the SUBSISTENCE USES AND RESOURCES, SOCIOCULTURAL SYSTEMS and ECONOMY sections for traditional knowledge that is also applicable to this section.

3.4.6 Recreation

Traditional knowledge holders from the six study communities generally do not consider their activities on the land to be "recreational." Therefore, see traditional knowledge provided in the SUBSISTENCE USES AND RESOURCES section for traditional knowledge that is also applicable to this section.

3.4.7 Wild and Scenic Rivers

See traditional knowledge provided in the other sections of this report for traditional knowledge that is applicable to wild and scenic rivers in the planning area, particularly the Colville, Kokolik, and Utukok rivers.

3.4.8 Wilderness Characteristics

Traditional knowledge holders from the six study communities generally discuss "Wilderness Characteristics" in the context of their subsistence activities. Therefore, see traditional knowledge provided in the SUBSISTENCE USES AND RESOURCES and CULTURAL RESOURCES sections for traditional knowledge that is also applicable to this section.

3.4.9 Visual Resources

I hadn't seen nothing, other than lights at night. Just when you're coming in from this side, you can see the lights; that's the only thing. [It can be] somewhat distracting – it's irritating. Because I remember on the blue moon days you can see Prudhoe Bay when I was a kid. [It is] hard to say if they caribou are affected. Normally if you see lights, you wouldn't want to be hunting in that direction. (Nuiqsut) (SRB&A 2014a)

I still have a complaint [about the pipeline]: it is just too shiny. It reflects too much. (Nuiqsut) (SRB&A 2015)

You can notice them [pipelines] from far away. Even from my camp I can see them [still shiny]. (Nuiqsut) (SRB&A 2011b)

I keep telling them that pipeline's got to be covered, because it's too shiny. They colored the one down by POW 2 - the one on the Oliktok Point - they colored that, and you can't see that one. It's like a dark green, navy color, army color. (Nuiqsut) (SRB&A 2011b)

3.4.10 Transportation

See traditional knowledge provided in the CLIMATE AND METEOROLOGY, VEGETATION, and SUBSISTENCE USES AND RESOURCES sections for traditional knowledge that is also applicable to this section.

3.4.11 Economy

See traditional knowledge provided in the SOCIOCULTURAL MIXED CASH/SUBSISTENCE ECONOMY section for traditional knowledge that is also applicable to this section.

Local Labor

People talk about the past and hunting with skin boats and dog I've never done that. I grew up at a life where I drive a snow machine. I drive outboard motors and four-wheelers to hunt. That's the life I know and that's the life my kids know. Nobody uses dog teams or skin boats to hunt year-round and where do I get that money from? My job, dividends from the companies that we're enrolled in [village and regional ANCSA corporations] and that's just for my family. What about the other hunters that I have to work with? That's where their income comes from, the North Slope Borough and that's how we live and that's the life we know and that's the life we have to continue to move forward. I cannot go back to dog -- I cannot envision myself using a dog team, let alone train a dog, because I don't even know how. I can train one to pee outside, but that's about it. You know, that's all animals are to us today. So I have to make up my mind and move forward and support projects like this that will benefit our people and not just us as Inupiats, everybody who lives on the North Slope, no matter what race, creed, or color they come from. That's the benefit of the -- of our system today. So we benefit everybody and that's why I have to support what we're doing here today. (Utqiaġvik) (BLM 2014b)

One of things that needs to be included in your alternatives is to see whether or not we can, economically, make Nuiqsut benefitted economy wise to create jobs. There's nothing. There's lot of people here that aren't working. They subsist, but we can't -- they can't go further out, because of their limited cash value that they have on hand. (Nuiqsut) (BLM 2018c)

I've noticed a lot of people who have worked for Prudhoe Bay or in the oil fields have moved to Fairbanks or Anchorage. It's easier for them to transit. Easier for them to spend their money. The ones who go to college get job offers to work in Anchorage. I'm afraid they will not come back. We have a brain drain. (Barrow active harvester; Experience timeline: since 1995 and ongoing; Experience location: North Slope. SRB&A Interview 2007) (SRB&A 2009)

I know they're always looking for qualified people. You need certification and lots of Iñupiat people are prepared for this. At the college we encourage them before they ever go get a job, they usually end up in laborer jobs because they're not prepared. They should notice this. (Wainwright) (SRB&A 2009)

Our younger generations are planning to move out because there are hardly any jobs. I have five kids of my own but one already moved out looking for a job. Oil companies *promise jobs, but they hire people from the Outside and don't keep the promise to hire locals. My oldest son went to Barrow for a job for three or four years.* (Nuiqsut active harvester; Experience timeline: since 2001 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

This doesn't happen to just the North Slope Borough. It goes right down to the families. If there is no work, it's the people who depend on oil development jobs who will be hurt. You hear this every year from the North Slope Borough. It'll affect everything we enjoy today. The revenues have been declining for years. They're laying off. People who thought they had jobs for life are unemployed. It's hard on the people. (Wainwright) (SRB&A 2009)

Alcohol problems. When you look at the people, right now I'm - have to deal with - without any federal monies, without no help, not from the churches, not from the state governments or from the federal governments - we have to deal with over 250 child cases every six months without no help, and a major portion of them is alcohol related because the parent's are worried about, 'Where am I going to feed my kids from? I can't find a job.' And we're sitting in the richest oil field in American. And major portions of our population are unemployed and can't get work, with the biggest oil field sitting right to the east of us here. George Edwardson. (Utqiaġvik) (MMS 1990)

Cost of Living and Economic Consequences of Subsistence Impacts

And then when the transportation to fly into a city, you don't get any discounts. You pay the price at price at all the time—the full 365 days a year. You know Alaska Airlines give out $76 one-way from Seattle to New York. We fly here from Fairbanks its $600 for a round trip. We don't get those deals. If some way, the state can help us to get some kind of deals. Everetts is trying, they are giving—once you reach Fairbanks that you'll be all right for a hotel. Which is highly needed because once you go Fairbanks, you are already spending your Christmas money and you go to a hotel. But Everetts is trying, they're trying they're giving once you land in Fairbanks, you're being delivered to a hotel for free and paying the taxes. We need to sometimes [unclear comment]. Give us a discount at Christmas holidays. WEIO. Activities that every community tries to come together and try to gather in one place. That was for transportation in that kind of way, maybe the state would have some more funding for the other people, people who don't have WEIO. Alaska Airlines does—give us some discount. (Anaktuvuk Pass) (BLM 2018a)

