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

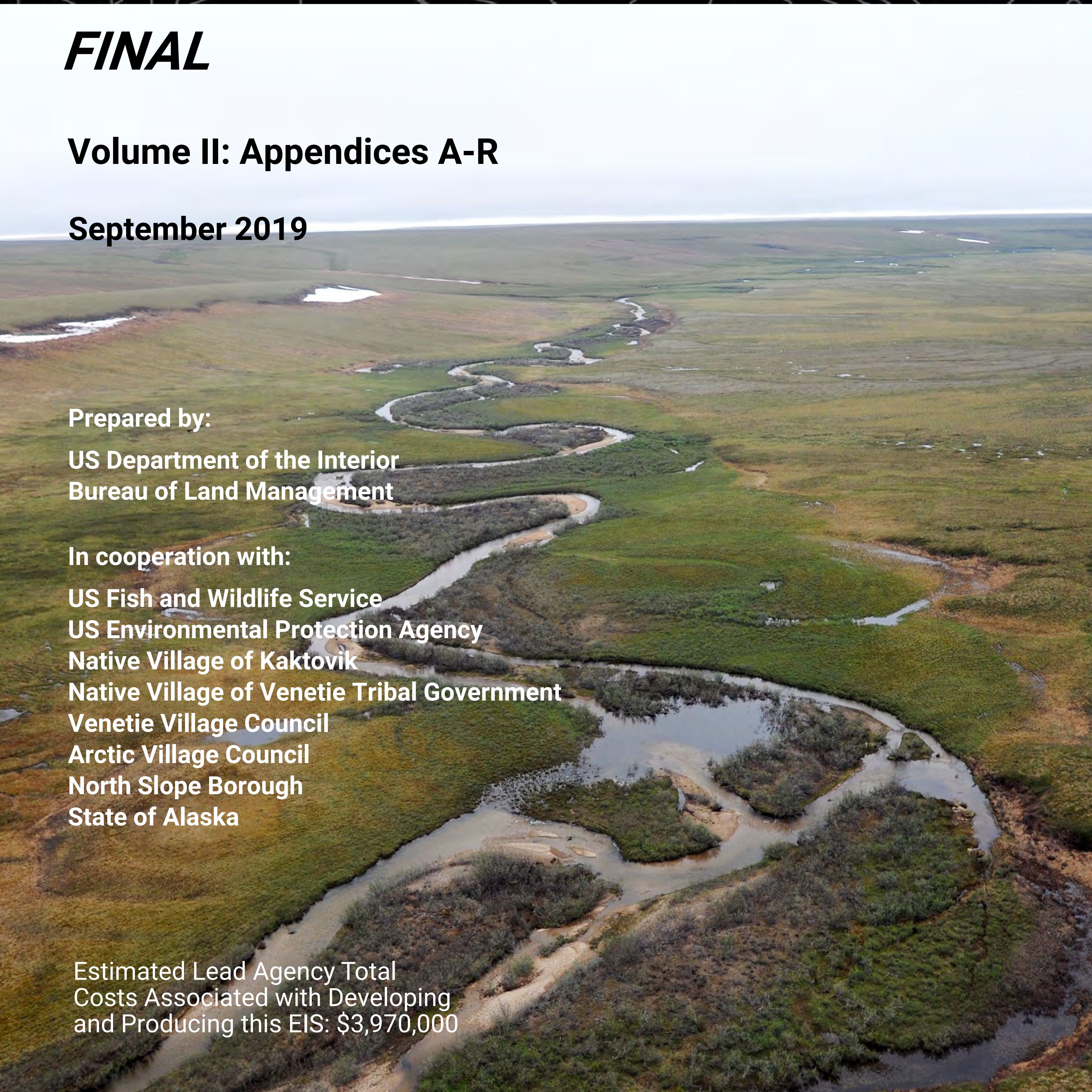
Coastal Plain Oil and Gas Leasing Program

Environmental Impact Statement

FINAL

Volume II: Appendices A-R

September 2019



Prepared by:

US Department of the Interior
Bureau of Land Management

In cooperation with:

US Fish and Wildlife Service
US Environmental Protection Agency
Native Village of Kaktovik
Native Village of Venetie Tribal Government
Venetie Village Council
Arctic Village Council
North Slope Borough
State of Alaska

Estimated Lead Agency Total
Costs Associated with Developing
and Producing this EIS: $3,970,000

Mission

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

Cover Photo: Northward view in central coastal plain area near the Sadlerochit River showing gently rolling topography typical of the area. Natural oil indications are visible of an oil seep that occurs along the coast (Barter Island). Photo by David Houseknecht (USGS).

DOI-BLM-AK-0000-2018-0002-EIS

BLM/AK/PL-19/014+1610+F020

APPENDICES

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Appendix A
Maps and Figures

APPENDIX A
Maps

APPENDIX A
Figures

Data from geographic information systems (GIS) have been used in developing acreage calculations and for generating the maps in this appendix. Calculations are dependent upon the quality and availability of data and most calculations in this EIS are rounded to the nearest one hundred acres. Given the scale of the analysis, the compatibility constraints between datasets, and lack of data for some resources, all calculations are approximate and serve for comparison and analytic purposes only. Likewise, the maps in this appendix are provided for illustrative purposes and subject to the limitations discussed above. BLM may receive additional GIS data; therefore, acreages may be recalculated and revised later.

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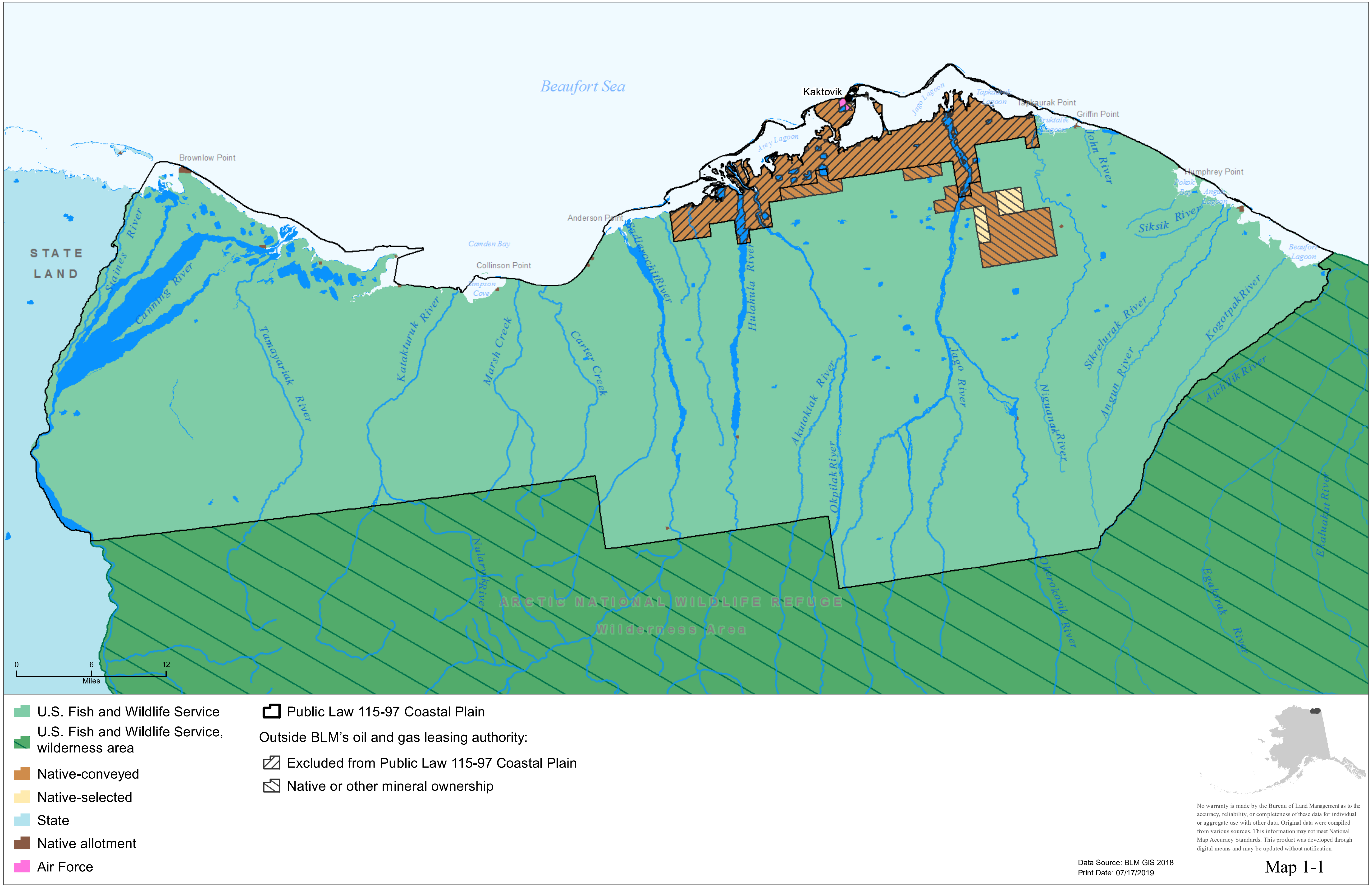
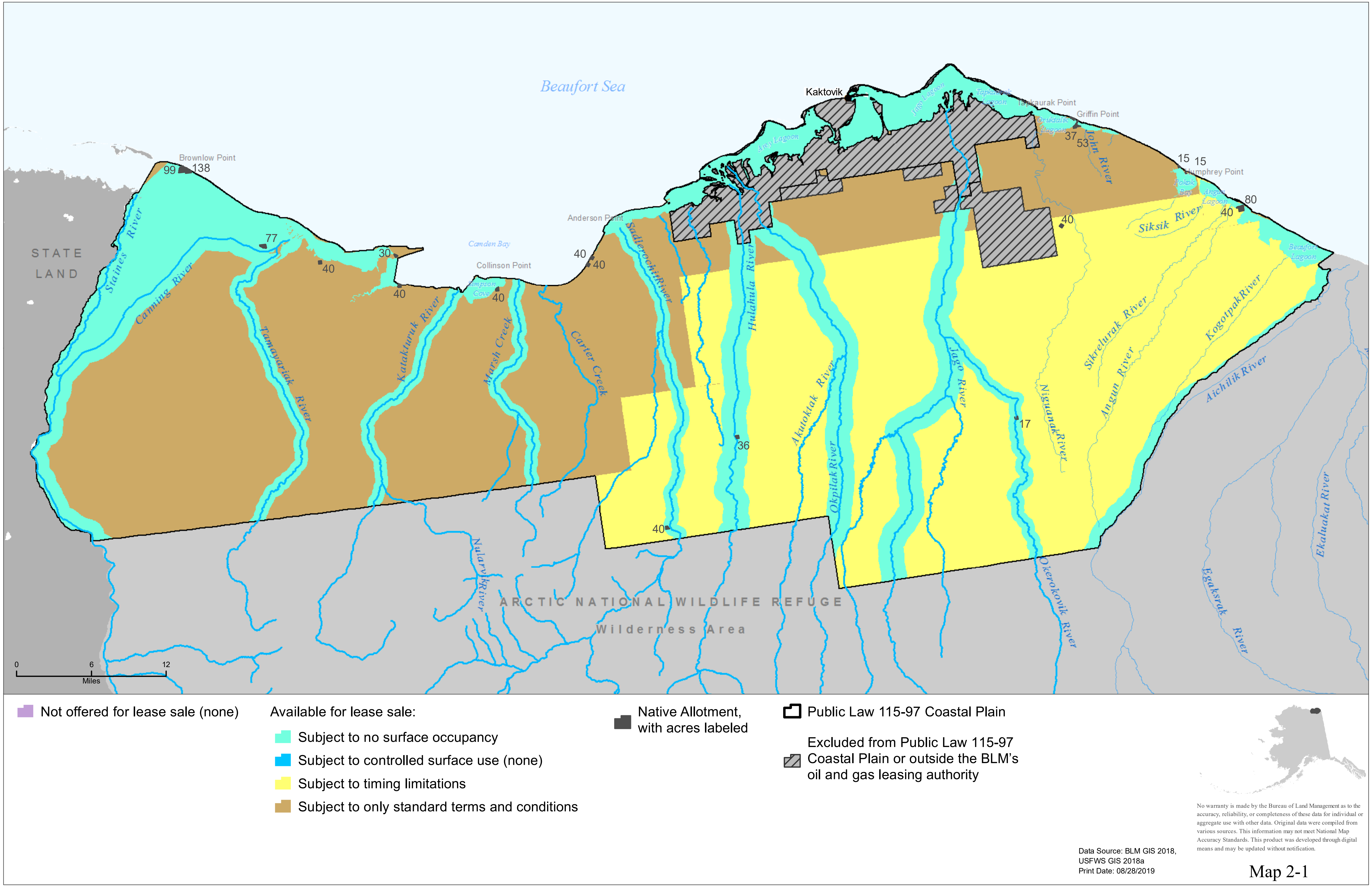
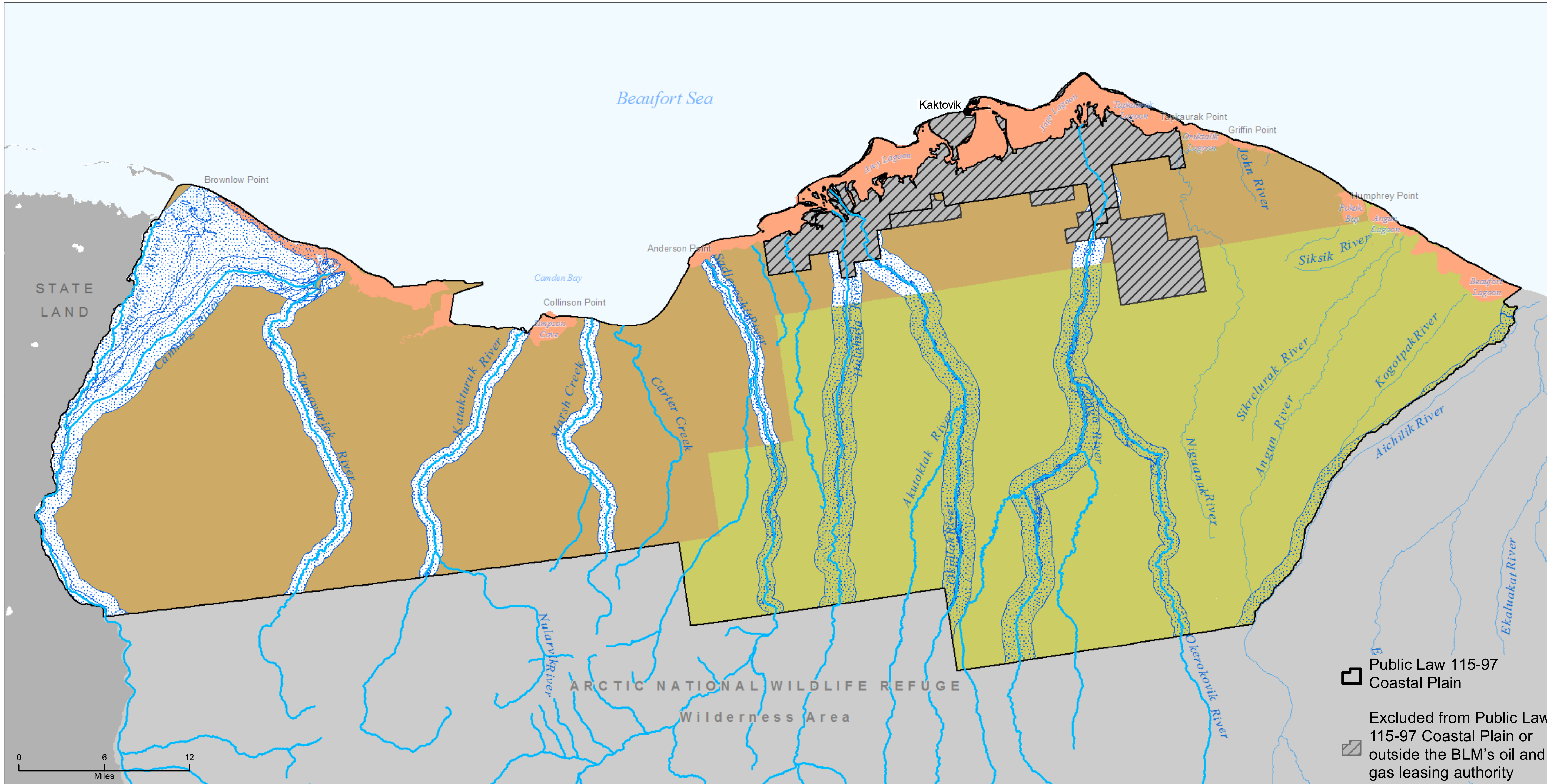

Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Tapkaurak Point
Griffin Point
Humphrey Point
Arey Lagoon
Jago Lagoon
Beaufort Lagoon
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Siksik River
Kogotpak River
Aichilik River
Egaksrak River
Ekaluakat River
Okerokovik River
Nularvik River
John River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
U.S. Fish and Wildlife Service
U.S. Fish and Wildlife Service, wilderness area
Native-conveyed
Native-selected
State
Native allotment
Air Force
Public Law 115-97 Coastal Plain
Outside BLM's oil and gas leasing authority:
Excluded from Public Law 115-97 Coastal Plain
Native or other mineral ownership
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.
Data Source: BLM GIS 2018
Print Date: 07/17/2019

Map 1-1


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
John River
Nularvik River
Okerokovik River
Egaksrak River
Ekaluakat River
99
138
77
30
40
15
80
37
53
36
17
0 6 12
Miles
Not offered for lease sale (none)
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use (none)
Subject to timing limitations
Subject to only standard terms and conditions
Native Allotment, with acres labeled
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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.
Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-1



Available for lease sale, subject to no surface occupancy

- Lease stipulation 1—rivers and streams
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration

Available for lease sale, subject to timing limitations

- Lease stipulation 7—Porcupine Caribou calving habitat

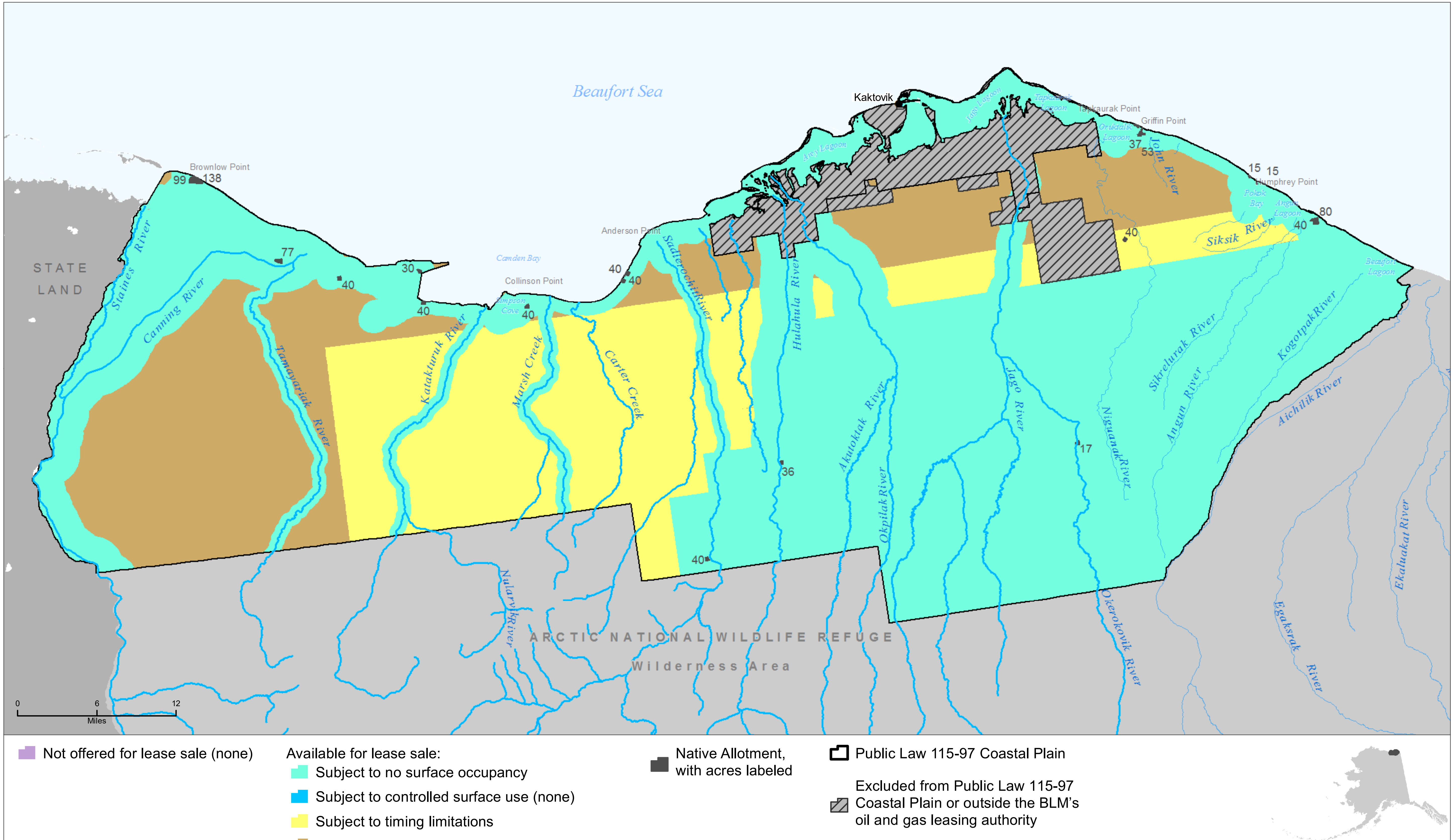
Available for lease sale

- Subject to only standard terms and conditions

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.

Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-2



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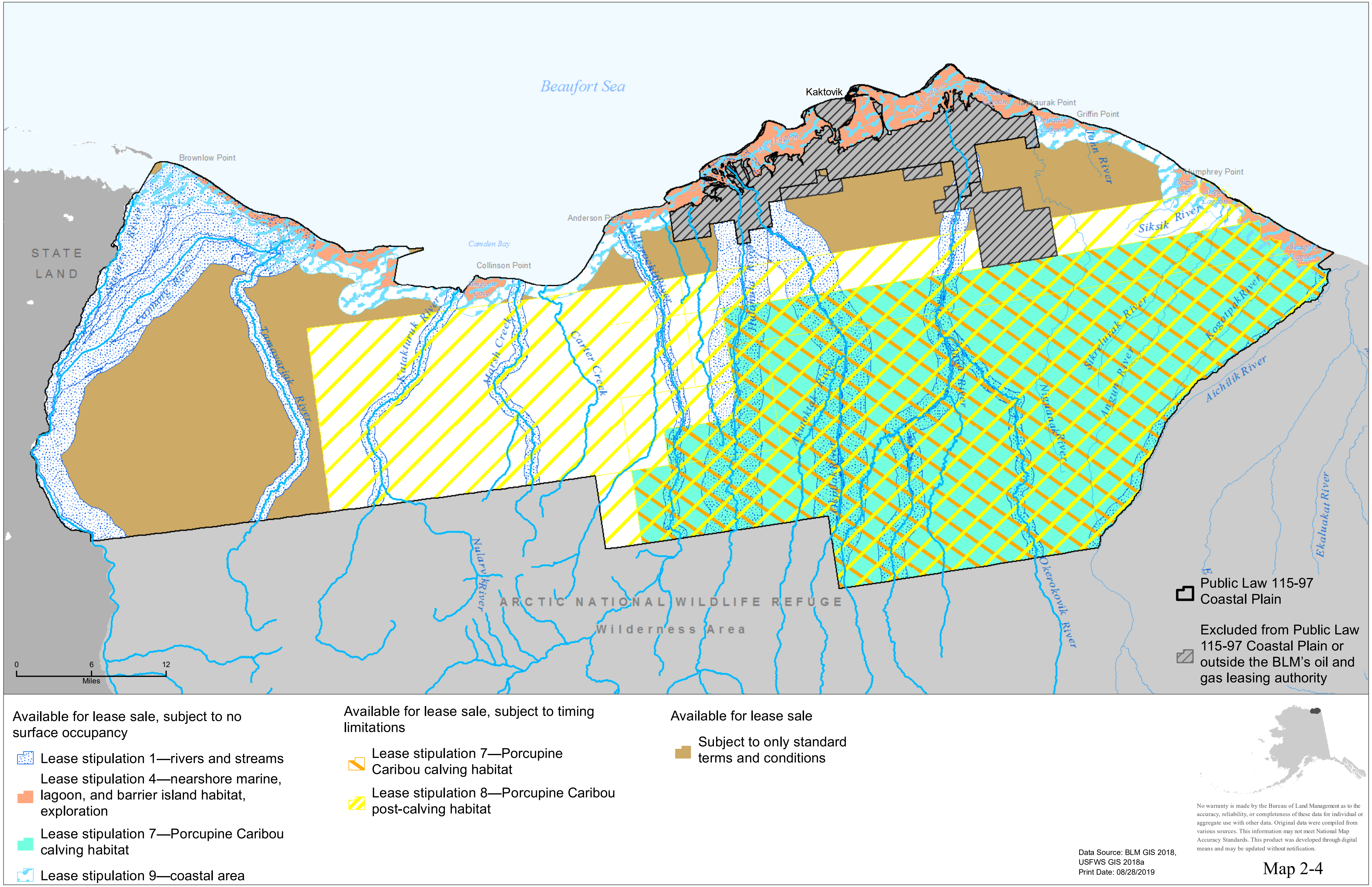
Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-3



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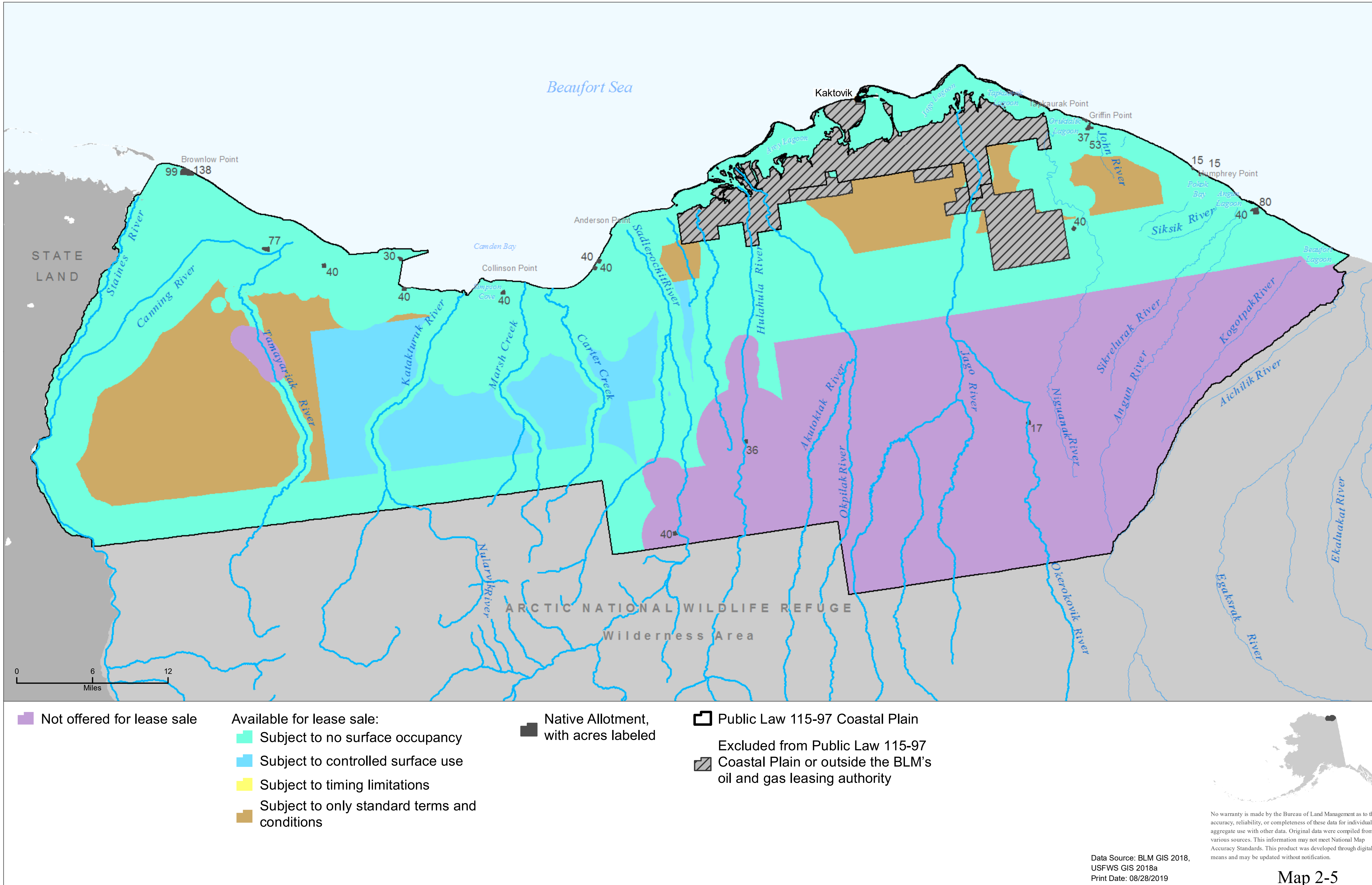
Map 2-4