They changed everything in this area [TAPS]. It's not what it used to be. [It's] more expensive, more money from somewhere, especially groceries. You buy one loaf of bread it costs you six bucks. (Anaktuvuk Pass) (SRB&A Unpublished-a)

[It costs] 295 dollars for a bottle [of propane]. [The pipeline is] so close and yet so far away. We don't benefit from it. (Anaktuvuk Pass) (SRB&A Unpublished-a)

It's always been part of our whaling community. Due to our subsistence way of life, we try to avoid compensation from the oil companies. We deal with the IWC [International Whaling Commission]. If they see we get monetary assistance, it will impact us. I know Nuiqsut does, but they have agreements. I'm talking about Barrow. This is our livelihood. We don't want to lose this. Sure gas is expensive and the equipment. The cost is there. Each individual is burdened with the price of oil, fuel, and equipment. It's the same difference on and off shore. Most of these people fight for their subsistence. They *get seasonal jobs so they don't have the money for fuel and equipment. Due to the impacts that affect most of our hunters. In Barrow we see this with the whaling captains and subsistence users. When I go to my cabin I used to be able to estimate exactly what I needed for fuel. Now you can't because you never know where the caribou will be. The cost of fuel is not going down. You've got to understand. They don't look back once they pass a community. They look to the next. Once they're done they're happy. They say, ok let's move. We could use the economics.* (Barrow active harvester; Experience timeline: 1965 and ongoing; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

When there are ships out there, you'll have to go further south to get your ugruk. You have to hunt ugruk in the summer to put skins on your whaling boat. When I have to change skins I will have to catch six the summer before I change them. You can't use the ones you catch a year or two before, they'll be rotten. It's expensive now. To get 10 gallons of gas you spend $45. Oil is another $30. The things the oil industry brought to the North Slope, more boats, more motors. You have to compete with that now. The things you buy up here are much more expensive than in Fairbanks or Anchorage. (Barrow active harvester; Experience timeline: since 1985 and ongoing; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

We recognize the importance of oil and gas development for the national need for energy, it's not that we oppose this, it's that we want development to be done in a way that's not costing to us. We have increased our distance of travel to try to attempt a harvest as well as the number of trips that we make to try to harvest. These are costs that come up on our families. Our families have to try to go without other things because we're trying to continue our traditional lifestyle. (Nuiqsut) (BLM 2004e)

The economy these days. We try to hunt. We got game coming toward us, then these planes, choppers fly over. It costs a lot. I spend $600 to $1,500 to go hunting for two weeks. Then the choppers fly over and the game gets scared off. It's very frustrating to come home with nothing. (Barrow active harvester; Experience timeline: 2003 and ongoing; Experience location: Peard Bay. SRB&A Interview 2007) (SRB&A 2009)

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Having to change my patterns of hunting and fishing. I had to change my calendar. I had to buy more gas and more food for my trips. I had to go to a whole new area. I *couldn't hunt and fish in the places I traditionally went. I have hunted in my traditional area all my life; now I have been approached by security and told that I'm not allowed to have a firearm in that area. That took a big toll on me. And in my house I found myself very frustrated and angry. And there's no counseling of any kind and no help. I found myself a very unpleasant person to be around. I had a good wife who told me that I would have to leave to get counseling and the proper help that I needed to learn how to deal with these problems. Then I tried to educate myself on the matter of development and learn how I can't stop it, how it's for the good of the country and how we will have to learn to live with it. I found myself reading EIS's constantly at work and learning everything I could. And then I became a local leader. You see, I grew up on caribou, whale, fish - hamburger was not available, but now I can't do that as much. I have less time and need more money to hunt and now my kids aren't learning the subsistence ways. It's not a priority to them. And that takes a toll on me. It makes me disappointed but not surprised that this next generation doesn't depend on subsistence. There is a lot of stuff for people to fight about. There's a lot of mitigation funds coming into the village and the North Slope. And for that money the people all fight. Local leaders, families, and there's controversies in the village itself. And there's no formula or method for resolving these problems. It's all new, and we're just still learning how to properly use these impact funds and mitigate.* (Nuiqsut active harvester; Experience timeline: 2001 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

Using the vouchers isn't enough. If you're gonna divert our caribou, that 10 gallons of gas ain't gonna get us there. We're gonna go further out, got to spend more money on gas. Mitigation hasn't done nothing, since they're gonna divert our caribou further south. That's from the oil company mitigation, from the city [City of Nuiqsut]. Some of these mitigations are being misused. Given to non-hunters around here. They want to gas up their vehicle, not go out there [hunting]. Go to City and write where you're going and what game you're going for. Some of the non-hunters mistreat it. Last year they shut it down cause there was misuse. (Nuiqsut) (SRB&A 2010b)

We have increased our distance of travel to try to attempt a harvest as well as the number of trips that we make to try to harvest. These are costs that come up on our families. Our families have to try to go without other things because we're trying to continue our traditional lifestyle. (Nuiqsut) (BLM 2004d)

The scientists at the beginning of all this, you could subsidize your diet with food at the store. Heck, no, we can't. It's over $20 for a steak, $50 for a box of 20 bullets. If you're a good hunter, that's 20 tuttus. That's a lot of meat for them 20 bullets. But we can't find them. These roads, all that gravel hauling -- I haven't been able to get tuttu in two years. Myself -- for my kids, we're getting from son, my son-in-law. Other people are giving to us because we're unable to. (Nuiqsut) (BLM 2018c)

We go to the store on payday. It's six to eight hundred dollars just to feed our family. And we still struggle to get to the next payday after paying six to eight hundred dollars to them. We can't subsidize our diet with these foods, what they cost… You're running all our food off and you're forcing us to subsidize our diet with what's at the store and order from other places. (Nuiqsut) (BLM 2018c)