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Angun River
Sikrelurak River
Kogotpak River
Aichilik River
Siksik River
John River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
99
138
77
30
40
36
17
37
53
15
80
0
6
12
Miles
Not offered for lease sale
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use
Subject to timing limitations
Subject to only standard terms and conditions
Native Allotment, with acres labeled
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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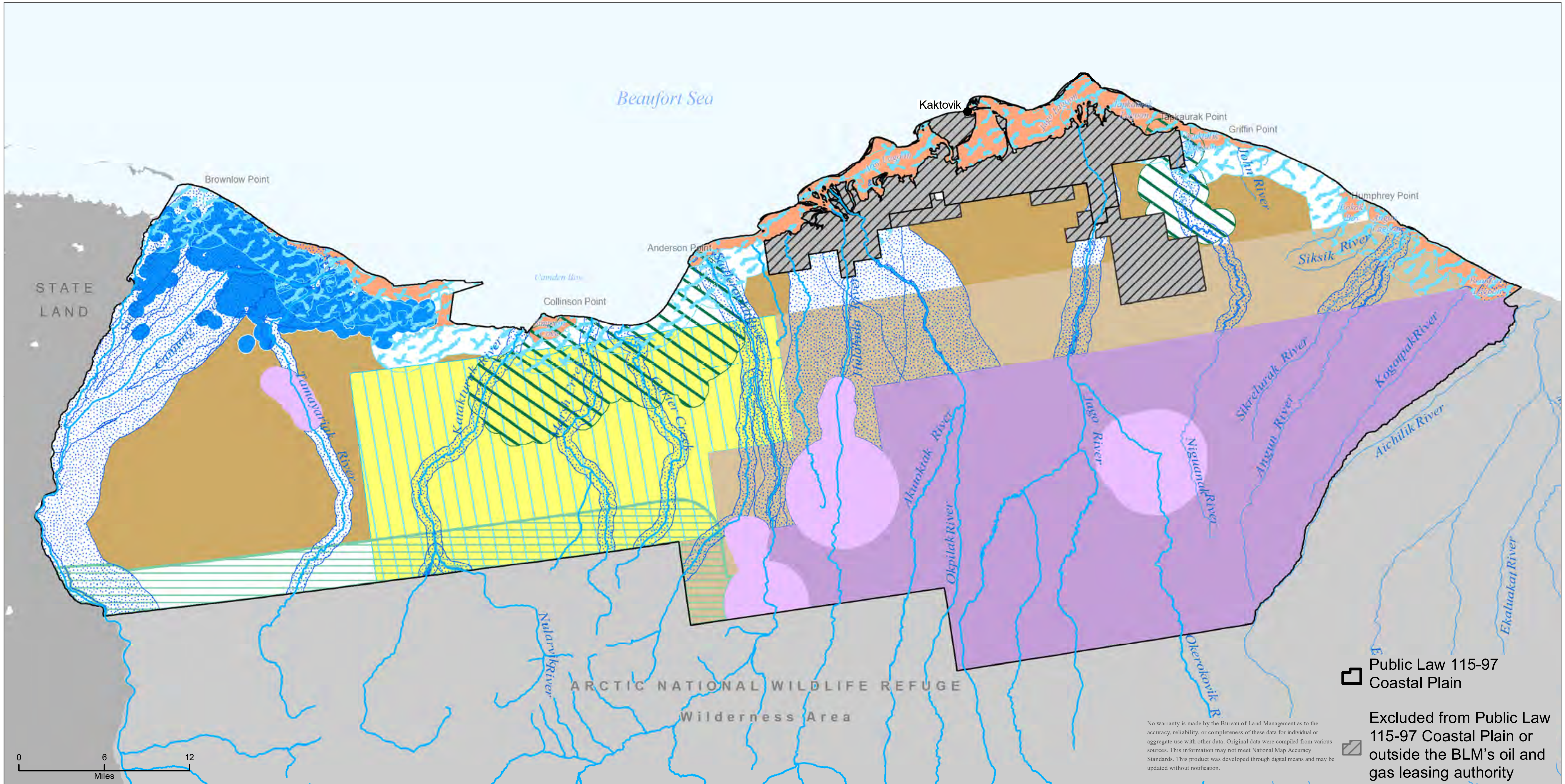
Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-5



Not offered for lease sale and not available for surface occupancy

- Lease stipulation 3—springs/aufeis
- Lease stipulation 7—Porcupine Caribou calving habitat

Available for lease sale, subject to no surface occupancy

- Lease stipulation 1—rivers and streams
- Lease stipulation 2—Canning River delta and lakes
- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration
- Lease stipulation 5—coastal polar bear river denning habitat
- Lease stipulation 7—Porcupine Caribou calving habitat
- Lease stipulation 9—coastal area
- Lease stipulation 10—Wilderness boundary

Available for lease sale, subject to timing limitations

- Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat

Available for lease sale, subject to timing limitations

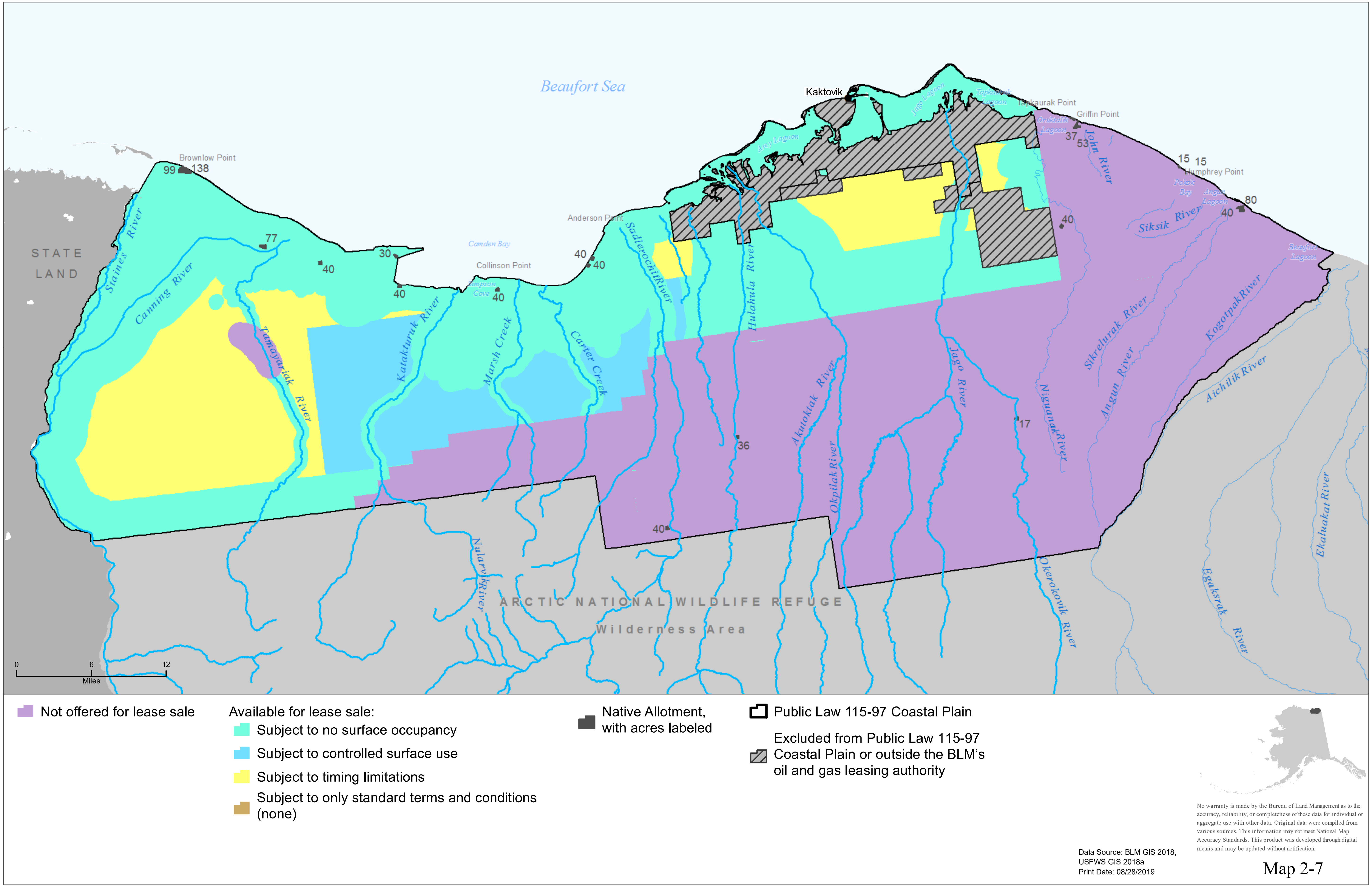
- Lease stipulation 8—Porcupine Caribou post-calving habitat

Available for lease sale

- Subject to only standard terms and conditions

Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-6


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
John River
Okerokovik River
Nularvik River
Egaksrak River
Ekaluakat River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Not offered for lease sale
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use
Subject to timing limitations
Subject to only standard terms and conditions (none)
Native Allotment, with acres labeled
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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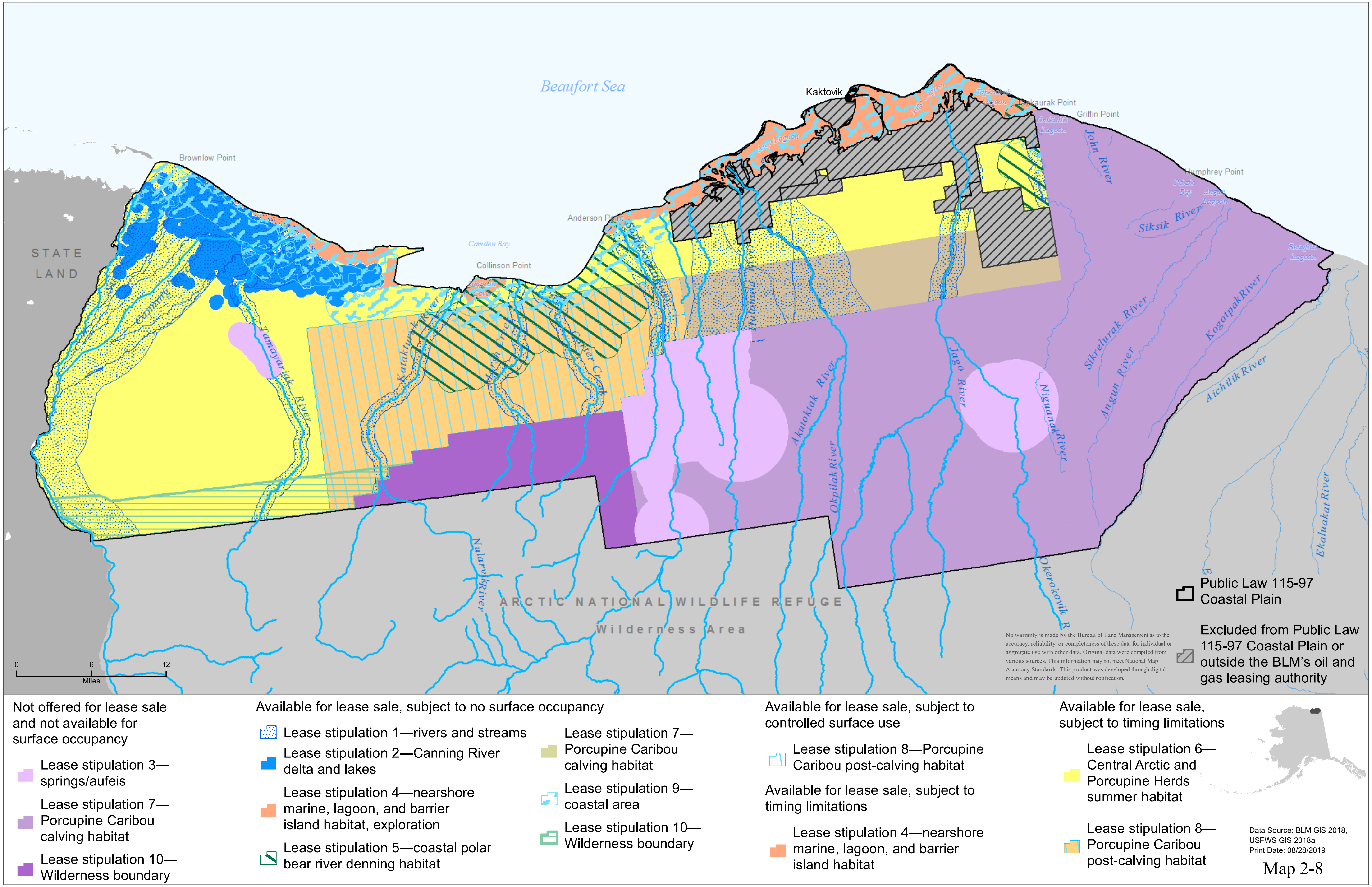
Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-7