You can see the frustration; frustrated not only with industry, but the State and agencies, because, How could this be happening to us? We used to be a thriving fishing community. Now all of a sudden we get two to three cisco. It is very frustrating to an individual and as a family as well. You spend time and effort and money. The average *family will set two nets, sometimes three nets to try to make up the loss of one net. It takes a lot of money to fish; prepare the snowmobile, buy gas and nets and you have to spend time away from your family and home. Our diet consists of 30-60%Arctic cisco.* (Nuiqsut) (MBC Applied Environmental Sciences 2004)

When my mother and I go hunting, my mother always says, and I say, I think we need more meat because prices in our store are getting higher and higher. Hardly any jobs and gas is getting expensive. We decide to go get meat. And we go by boat for caribou and there is Alpine aircraft and helicopters flying over and it seems like they are disturbing our hunting. And all of a sudden a helicopter files over us and scares our caribou away. My mother gets so mad. It used to not be like this before Alpine came around. Alaska Airlines too. Alpine helicopters and Frontier Airlines. (Nuiqsut active harvester; Experience timeline: 1990 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

This is a true statement in itself. Some of our relatives don't make that much money so they cannot even go out to hunt. Quite a few people have had to make longer travels whether it's for consumption or clothing. We're used to going to a general area. Now we have to go out further because there are no animals in the general area. (Barrow active harvester; Experience timeline: since 2001 and ongoing; Experience location: 20-30 miles south of Barrow. SRB&A Interview 2007) (SRB&A 2009)

And things that will help to reduce these are looking at the pipeline routes, making sure that the pipeline is high enough that the caribou are able to migrate, that we're able to follow the migration and hunt without having to travel to an area that's designed to allow us to hunt through them. The cost of our travels come out of our pockets, it takes away from other things that our families need. And it's really important that the cost of trying to live our lifestyle is not taken from our families. (Nuiqsut) (BLM 2004e)

Most of the people who can hunt have to work. If the hunting is 50 miles out, I will not go. Even if there is an agreement between the workers and the employers. If the animals are too far out, people will not go. They have to worry about the job that puts food on the table. This is why you find people in town who've never had a permanent job. (Wainwright active harvester; Experience timeline: Since 1972 and ongoing; Experience location: Wainwright. SRB&A Interview 2007) (SRB&A 2009)

It's always been part of our whaling community. Due to our subsistence way of life, we try to avoid compensation from the oil companies. We deal with the IWC [International Whaling Commission]. If they see we get monetary assistance, it will impact us. I know Nuiqsut does, but they have agreements. I'm talking about Barrow. This is our livelihood. We don't want to lose this. Sure gas is expensive and the equipment. The cost is there. Each individual is burdened with the price of oil, fuel, and equipment. It's the same difference on and off shore. Most of these people fight for their subsistence. They get seasonal jobs so they don't have the money for fuel and equipment. Due to the impacts that affect most of our hunters. In Barrow we see this with the whaling captains and subsistence users. When I go to my cabin I used to be able to estimate exactly what I needed for fuel. Now you can't because you never know where the caribou will be. The cost of fuel is not going down. You've got to understand. They don't look back once they pass a community. They look to the next. Once they're done they're happy. They say, ok let's move. We could use the economics. (Barrow active harvester; Experience timeline: 1965 and ongoing; Experience location: Barrow. SRB&A Interview 2007) (SRB&A 2009)

3.4.12 Public Health

See traditional knowledge provided in the SUBSISTENCE USES AND RESOURCES CONTAMINATION, SOCIOCULTURAL SYSTEMS MIXED CASH/SUBSISTENCE ECONOMY and ECONOMY COST OF LIVING AND ECONOMIC CONSEQUENCES OF SUBSISTENCE IMPACTS sections for traditional knowledge that is also applicable to this section.

Human Health

> *I have been a health aid for over a year now in Nuiqsut. And it is a tough job and I know. And I have found out in one year, that on our little children and the older people, their hemoglobin has dropped way down. Some of the little children have to have two doses of iron. And it's really hard. And it's because we are so short on our caribou and all the animals are scarce. Rosa Kaigelak.* (Nuiqsut) (MMS 1979b)

> *Health problems. Thyroid problems. People are starting to complain about inner problems [like] asthma. Non-smokers too. Like my mother, her doctor told her that she should consider moving to where there's less development and better air. And this isn't from smoking. These health problems are between her family and her health. Should she leave the community and her family and her husband's grave? For her health? And we don't even have anything but a health aide here. When we came up with 15 people who have died of cancer, in the past few years, well, maybe something's happening here. I blame it on development. On the days when they have those flares from Alpine, my mother feels sick. And it's not just her. It's her peers too. It's not good for us, the people who live here, to have all that smoke in the village. The doctors don't know what's wrong with my mom. All the data doesn't match up.* (Nuiqsut active harvester; Experience timeline: 2005 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)

> *I know our health care system can't afford the cost that respiratory illness is causing our region right now. This data isn't even there to fully assess how much our exposure is, because the data sets are mixed into a very difficult assessment process where you have to know who the people are, where you're reading it from, to know where to get the data sets from. Some of our information might be in the village, some of it might be in Barrow, some of it might be in Fairbanks, some of it might be in Anchorage, some of it is nonexistent, but the cost is tremendous for one person on a ventilator for a short period of time. Our village suffered 10 people at one time on a ventilator. That's a small village. Why? Why? Why? I still don't have the answers, but I'm still here asking these serious questions. I want to believe that not all my grandchildren will need inhalers to breathe because there are many that do and some of them are very serious. When there's flares that are going on and there's lots of them, those are hard days for people who have trouble breathing and it's serious. This is a drawing point in the sand. Clean up what you've already done before you get into this area because the devastation is going to be tremendous.* (Utqiaġvik) (BLM 2014b)

> *When I started as a health aide in 1985 I had one asthma patient. By the time I went to the University of Washington for my physician assistant certificate in 1989, I had 20 to 25. When I came back in '91, there were 35. When I quit in 2000, there were over 60. The village make-up has not changed; it is still mostly Inupiaq. What was contributing, the most overwhelming issue, was that oil development around the community had increased and gotten closer. The worst nights on call were nights with many natural gas flares occurring. We could see it in the flares or in the fields around us. They release particles*

and they travel to us. The chance of an inversion will affect us. An inversion is a bowl-like air trap with cold air trapped by warm air. Increased concentrations of particulate matter occurs during these episodes. (Nuiqsut) (BLM 2003b)

Oil and gas. I think that that onshore development definitely has some issues with the resources. They use our lakes for water to build ice roads, and there are just a lot of little things that can add up to make the caribou have sicknesses. I've helped with little spills and I know they have that. It's the same thing with our humans. I can guarantee that at least 10 of my elders passed away from cancer, we had some from heart attacks, but at least 10 from cancer. I think it might be the air pollution, it might contain small particles, but it adds up. That one with the tumor, I cut off the head and took the horns, but I left the rest for the animals to eat, cut the gut open so it wouldn't explode. (Nuiqsut) (SRB&A 2010b)

I'm concerned for our health too. You can see those flares for miles. What they're burning is, I think unwanted gas and it's harmful to us humans over here in the village and the animals too. I just see that smoke from miles away. Alpine's north and a lot of time we have north, northeast wind in the village here. It's not good for us when they burn. (Nuiqsut active harvester; Experience timeline: 2004; Experience location: Just up the river. SRB&A Interview 2007) (SRB&A 2009)

Other factors that need to be looked at are unknown toxins. Take samples at the DEW line (old military sites) along the coast at Oliktok Point. When we first came in 1973, there were so many barrels and debris scattered around. There was a lot of dumping early on that was just buried over and now this has created a problem with the onset of erosion. I think these could be some factors affecting the water. (Nuiqsut) (MBC Applied Environmental Sciences 2004)

So we don't have good data sets to know what are all these things, but I know we have a tremendous amount of asthma. We have a tremendous amount of diabetes. We have a tremendous amount of heart disease. We have a tremendous amount of obesity. We have a tremendous amount of thyroid disease. These are all different things that are happening to our people, without the studies to assess what's going on, but we have only one industry that are contributing tons of emissions to the air that we breathe, the animals that we depend on, to the waters that we feed our families from and that we feed our -- we give to our families to drink, to bathe, to hunt, to fish in. (Utqiaġvik) (BLM 2014b)

I know our health care system can't afford the cost that respiratory illness is causing our region right now. This data isn't even there to fully assess how much our exposure is, because the data sets are mixed into a very difficult assessment process where you have to know who the people are, where you're reading it from, to know where to get the data sets from. Some of our information might be in the village, some of it might be in Barrow, some of it might be in Fairbanks, some of it might be in Anchorage, some of it is nonexistent, but the cost is tremendous for one person on a ventilator for a short period of time. Our village suffered 10 people at one time on a ventilator. That's a small village. Why? Why? Why? I still don't have the answers, but I'm still here asking these serious questions. I want to believe that not all my grandchildren will need inhalers to breathe because there are many that do and some of them are very serious. When there's flares that are going on and there's lots of them, those are hard days for people who have trouble breathing and it's serious. This is a drawing point in the sand. Clean up *what you've already done before you get into this area because the devastation is going to be tremendous.* (Utqiaġvik) (BLM 2014b)

There's a lot of social and health impacts because we're connected to the food chain and we eat the fish and caribou and, you know we, for the past 2–3 years we've been having the fish crisis, we're getting more fish that are being sick. I know of an elder family that don't even fish in the rivers no more they now go to the lakes because they know the river's contaminated by the legacy wells that eroded into the river by Umiat coming down and coming from up river going down to the ocean. (Nuiqsut) (Brown et al. 2016)

Like maybe there is something we have to do to protect ourselves if there is some type of adverse event, if there is gas in the air or drilling mud. And you know, the drilling mud has chemicals in it. and It sits there, but it dries up pretty easily and it can easily get into our air. It can get turned to dust. And that, because, you know, it is so windy it can dry pretty fast and you know, particulates from that dust can get in the air and that can really affect a lot of people's respiratory especially around here, people have– they are more susceptible to respiratory issues because of that. And there's a lot of people that have sensitivities, they have asthma, the have… you know. Some people are more sensitive to those kinds of things. And the younger they are, and the older – the risk is even more. (Nuiqsut) (BLM 2016a)

I have a concern on air quality too, we've had concerns on the Alpine and we didn't know how much of a concern it was until Alpine came out of what air quality, that's going to be a major concern for the village, we've seen some gathering stations in Prudhoe where they pollute quite a bit, especially during the winter where it's real visible, so that's going to be another real concern of the village is air quality. We have quite a few numbers of children with asthma and bronchitis cases and we still haven't figured out exactly where's that coming from and how's that affecting the village, it's not only children, it's adults as well with bronchitis and asthma that didn't occur, these disease until later in their lives and that now occurring in Nuiqsut, most of these cases, so air quality is a big concern of mine. (Nuiqsut) (BLM 1997b)

And when you look at the cause of death, you will see a lot of suicide. And if you want to know why there is suicide, let me tell you something. These Elders taught us, you know, how we lived, who we are, and how proud we are supposed to be. Taught us how to hunt. And then these children of ours get big enough to go do that, what do they run into? State law that says no, federal law that says no, oil development that have destroyed the land. This is the reason for suicide amongst our young kids, something that should have never happened. We can't stop it. All we can do is try to teach them how to be proud of who they are. (Utqiaġvik) (MMS 2009a)

And I'd just like to say that, you know, with the air emission, the air quality, it is not being analyzed. It's not being looked at. We have a lot of people with chronic illnesses that is being ignored. A lot of lung disease that -- that -- that federal, state government and other agencies have not even looked at. (Nuiqsut) (MMS 2009b)

When you look at the North Slope, we have the highest suicide rates of our youngsters. I lost two of my brothers. They both worked in the oil patch. One was a truck driver. They couldn't take it anymore and they both killed themselves. I can't afford that. I've got kids. When you teach a child what kind of culture and what kind of things their ancestors did, you can go into any village and you will end up with the same story.