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Tamayariak River
Katakturuk River
Jago River
Okpilak River
Akutoktak River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
John River
Okerokovik R.
Nularvik River
Ekaluakat River
Miles
0
6
12
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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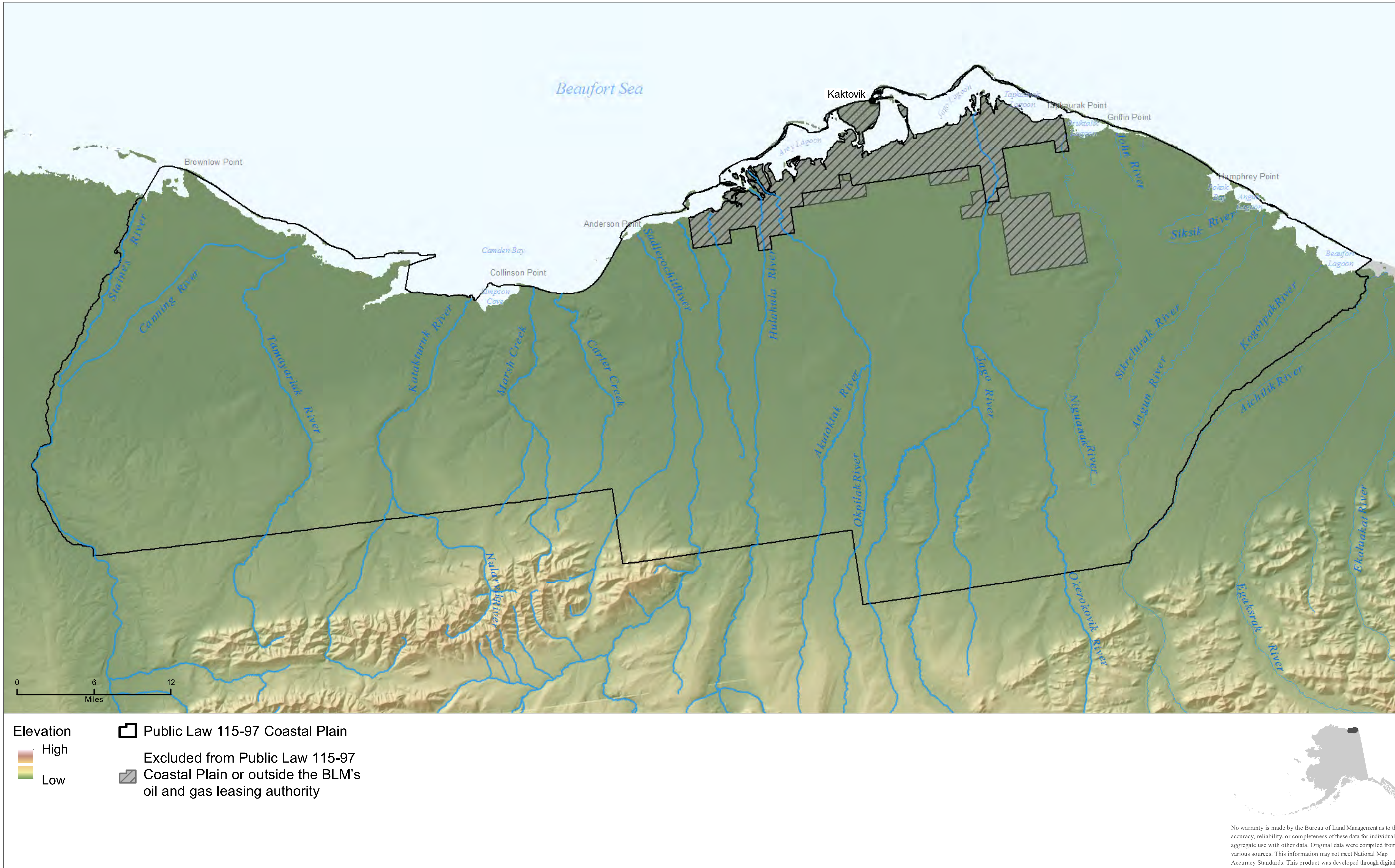
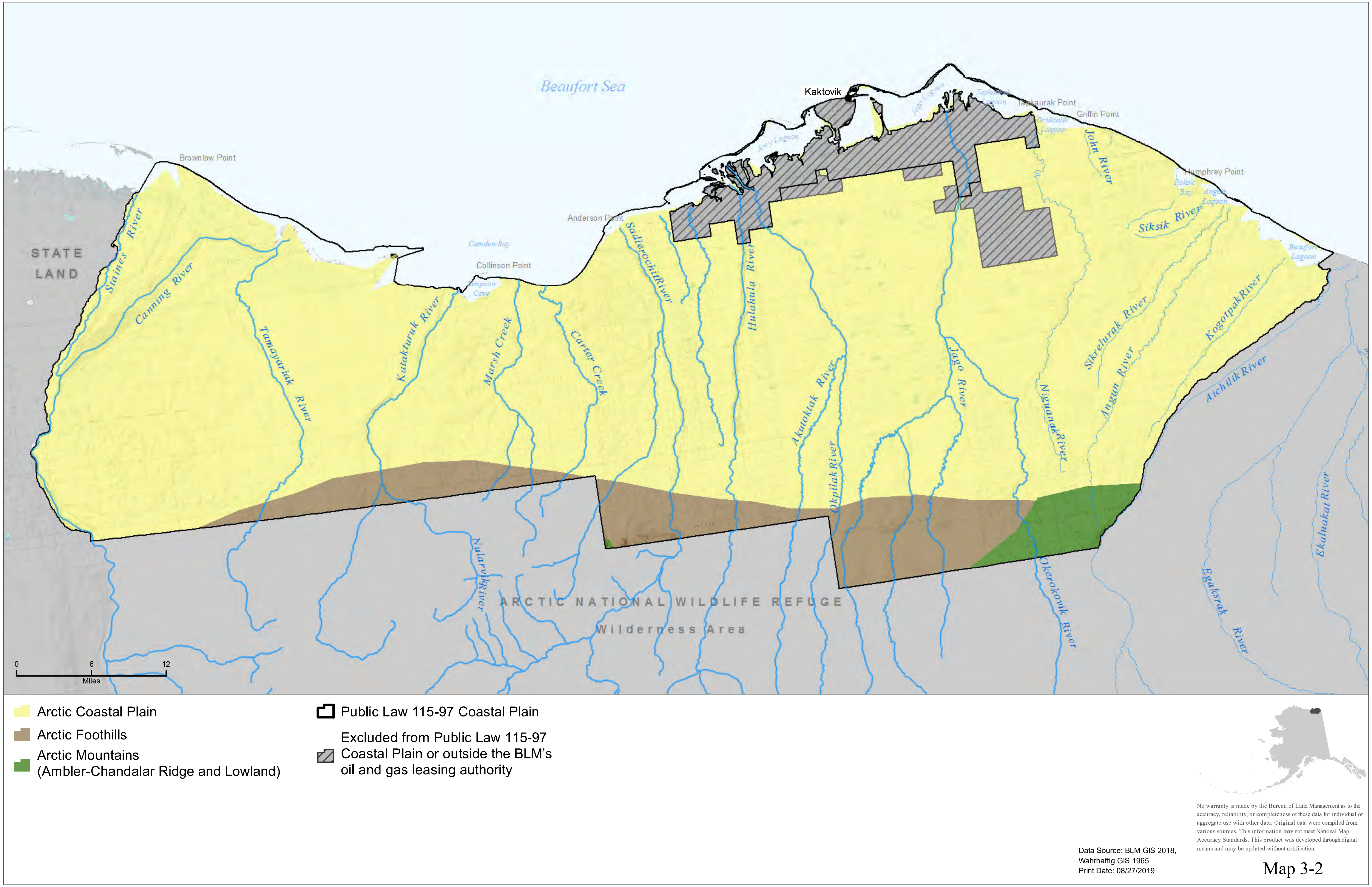
Not offered for lease sale and not available for surface occupancy
Lease stipulation 3—springs/aufeis
Lease stipulation 7—Porcupine Caribou calving habitat
Lease stipulation 10—Wilderness boundary
Available for lease sale, subject to no surface occupancy
Lease stipulation 1—rivers and streams
Lease stipulation 2—Canning River delta and lakes
Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat, exploration
Lease stipulation 5—coastal polar bear river denning habitat
Lease stipulation 7—Porcupine Caribou calving habitat
Lease stipulation 9—coastal area
Lease stipulation 10—Wilderness boundary
Available for lease sale, subject to controlled surface use
Lease stipulation 8—Porcupine Caribou post-calving habitat
Available for lease sale, subject to timing limitations
Lease stipulation 4—nearshore marine, lagoon, and barrier island habitat
Available for lease sale, subject to timing limitations
Lease stipulation 6—Central Arctic and Porcupine Herds summer habitat
Lease stipulation 8—Porcupine Caribou post-calving habitat
Data Source: BLM GIS 2018, USFWS GIS 2018a
Print Date: 08/28/2019

Map 2-8


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
Egaksrak River
Ekaluakat River
Okerokovik River
Nularvik River
0 6 12
Miles
Elevation
High
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018
Print Date: 08/27/2019

Map 3-1


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Camden Bay
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Arctic Coastal Plain
Arctic Foothills
Arctic Mountains (Ambler-Chandalar Ridge and Lowland)
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, Wahrhaftig GIS 1965
Print Date: 08/27/2019
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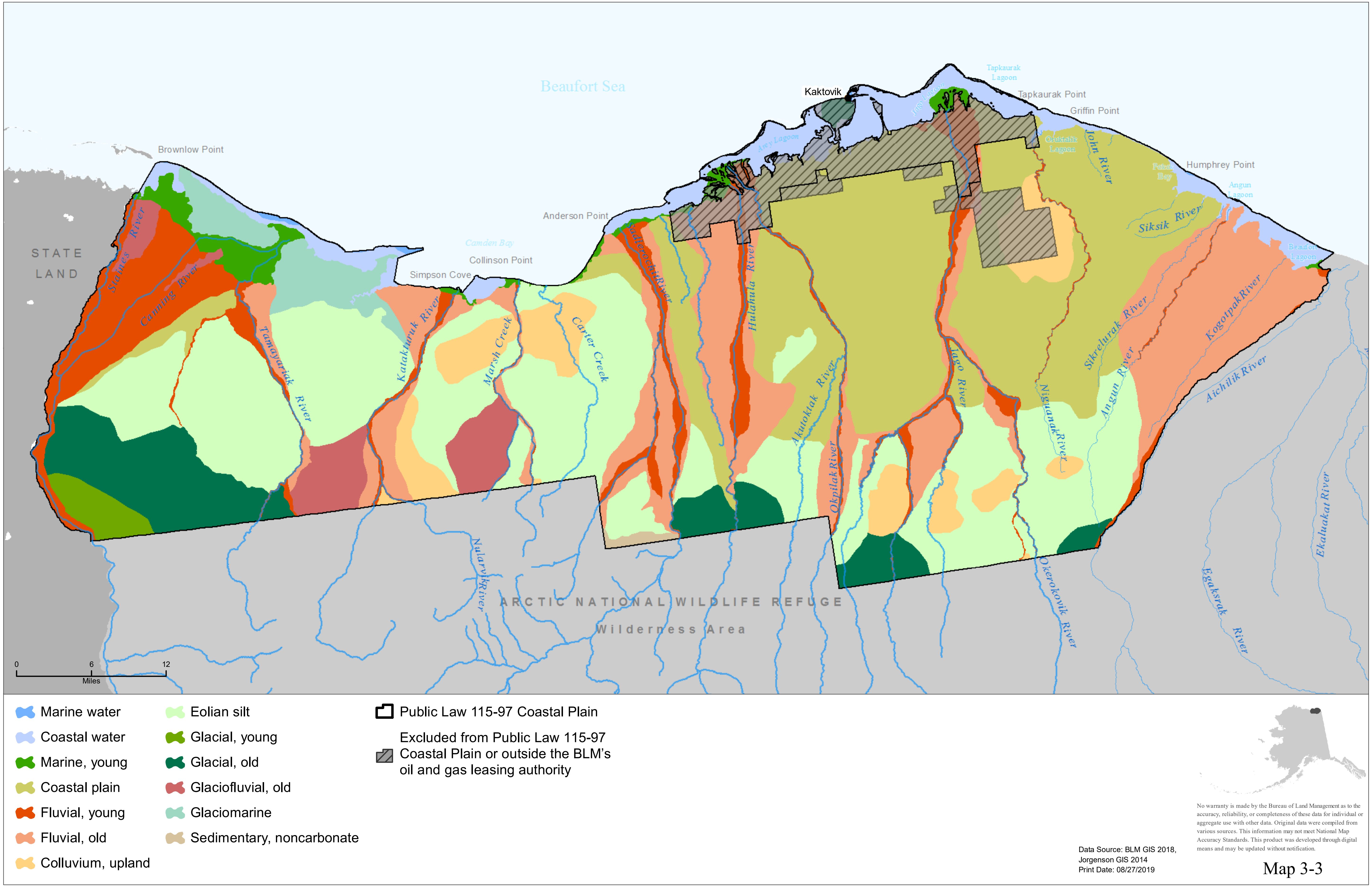
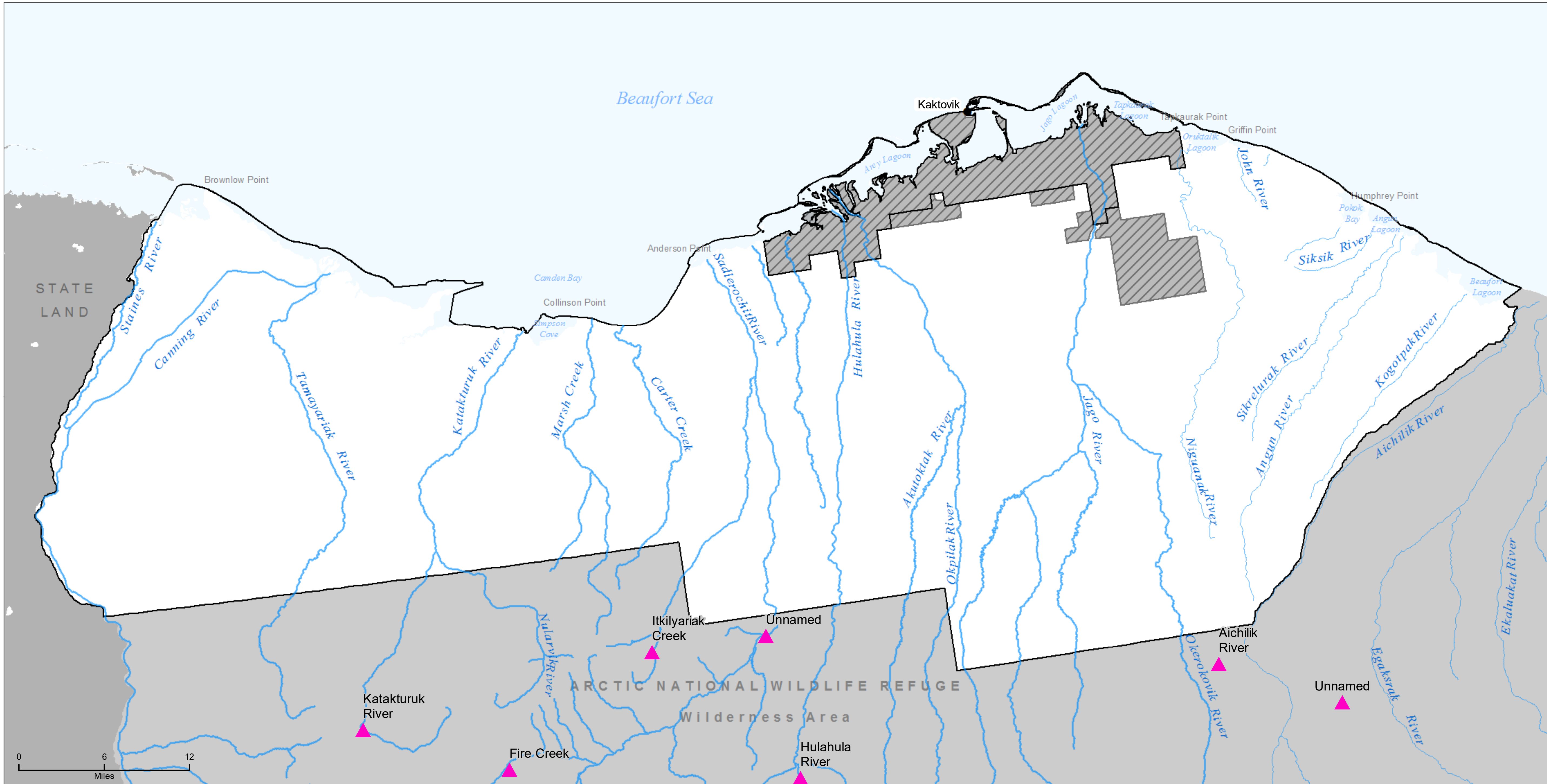
Map 3-2