Teenagers, some of them in their pre-teens. You show them the longest lasting culture and they get to watch it die in their minds. I'm not worried because it's not going to die, but they don't know it. There's not one family who hasn't lost someone like that. There's going to be a dying peak in the next three to four years (of elders in the community). There was no oil and gas when I was valedictorian. I learned what I was taught. (Barrow active harvester; Experience timeline: since 1971 and ongoing; Experience location: The whole state of Alaska. SRB&A Interview 2007) (SRB&A 2009)

The worst part of it is, is the social disruption that occurs to our families. When you have the young hunter that's gone out and now this $10,000 snow machine is broken and the parts to replace it cost $500, but it costs over $100 to even attempt to go out to do a short hunt, it's tremendous impacts to what we're thinking about, but when you have those young men commit suicide because they can't find a way to understand the changes to our lands and the changes to our way of life and the value they are felt (sic) as hunters to our village, it's a big problem for our whole community. When our young hunters see the infrastructure and they can make the logical decision that it's not logical to try and go out into traditional lands because you can't harvest in the way that our elders have taught us to. That's tremendous impacts. (Utqiaġvik) (BLM 2014b)

There's no way for people to be protected from the air pollution. Its ultra fine particulate matter from these diesel exhaust emissions from all these drilling rig emission. All the big risk that's coming from oil and gas development rigs catching on fire or, not just the rigs, the chances for that—explosions happening. Cranes and equipment catching fire. All of that happened last year. There was, you know, a crane caught on fire and it was near the pipeline. What chances of that happening for a pipeline explosion are great, the risks and the chances are great. Yeah, for what little resources they want to get from the oil and gas underneath. But the chances of the oil still happening and the risk of all the air pollution greatly harming the people, all of that—those are not being monitored. All that always ozone being created—the warmer temperatures being created from all of this oil and gas industries are creating warmer temperatures. All those warmer temperatures are increasing all the ozone in the air and they say, well, there's not very much ozone and what they don't even monitor for it. They don't even put it in their analysis. How much of that ozone is in our air and it's affecting our children and is affecting our elders? It's affecting people's health. And they're not even trying to even acknowledge that. There's not even a working system for the state of Alaska or the health department or the planning department or the North Slope Borough to even come together to even understand those issues of the health impacts. (Nuiqsut) (BLM 2019c)

Like maybe there is something we have to do to protect ourselves if there is some type of adverse event, if there is gas in the air or drilling mud. And you know, the drilling mud has chemicals in it. and It sits there, but it dries up pretty easily and it can easily get into our air. It can get turned to dust. And that, because, you know, it is so windy it can dry pretty fast and you know, particulates from that dust can get in the air and that can really affect a lot of people's respiratory especially around here, people have– they are more susceptible to respiratory issues because of that. And there's a lot of people that have sensitivities, they have asthma, the have… you know. Some people are more sensitive to those kinds of things. And the younger they are, and the older – the risk is even more. (Nuiqsut) (BLM 2016a)

A lot of people have been getting sick from the air lately. There are a lot of people that have been getting bronchitis and pneumonia for how many years. My buddy worked *with the air quality people over here and he put out air canisters. He is still waiting to see the results of the air quality out here.* (Nuiqsut) (SRB&A Unpublished-b)

She has noticed a change in the air as the industry was working westward. None of our people got sick and no one experienced any strange odors. We noticed our air started to change. Today the air has changed a lot. The air is blowing towards the village and today we are experiencing the problems with Alpine too. The blowout has really affected the village big time. (Nuiqsut) (SRB&A Unpublished-b)

I've been here -- a resident since then. I've seen some changes since I've been here, and mostly in the air quality portion. There's a lot of air pollution coming from a lot of this exploration and developments that are going on, especially with oil and gas industries. There's a lot of risk that come with the oil and gas industries in -- in our area. There's a lot of risk of blowout, fires, and a lot of hazardous air pollutants that are being produced from all of these developments with the flaring going on, with a lot of things going on here, especially with utilizing a lot of diesel equipment. There's a lot of diesel exhaust being produced. And a lot of the times, these diesel vehicles will be parked or running and idling and they'll be producing a lot of emissions, and it's at a ground level. This is where we breathe. A lot of our people are being impacted health wise. There's so many health problems that come with breathing in oil and gas development emissions, especially even from the diesel exhaust. Brings on cardiovascular health issues. It brings respiratory health issues to our people here. (Nuiqsut) (BLM 2018c)

If you talk to the elders every one of them takes oxygen. I don't know why, some of these elders can't breathe sometimes. It makes me worried. What happens if that blowout air comes over here? There are going to be a lot of sickness that comes from that. (Nuiqsut) (SRB&A Unpublished-b)

Sharing and Community Networks

Our Inupiat way of life is centered around sharing what food is available. We also exchange fish with other villages of the North Slope so that, in return, they may send us what they have that we don't have. The stores supplies only supplement food like milk for the babies. The main plane that carries our supplements does not come in for weeks in the wintertime when the weather is bad. Trisa Hopson. (Nuiqsut) (MMS 1979b)

And we support the villages up north, like Nuiqsut I know they will also have that problem like we have had in the years since the pipeline had come. And if those other villages stop having caribou too, when our caribou doesn't come around those villages up north they gather up money somewhere to bring us caribou. They go out hunting and take just caribou to bring up here because that's the only food we eat up here. We do eat fish, too, but we only have little graylings in our river. And they're usually easy to catch around last part of July and August in our little river. Delia Ahgook. (Anaktuvuk Pass) (BLM 1998d)

The other thing is, we share our food. I just sent over 3,000 pounds of Arctic cisco to Barrow to Wainwright and that's every year. We share with family across the North Slope and that's going to affect not just this community with our Arctic cisco, it's going to affect the North Slope. (Nuiqsut) (MMS 2006)

No, not enough. One caribou will feed your family but you got to worry about other families too. If you catch one you can't just keep it, so you have to share it between *households. I would say about 10 [caribou is ideal]. Yeah – 10 or 12 [caribou], that would be enough to last all winter. When you haven't had it in a while and someone brings it over it is so exciting, when someone brings it over it is like a delicacy now, it is like a treat now. Caribou are so hard to find now, it is such a treat. When you catch one it is gone in a week because you are sharing it between so many families. We all watch out for each other when it comes to caribou. The other day a buddy of mine dropped off a caribou. There were 13 of us living in my house, so that one caribou went a long way for us. My kids, they love it. When you cut it up they can't get enough.* (Nuiqsut) (SRB&A 2015)

4.0 References

ABR Inc., Sigma Plus Statistical Consulting Services, Stephen R. Braund & Associates, and Kuukpik Subsistence Oversight Panel Inc. 2007. Variation in the Abundance of Arctic Cisco in the Colville River: Analysis of Existing Data and Local Knowledge. OCS Study MMS 2007-042. The U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, Environmental Studies Section. Fairbanks, AK. Available online at http://www.arlis.org/docs/vol1/226506635v2.pdf; http://www.arlis.org/docs/vol1/226506635v1.pdf.