Beaufort Sea
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Simpson Cove
Kaktovik
Tapkaurak Lagoon
Tapkaurak Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Siksik River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
0 6 12
Miles
Marine water
Coastal water
Marine, young
Coastal plain
Fluvial, young
Fluvial, old
Colluvium, upland
Eolian silt
Glacial, young
Glacial, old
Glaciofluvial, old
Glaciomarine
Sedimentary, noncarbonate
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, Jorgenson GIS 2014
Print Date: 08/27/2019

Map 3-3



Prospects or mineral occurrences

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

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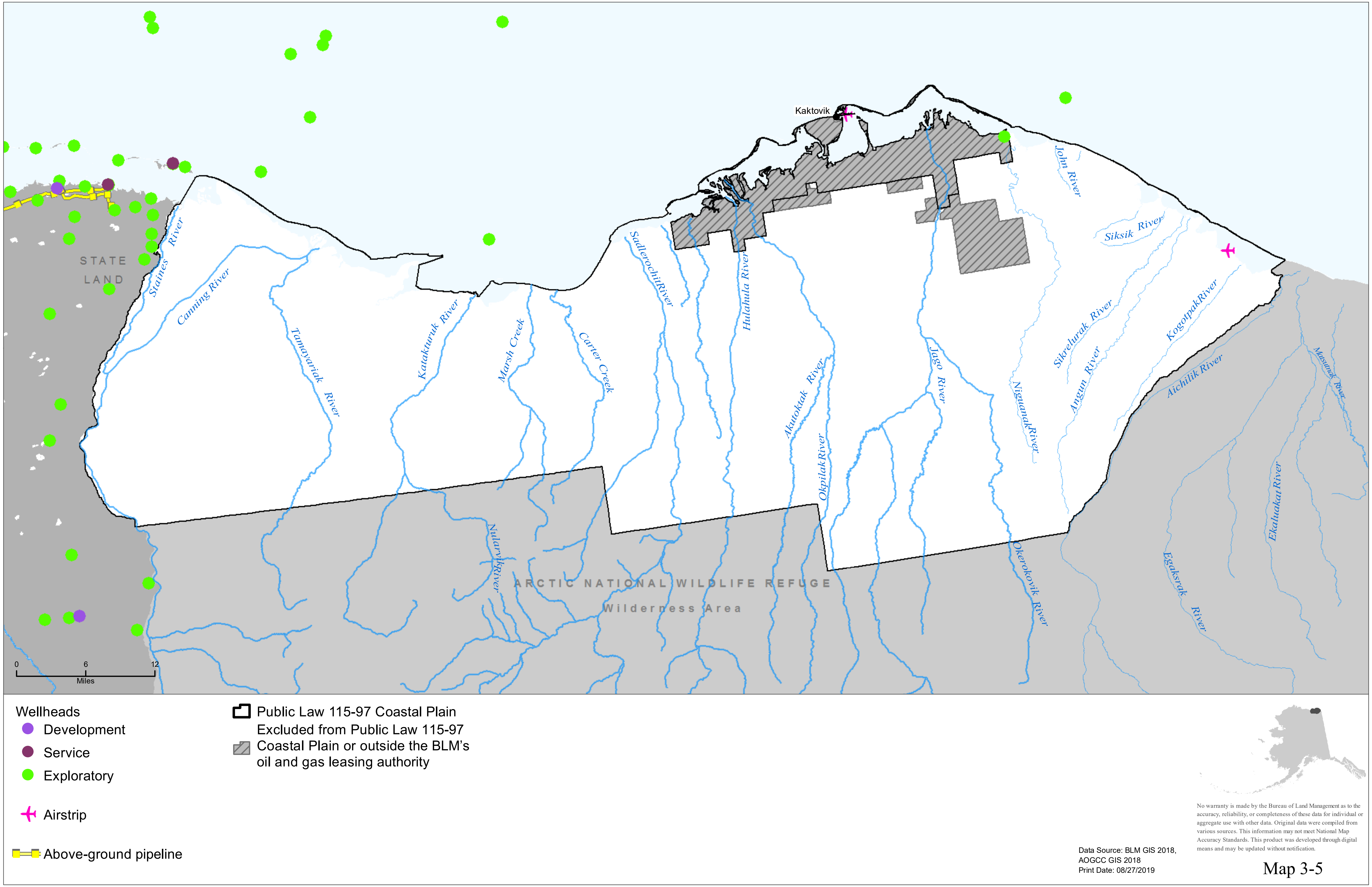
Data Source: BLM GIS 2018, ARDF GIS 2018
Print Date: 08/27/2019

Map 3-4


Kaktovik
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Egaksrak River
Ekaluakat River
Nularvik River
Okerokovik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Wellheads
Development
Service
Exploratory
Airstrip
Above-ground pipeline
Public Law 115-97 Coastal Plain
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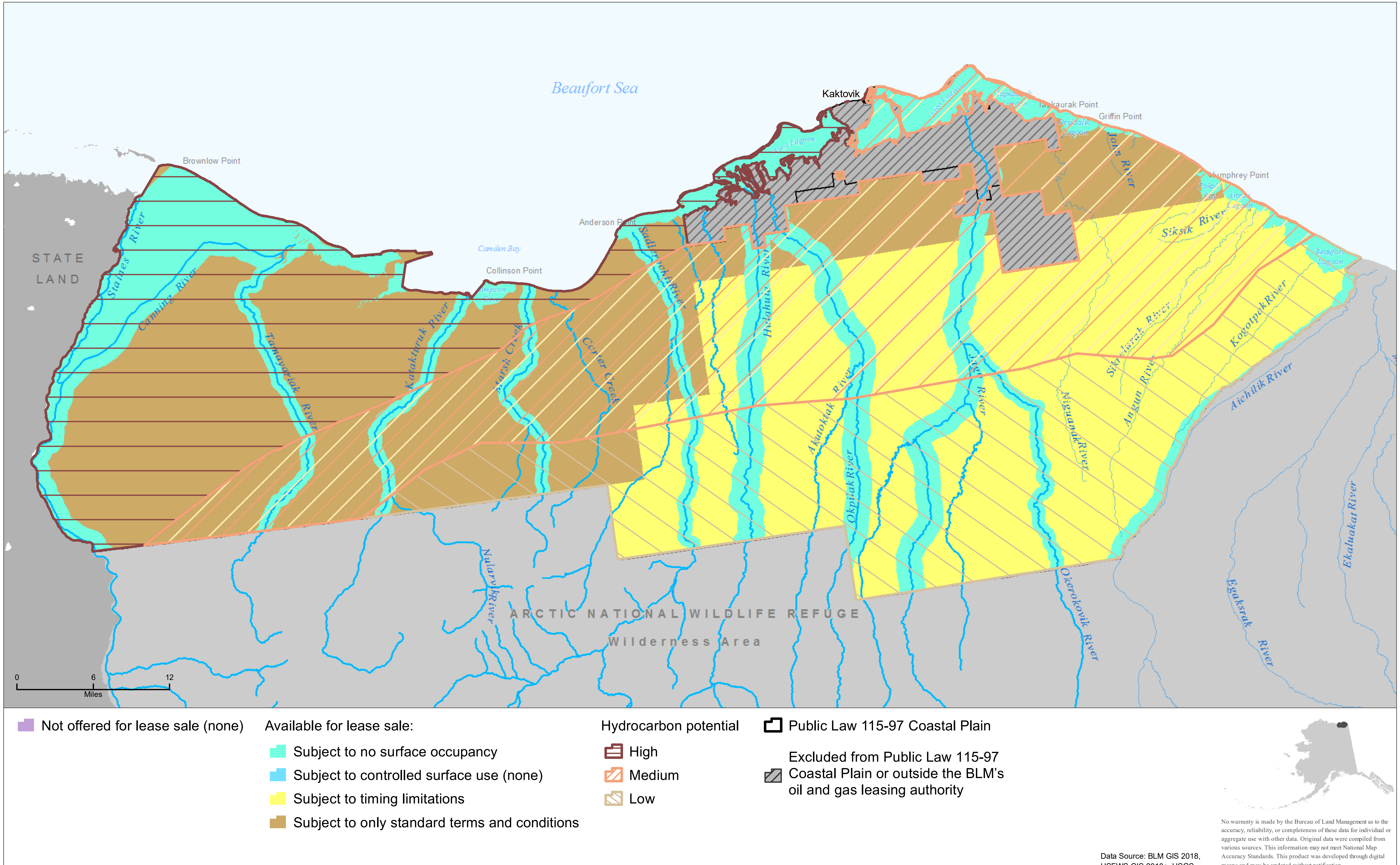
Data Source: BLM GIS 2018, AOGCC GIS 2018
Print Date: 08/27/2019

Map 3-5


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Camden Bay
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Angun River
Sikrelurak River
Siksik River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
John River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Not offered for lease sale (none)
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use (none)
Subject to timing limitations
Subject to only standard terms and conditions
Hydrocarbon potential
High
Medium
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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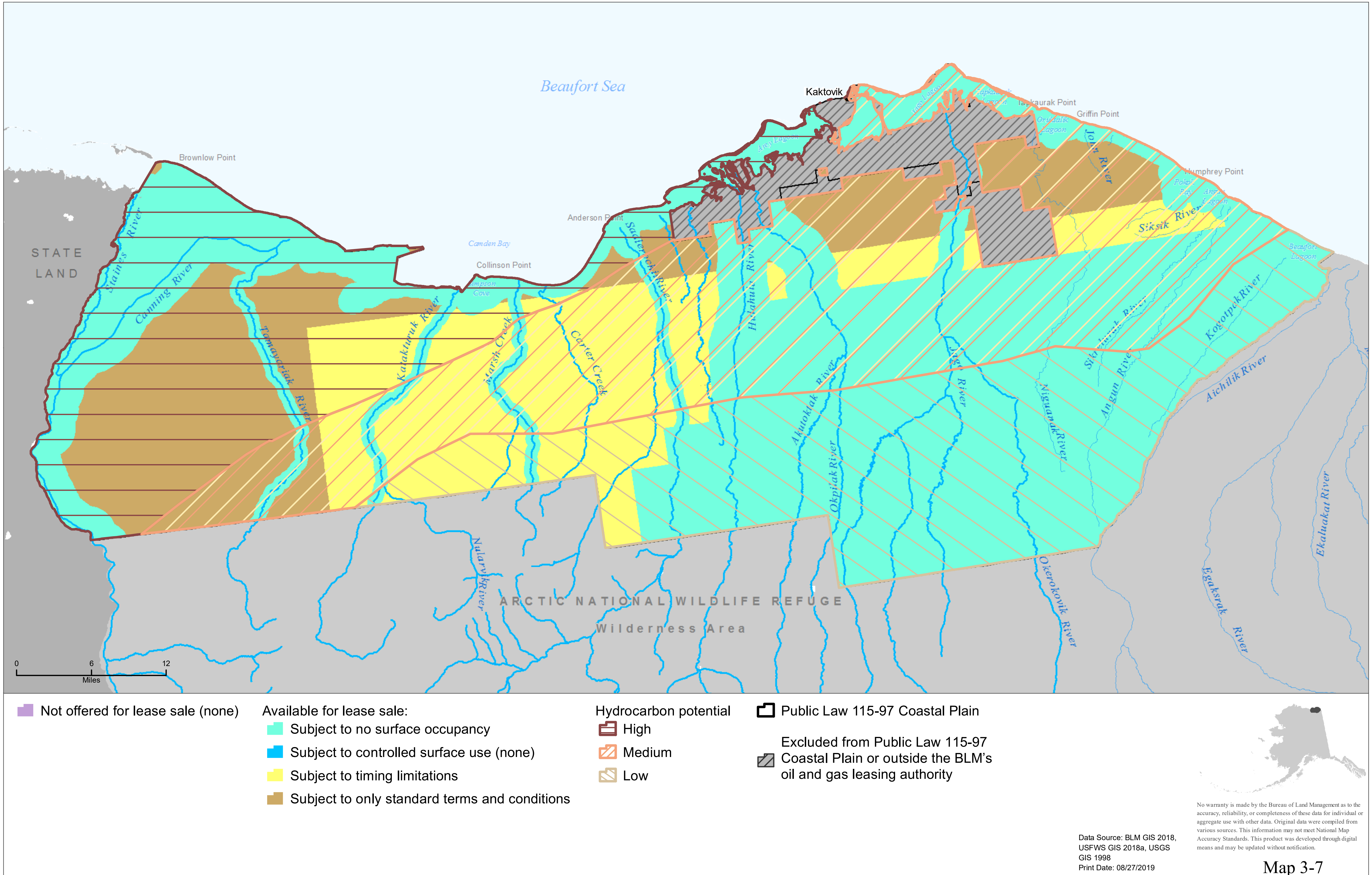
Data Source: BLM GIS 2018, USFWS GIS 2018a, USGS GIS 1998
Print Date: 08/27/2019