BLM, (Bureau of Land Management). 1982. National Petroleum Reserve-Alaska (Npr-a). Subsistence Hearings. Barrow, Alaska. November 22, 1982. U.S. Department of the Interior.

_____. 1997a. Npr-a Integrated Activity Plan Environmental Impact Statement. Scoping Meeting. Barrow, Alaska. March 17, 1997. U.S Department of the Interior.

_____. 1997b. Npr-a Integrated Activity Plan Environmental Impact Statement. Scoping Meeting. Nuiqsut, Alaska. April 10, 1997. U.S Department of the Interior.

_____. 1998a. National Petroleum Reserve-Alaska. Public Hearings. Barrow, Alaska. January 13, 1998.

_____. 1998b. National Petroleum Reserve-Alaska. Public Hearings. Anaktuvuk Pass, Alaska. January 15, 1998. U.S. Department of the Interior.

_____. 1998c. National Petroleum Reserve-Alaska. Public Hearings. Nuiqsut, Alaska. January 14, 1998. U.S. Department of the Interior.

_____. 1998d. Volume 2 of the Northeast National Petroleum Reserve-Alaska Iap/Eis. Anaktuvuk Pass Public Hearing Testimony Excerpts.

_____. 2002. Final Environmental Impact Statement, Renewal of the Federal Grant for the Trans-Alaska Pipeline System Right of Way. Public Hearing Transcripts. August 9, 2002. Barrow, Alaska.

_____. 2003a. Alpine Satellite Development Plan Environmental Impact Statement. Transcript of Scoping Meeting Proceedings. Barrow, Alaska. March 17, 2003. U.S. Department of the Interior.

_____. 2003b. Alpine Satellite Development Plan Environmental Impact Statement. Transcript of Scoping Meeting Proceedings. Nuiqsut, Alaska. March 18, 2003. U.S. Department of the Interior.

_____. 2003c. Draft Integrated Activity Plan/ Environmental Impact Statement Northwest Portion, National Petroleum Reserve-Alaska. Anaktuvuk Pass, Alaska. February 19, 2003.

_____. 2003d. Scoping Meeting. In Re: Amendment to the Northeast Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement. U.S. Deparment of the Interior. Barrow, Alaska.

_____. 2004a. Burea of Land Management Public Hearing Atqasuk, Alaska in Re: Anilca 810 Analysis for the Amended Iap/Eis of the Northeast Npr-a Transcript of Proceedings.

_____. 2004b. Bureau of Land Management Public Hearing Atqasuk, Alaska in Re: Amendment to the Northeast National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement: Transcript of Proceedings Atqasuk, Alaska.

_____. 2004c. Bureau of Land Management Public Hearing Barrow, Alaska in Re: Amendment to the Northeast National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement: Transcript of Proceedings. August 12, 2004. Barrow, Alaska.

_____. 2004d. Public Hearing. In Re: Amendment to the Iap/Eis of the Northeast Npr-A. Transcript of Proceedings. Nuiqsut, Alaska Kisik Community Center. U.S. Department of the Interior.

_____. 2004e. Public Hearing. In Re: Anilca 810 Analysis for the Amended Iap/Eis of the Northeast Npr-A. Transcript of Proceedings. Nuiqsut, Alaska Kisik Community Center.

_____. 2004f. Public Hearing. In Re: Anilca 810 Analysis for the Amended Iap/Eis of the Northeast Npr-A. Transcript of Proceedings. Barrow Native Heritage Center. November 5, 2004. U.S. Department of the Interior.

_____. 2007. Northeast National Petroleum Reserve-Alaska Draft Integrated Activity Plan and Environmental Impact Statement. Transcript of Public Meeting Proceedings. October 9, 2007. Anaktuvuk Pass, Alaska.

_____. 2014a. Greater Moose's Tooth Unit 1 Supplemental Environmental Impact Statement Public Participatino/ Anilca 810 Hearing Point Lay, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/37035/47799/53746/GMT1_PTLay_FINAL.pdf.

_____. 2014b. Greater Mooses Tooth Unit 1 Supplemental Environmental Impact Statement Public Participation/ Anilca 810 Hearing Barrow, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/37035/47801/53748/GMT1_Barrow_FINAL.pdf.

_____. 2014c. Greater Mooses Tooth Unit 1 Supplemental Environmental Impact Statement Public Participation/ Anilca 810 Hearing Nuiqsut, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/37035/47802/53749/GMT1_Nuiqsut_FINAL.pdf.

_____. 2014d. Supplemental Environmental Impact Statement Public Participation/Anilca §810 Hearing. Nuiqsut, Alaska. March 13, 2014. U.S Department of the Interior.

_____. 2016a. Meeting Proceedings (Public Comments) Greater Moose's Tooth 2 Seis Public Scoping Meeting #1 Nuiqsut, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/65817/89370/106877/2016_8_22_NUI_GMT2_scoping_meeting_transcript.pdf.

_____. 2016b. Meeting Proceedings (Public Comments) Greater Moose's Tooth 2 Seis Public Scoping Meeting #2 Nuiqsut, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/65817/89371/106878/2016_9_27_GMT2_Scoping_Meeting_2_NUI_transcript.pdf.

______. 2018a. National Petroleum Reserve in Alaska (Npr-a) Public Meeting: Scoping for the National Petroleum Reserve in Alaska Integrated Activity Plan Public Scoping Meeting. Anaktuvuk Pass, AK.

______. 2018b. Willow Master Development Plan Scoping Meeting Anaktuvuk Pass, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/158634/193866/Willow_Project_Anaktuvuk_Pass.pdf.

______. 2018c. Willow Master Development Plan Scoping Meeting Nuiqsut, Alaska. Available online at https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/158637/193869/Willow_Project_Nuiqsut.pdf.

______. 2019a. National Petroleum Reserve in Alaska (Npr-a) Integrated Activity Plan and Environmental Impact Statement Public Scoping Meeting: Transcript for Public Scoping Meeting at the Inupiat Heritage Center. Utkiagvik, Alaska.

______. 2019b. National Petroleum Reserve in Alaska (Npr-a) Integrated Activity Plan and Environmental Impact Statement Public Scoping Meeting: Transcript for Public Scoping Meeting at the Point Lay Community Center. Point Lay, AK.

______. 2019c. National Petroleum Reserve in Alaska (Npr-a) Public Meeting: Scoping for the National Petroleum Reserve in Alaska Integrated Activity Plan Public Scoping Metting. Nuiqsut, AK.

______. 2019d. National Petroleum Reserve in Alaska (Npr-a) Public Meeting: Scoping for the National Petroleum Reserve in Alaska Integrated Activity Plan Public Scoping Metting: Transcript for Public Scoping Meeting at the Wainwright Community Centr. Wainwright, AK.

______. 2019e. National Petroleum Reserve in Alaska Public Meeting: Scoping for the National Petroleum Reserve Inalaska Integrated Activity Plan. Saturday, January 5, 2019. Nuiqsut, Alaska.

BOEM, (Bureau of Ocean Energy Management). 2011. 2012-2017 Five-Year Scoping Meeting for Programmatic Environmental Impact Statement. Transcript of Scoping Meeting Proceedings. Nuiqsut, Alaska. February 22, 2011. U.S. Department of the Interior.

BOEM, (Bureau of Ocean Energy Management), and (Bureau of Safety and Environmental Enforcement) BSEE. 2013. Listening Session No. 2. Barrow, Alaska June 7, 2013. U.S. Department of the Interior.

Braem, Nicole M., Elizabeth H. Mikow, Andrew R. Brenner, Anna R. Godduhn, Brittany Retherford, and Marylynne L. Kostick. 2017. Chukchi Sea and Norton Sound Observation Network: Harvest and Use of Wild Resources in 9 Communities in Arctic Alaska, 2012-2014. Technical Paper No. 403. Alaska Department of Fish and Game, Division of Subsistence. Available online at http://www.adfg.alaska.gov/techpap/TP403.pdf.

Braund, S., P. Lawrence, E. Sears, S. Schraer, E. Regehr, B. Adams, R.T. Hepa, J.C. George, and A. Von Duyke. 2018. Polar Bear Tek: A Pilot Study to Inform Polar Bear Management Models. Research Report NSB.DWM.RR 2018-01. North Slope Borough Department of Wildlife Management. Utqiagvik, Alaska.

Brewster, K., and C. George. No Date. Inupiat Knowledge of Selected Subsistence Fish near Barrow, Alaska. Funded by the Bureau of Land Management through an Assistance Agreement to the North Slope Borough Department of Wildlife Management.

Brown, Caroline L., Nicole M. Braem, Elizabeth H. Mikow, Alida Trainor, Lisa J. Slayton, David M. Runfola, Hiroko Ikuta, Marylynne L. Kostick, Christopher R. McDevitt, Jeff Park, and James J. Simon. 2016. Harvests and Uses of Wild Resources in 4 Interior Alaska Communities and 3 Arctic Alaska Communities, 2014. Technical Paper No. 426. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.adfg.alaska.gov/techpap/TP426.pdf.

Brown, William E. 1979. Nuiqsut Paisanich: Nuiqsut Heritage, a Cultural Plan. Prepared for the Village of Nuiqsut and the North Slope Borough Planning Commission on History and Culture. Arctic Environmental Information and Data Center. Anchorage, Alaska.

Carothers, C., S. Cotton, and K. Moerlein. 2013. Subsistence Use and Knowledge of Salmon in Barrow and Nuiqsut, Alaska. Final Report. OCS Study BOEM 2013-0015. University of Alaska. Coastal Marine Institute.

EDAW Inc., Adams/Russel Consulting, Applied Sociocultural Research, Donald G. Callaway, Circumpolar Research Associates, and Northern Economics. 2008. Quantitative Description of Potential Impacts of Ocs Activities on Bowhead Whale Hunting Activities in the Beaufort Sea. MMS OCS STUDY # 2007-062. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at https://www.boem.gov/BOEM-Newsroom/Library/Publications/2007/2007_062.aspx.

FEA, (Federal Energy Administration). 1976. Federal Energy Hearings. Public Hearings. Barrow, Alaska. April 10, 1976.

HDR Alaska, Inc. 2015. Nanushuk Project Cultural Resources and Subsistence Technical Report. A1-000-GE-RV-4H-0008 Rev 3: Repsol.

Mager, K. H. 2012. "Population Structure and Hybridization of Alaskan Caribou and Reindeer : Integrating Genetics and Local Knowledge."Thesis (Ph D), University of Alaska Fairbanks, 2012. 'Available online.

MBC Applied Environmental Sciences. 2004. Proceedings of the Workshop on the Variability of Arctic Cisco (Qaaktaq) in the Colville River : November 18, 19, and 20, 2003, Kisik Community Center, Nuiqsut, Alaska. OCS study. MMS 2004-033. U.S. Department of the Interior, Minerals Management Service. Springfield, Va. Available online at http://www.boem.gov/BOEM-Newsroom/Library/Publications/2004/2004_033.aspx.

McBeath, J., and C. Shepro. 2007. "The Effects of Environmental Change on an Arctic Native Community: Evaluation Using Local Cultural Perceptions." *American Indian Quarterly* 31 (1).

MMS, (Minerals Management Service). 1979a. Federal / State Proposed Oil and Gas Lease Sale (Sale Bf). Barrow, Alaska. North Slope Borough Assembly Room. June 4, 1979. U.S. Department of the Interior.