Map 3-6


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Angun River
Sikrelurak River
Kogotpak River
Aichilik River
Siksik River
John River
Nularvik River
Okerokovik River
Egaksrak River
Ekaluakat River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Not offered for lease sale (none)
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use (none)
Subject to timing limitations
Subject to only standard terms and conditions
Hydrocarbon potential
High
Medium
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, USFWS GIS 2018a, USGS GIS 1998
Print Date: 08/27/2019
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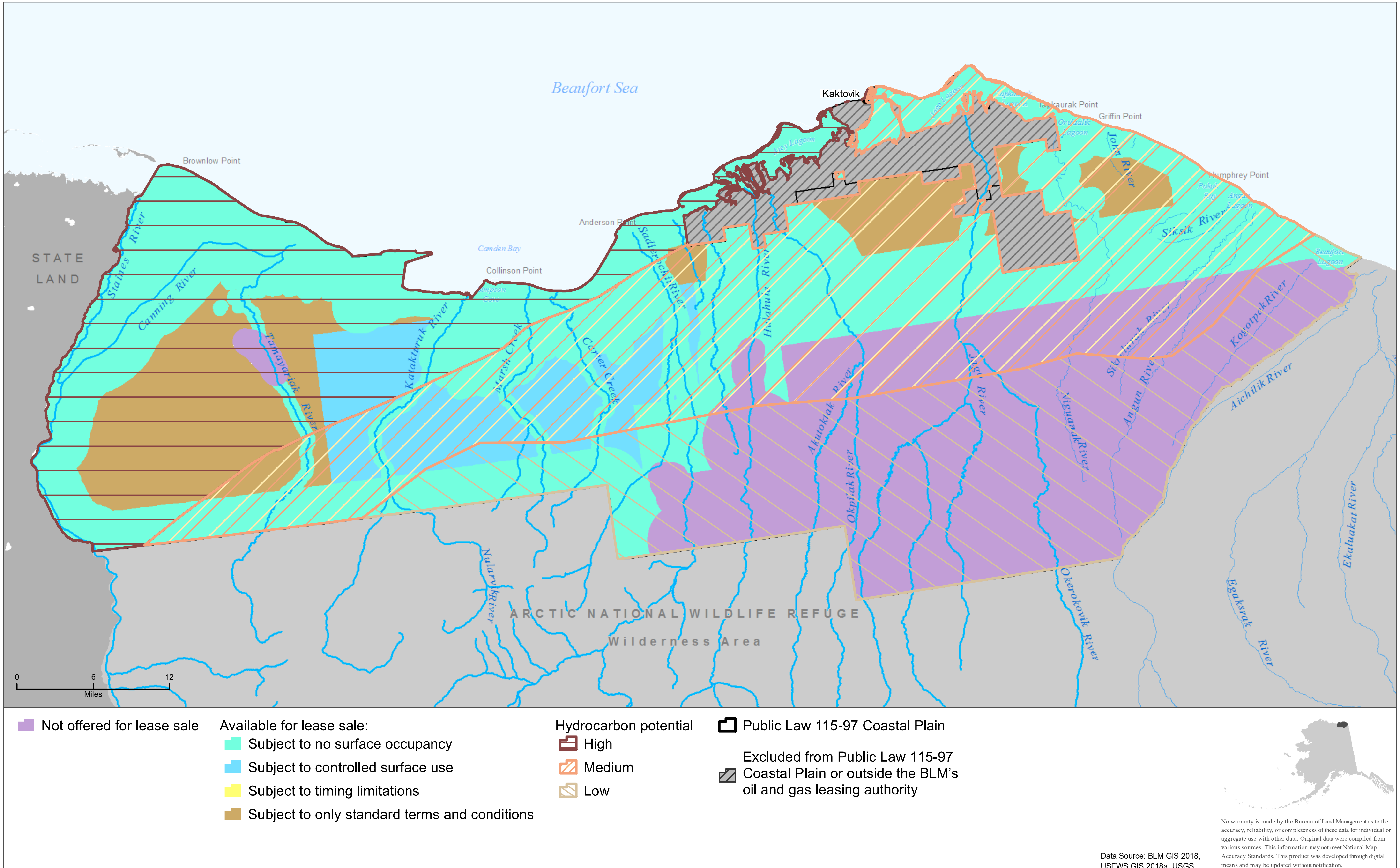
Map 3-7


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Camden Bay
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoaktak River
Okpilak River
Jago River
Niguanak River
Angun River
Sikrelurak River
Kogotpak River
Aichilik River
Siksik River
John River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Not offered for lease sale
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use
Subject to timing limitations
Subject to only standard terms and conditions
Hydrocarbon potential
High
Medium
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, USFWS GIS 2018a, USGS GIS 1998
Print Date: 08/27/2019
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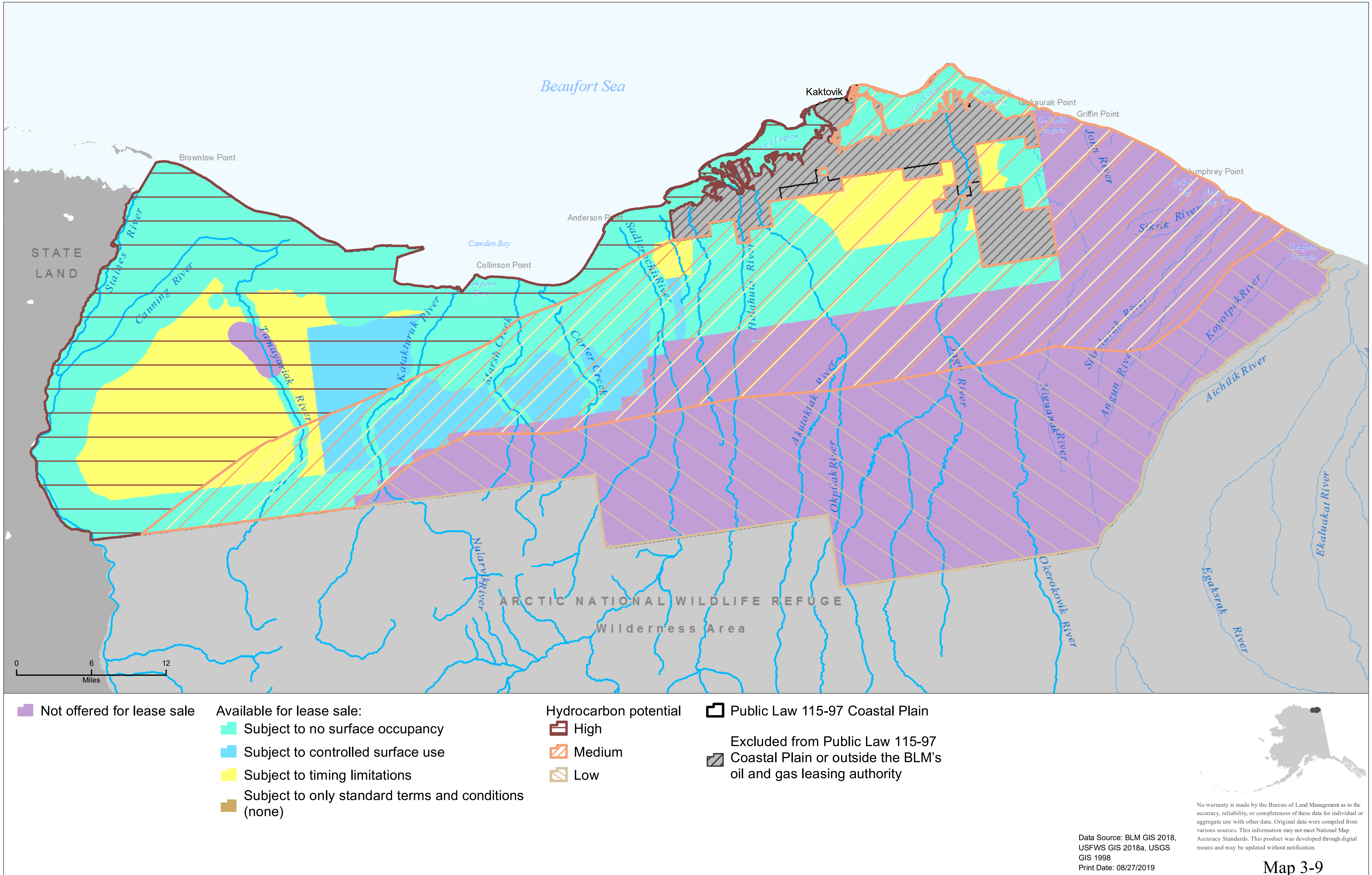
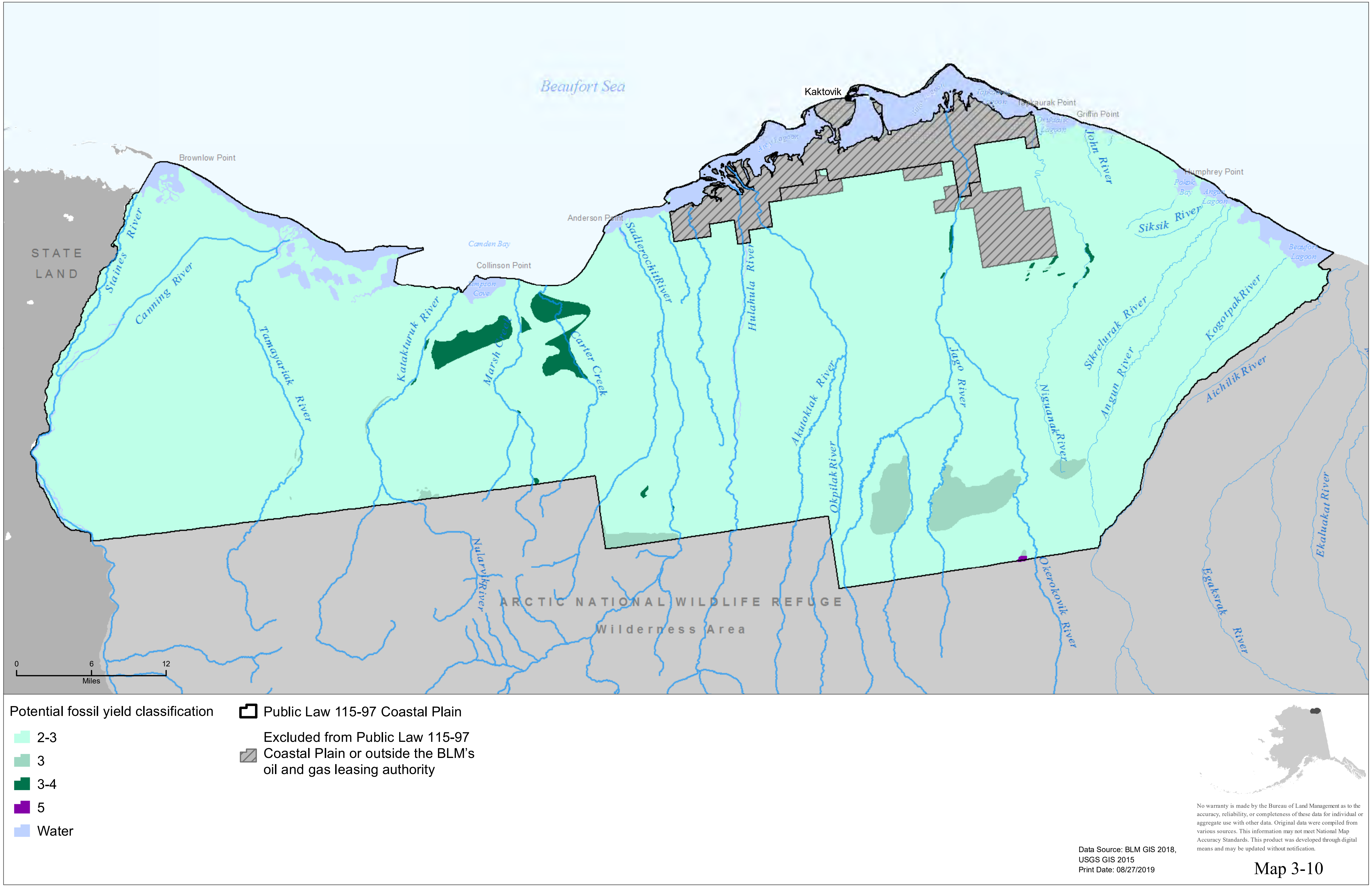
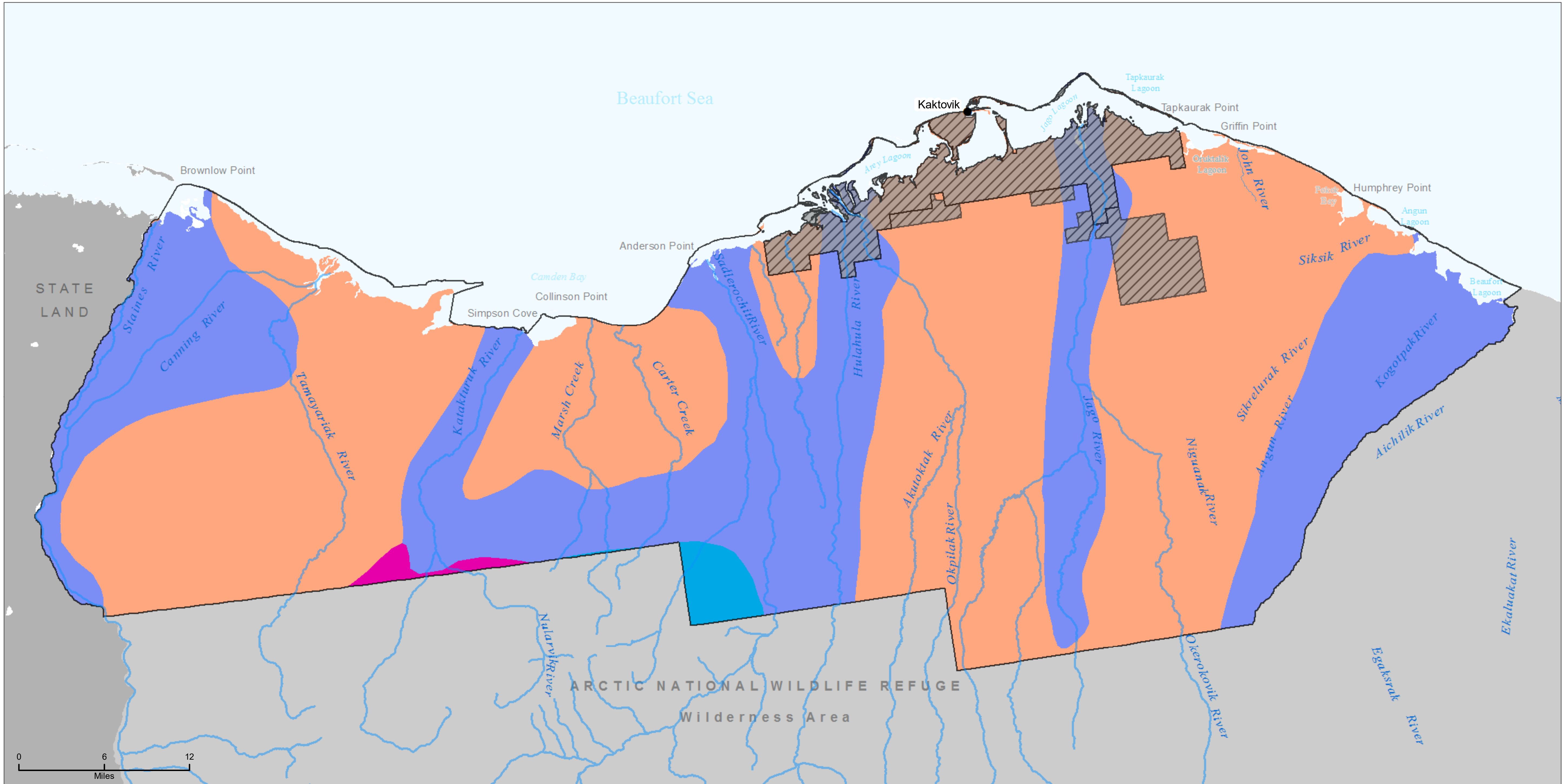
Map 3-8


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoaklak River
Okpilak River
Jago River
Niguanak River
Angun River
Sikrelurak River
Kogotpak River
Aichilik River
Siksik River
Jones River
Nularvik River
Okerokovik River
Egaksrak River
Ekaluakat River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Not offered for lease sale
Available for lease sale:
Subject to no surface occupancy
Subject to controlled surface use
Subject to timing limitations
Subject to only standard terms and conditions (none)
Hydrocarbon potential
High
Medium
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, USFWS GIS 2018a, USGS GIS 1998
Print Date: 08/27/2019
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.

Map 3-9


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Potential fossil yield classification
2-3
3
3-4
5
Water
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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.
Data Source: BLM GIS 2018, USGS GIS 2015
Print Date: 08/27/2019

Map 3-10



Typic Haploturbels-Typic Aquiturbels (s9323)

Typic Histoturbels-Typic Aquiturbels (s9256)

Typic Histoturbels-Typic Haploturbels-Typic Fibristels-Typic Aquiturbels-Ruptic histic aquiturbels (s9389)

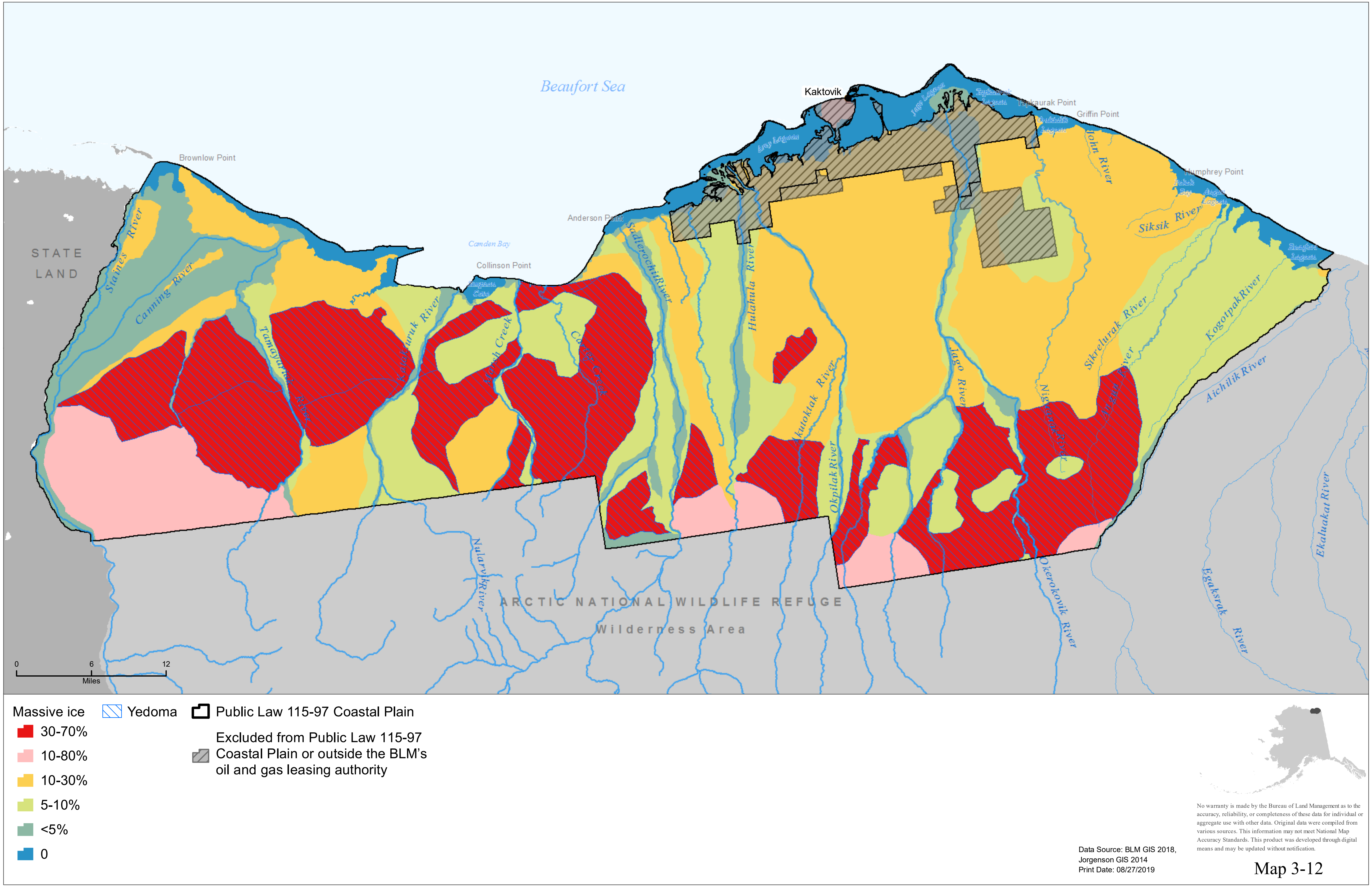
Typic Molliturbels-Typic Aquiturbels-Lithic Haploturbels (s9396)

Public Law 115-97 Coastal Plain

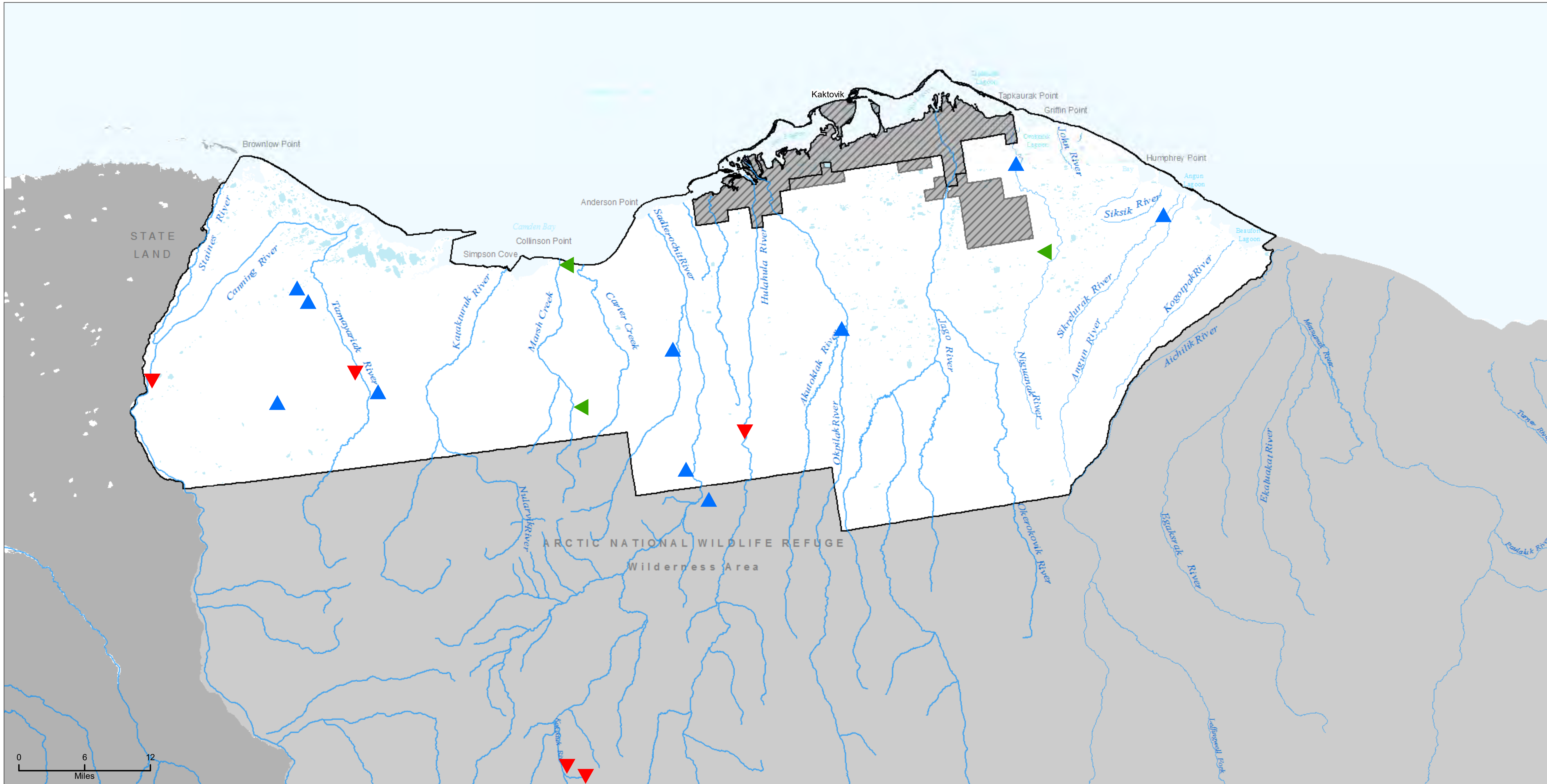
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, Jorgenson GIS 2014
Print Date: 08/27/2019

Map 3-11


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Carter Creek
Sadlerochit River
Hulahula River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Kogotpak River
Aichilik River
Siksik River
John River
Nularvik River
Okerokovik River
Egaksrak River
Ekaluakat River
0 6 12
Miles
Massive ice
30-70%
10-80%
10-30%
5-10%
<5%
0
Yedoma
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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.
Data Source: BLM GIS 2018, Jorgenson GIS 2014
Print Date: 08/27/2019