_____. 1979b. Federal / State Proposed Oil and Gas Lease Sale (Sale Bf). Public Hearings. Nuiqsut Alaska. May 16, 1979. U.S. Department of the Interior.

_____. 1982. Proposed Oil and Gas Lease Sale in the Diapir Field (Sale 71). Public Hearings. Barrow, Alaska. Presbyterian Church. February 2, 1982. U.S. Department of the Interior.

_____. 1990. Beaufort Sea Oil and Gas Lease (Sale 124). Public Hearings. Barrow, Alaska. North Slope Borough Conference Chambers. April 17, 1990. U.S. Department of the Interior.

_____. 1997. Official Transcript-Public Hearing Barrow. Draft Environmental Impact Statement for Beaufort Sea Proposed Oil and Gas Lease Sale 170. U.S. Department of the Interior. Barrow, Alaska.

_____. 2001a. Official Transcript-Public Hearing Barrow. Draft Environmental Impact Statement for Liberty Development and Production Plan. OCS EIS/EA MMS 2001-001. U.S. Department of the Interior. Barrow, Alaska.

_____. 2001b. Official Transcript-Public Hearing Nuiqsut. Draft Environmental Impact Statement for Liberty Development and Production Plan. March 20, 2001. OCS EIS/EA MMS 2001-001. U.S. Department of the Interior. Nuiqsut, Alaska.

_____. 2006. 5-Year Ocs Oil and Gas Proposed Leasing Program. Nuiqsut Public Hearing/Meeting for the Draft Environmental Impact Statement and Proposed Program. Nuiqsut, Alaska. November 8, 2006. U.S. Department of the Interior.

_____. 2007a. Chukchi Sea Planning Area, Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea: Final Environmental Impact Statement. Anchorage, Alaska: Minerals Management Service U.S. Department of the Interior, Alaska OCS Region.

_____. 2007b. Programmatic Deis Seismic Surveys in the Beaufort and Chukchi Seas. Public Hearing/Meeting. Barrow, Alaska. April 26, 2007. U.S. Department of the Interior.

_____. 2007c. Programmatic Deis Seismic Surveys in the Beaufort and Chukchi Seas. Public Hearing/Meeting. Nuiqsut, Alaska. April 17, 2007. U.S. Department of the Interior.

_____. 2009a. Public Hearing for Draft Environmental Impact Statement, Minerals Management Service Proposed Arctic Multi-Sale. Barrow, Alaska. February 6, 2009. U.S. Department of the Interior.

_____. 2009b. Public Hearing for Draft Environmental Impact Statement, Minerals Management Service Proposed Arctic Multi-Sale. Nuiqsut, Alaska. February 4, 2009. U.S. Department of the Interior.

Spearman, Grant R., and James Mumigana Nageak. 2005. Into the Headwaters: A Nunamuit Ethnography of Fishing. [Final]. ed. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Management Program. Anchorage, Alaska. Available online at http://alaska.fws.gov/asm/pdf/fisheries/reports/02-050final-2.pdf.

SRB&A, (Braund, Stephen R. & Associates). 2003. Alpine Satellite Development Plan Final Environmental Impact Statement. Appendix A: Technical Report: Public Testimony / Traditional Knowledge by Resource.

_____. 2009. Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters. Prepared for North Slope Borough, Department of Wildlife Management. Anchorage, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/Braund%20NSB%20Oil%20and%20Gas%20Impacts%20July%2009.pdf.

_____. 2010a. Mms Ocs Study No. 2009-003: Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow. U.S. Department of the Interior Minerals Management Service, Alaska OCS Region, Environmental Studies Program. Anchorage, Alaska. Available online at https://www.boem.gov/BOEM-Newsroom/Library/Publications/2009/2009_003.aspx.

_____. 2010b. Nuiqsut Caribou Subsistence Monitoring Project: Results of 2009 Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2011a. Chukchi and Beaufort Seas National Pollutant Discharge Elimination System Exploration General Permits Reissuance: Report of Traditional Knowledge Workshops - Point Lay, Barrow, Nuiqsut, and Kaktovik. Prepared for Tetra Tech and U.S. Environmental Protection Agency.

_____. 2011b. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Two Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2013a. Comida: Impact Monitoring for Offshore Subsistence Hunting, Wainwright and Point Lay, Alaska. OCS Study BOEM 2013-211. US Department of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Available online at https://www.boem.gov/uploadedFiles/BOEM/BOEM_Newsroom/Library/Publications/BOEM_2013-0211.pdf.

_____. 2013b. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 4 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2013c. Subsistence Use Area and Traditional Knowledge Studies: Anaktuvuk Pass, Barrow, and Nuiqsut. Foothills West Transportation Access Environmental Studies. Prepared for Three Parameters Plus, Inc. and Alaska Department of Transportation and Public Facilities. Anchorage, Alaska.

_____. 2014a. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 5 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2014b. Point Lay Subsistence Use Areas and Traditional Knowledge Interviews. Supported by the North Slope Borough Department of Wildlife.

_____. 2015. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 6 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2016. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 7 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. Unpublished-a. Anaktuvuk Pass - Traditional Knowledge Workshop Responses. Workshop Held on March 13, 2012. Alaska Pipeline Project Baseline Studies. Anchorage, Alaska.

_____. Unpublished-b. Nuiqsut - Traditional Knowledge Workshop Responses. Workshops Held on March 15-16, 2012. Alaska Pipeline Project Baseline Studies. Anchorage, Alaska.

USACE, (U.S. Army Corps of Engineers). 1983. Endicott Development Project. Public Scoping Meeting. Barrow, Alaska. January 21, 1983.

_____. 2010. Point Thomson Project Eis Public Scoping Meeting. Barrow, Alaska. January 14, 2010.

Wolfe, Robert J. 2013. Sensitive Tribal Areas on the Arctic Slope. Available online at https://www.inupiatgov.com/files/North%20Slope%20Sensitive%20Tribal%20Areas%20Final%20Report.pdf.

Worl, Rosita, and Charles W. Smythe. 1986. Barrow : A Decade of Modernization : The Barrow Case Study. OCS study. no 125. The Program. [Anchorage, Alaska].