Map 3-12

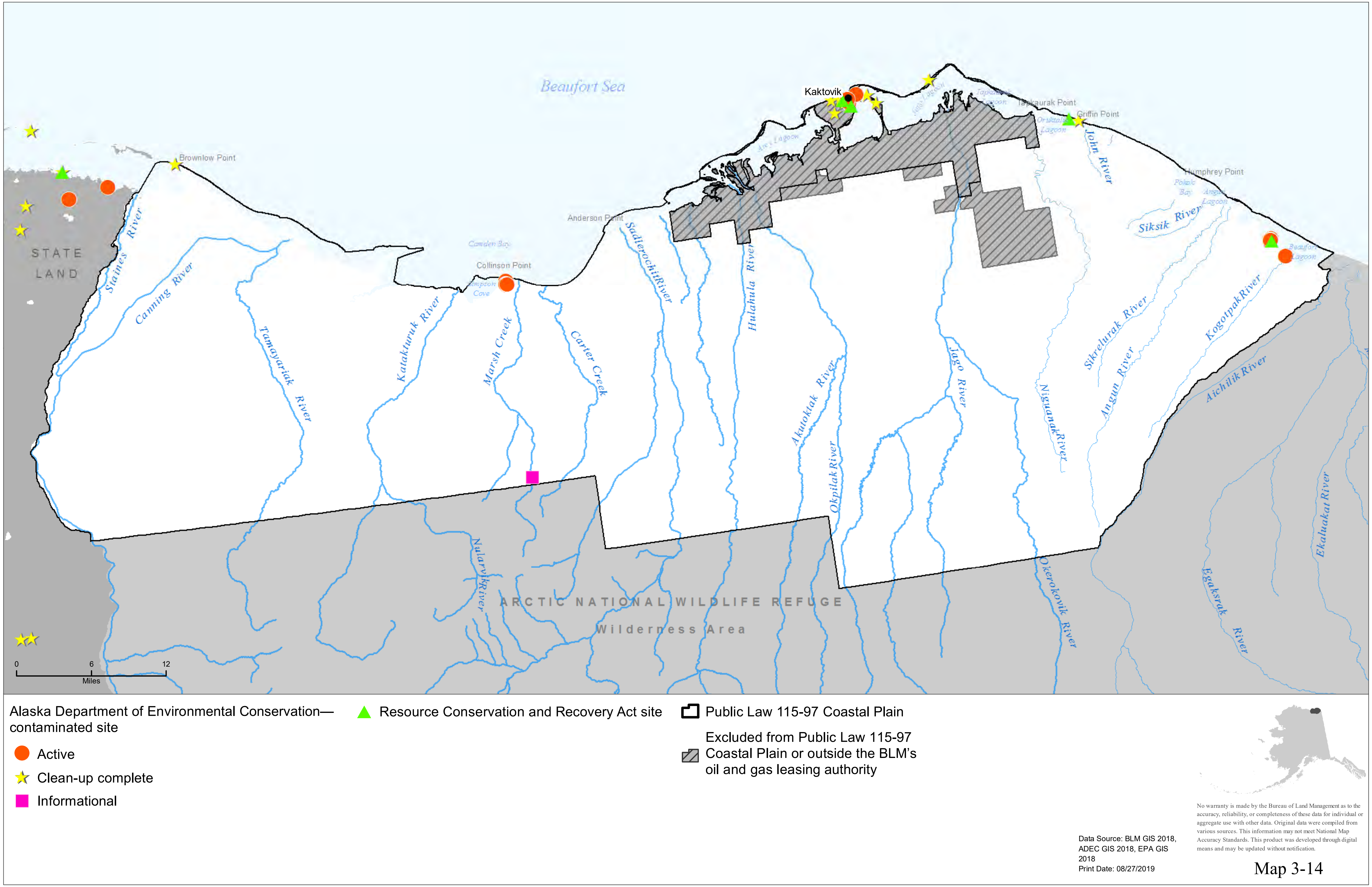


FWS gaging station
USGS gaging station
Climate monitoring gaging station
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

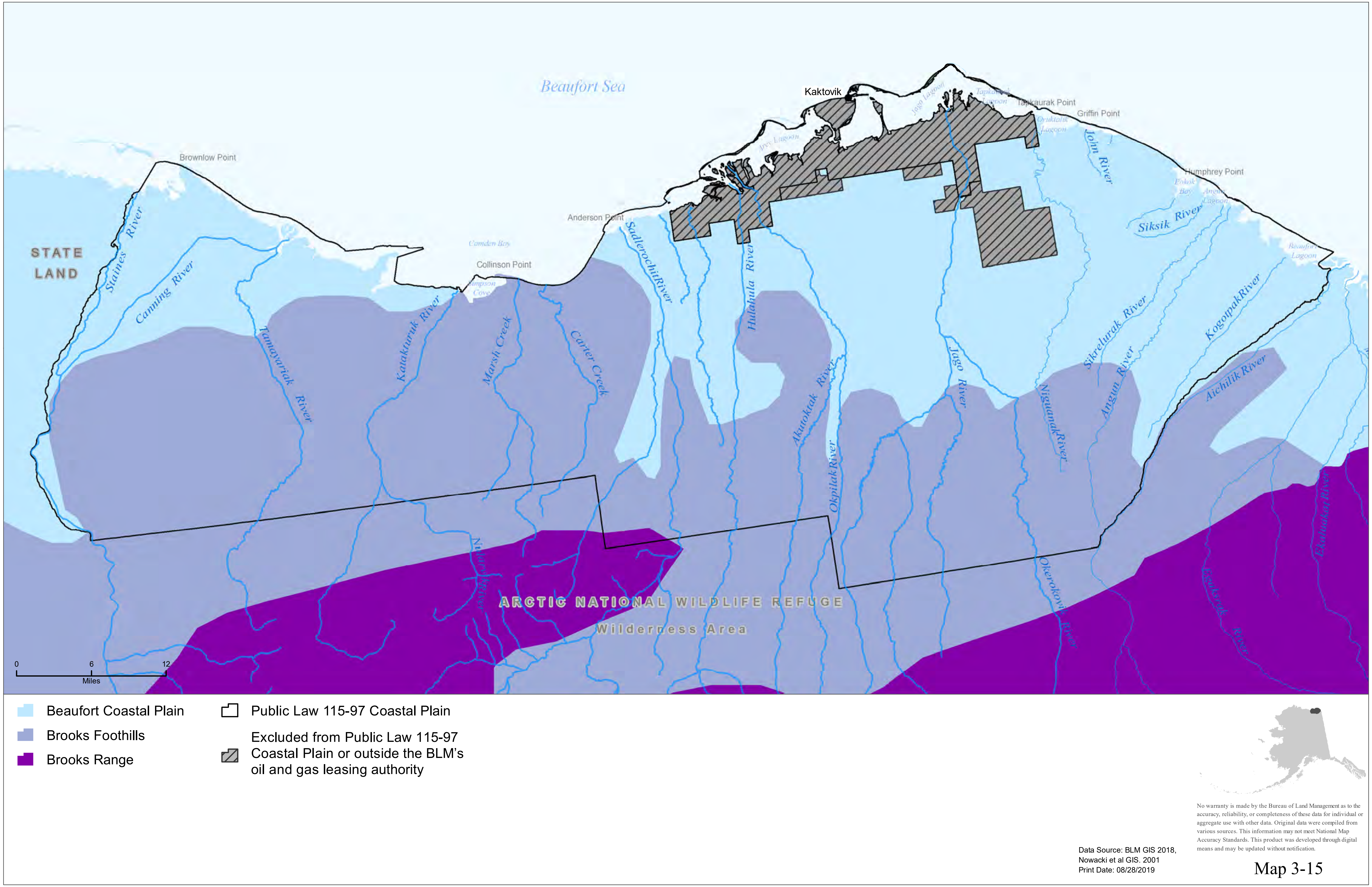
Data Source: BLM GIS 2018, NOAA GIS 2018
Print Date: 08/27/2019

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.

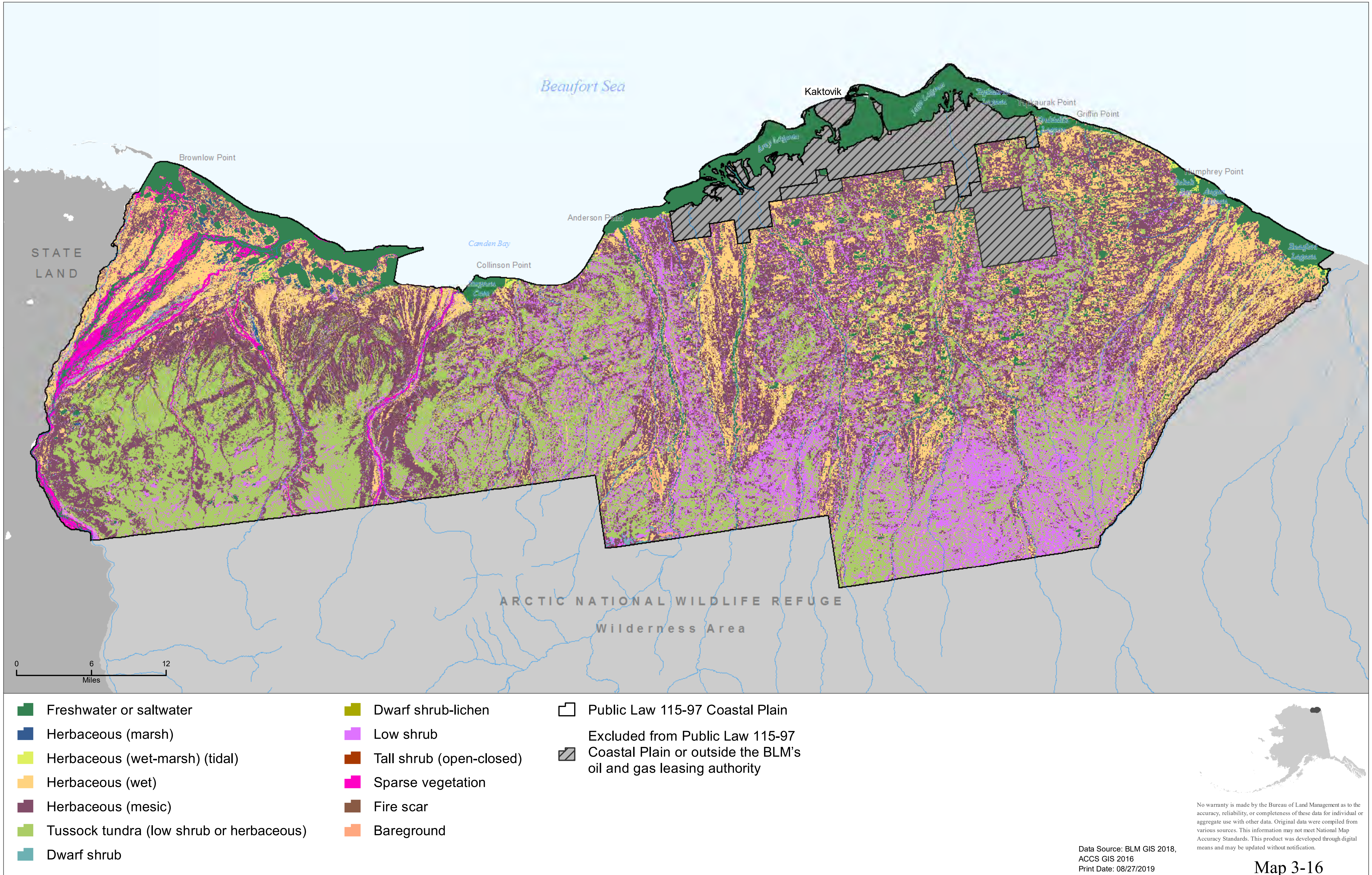
Map 3-13


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Camden Bay
Tapkaurak Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
0 6 12
Miles
Alaska Department of Environmental Conservation—contaminated site
Active
Clean-up complete
Informational
Resource Conservation and Recovery Act site
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, ADEC GIS 2018, EPA GIS 2018
Print Date: 08/27/2019
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.

Map 3-14

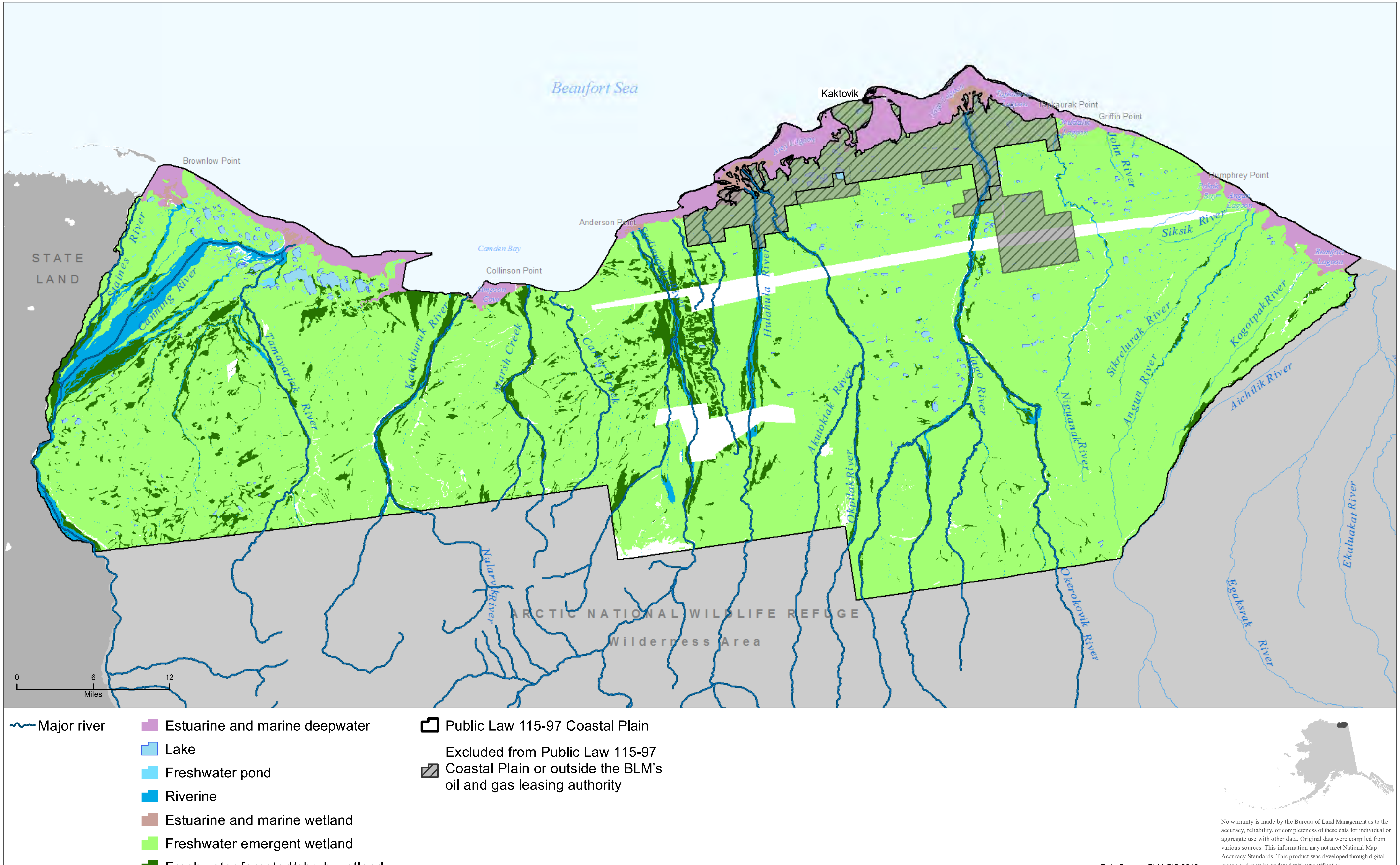

Beaufort Sea
Kaktovik
Tapkaurak Point
Griffin Point
Brownlow Point
Humphrey Point
Anderson Point
Collinson Point
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Aichilik River
Kogotpak River
Sikrelurak River
Angun River
Siksik River
Okerokovik River
Egaksrak River
Ekaluakat River
Jojo River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Beaufort Coastal Plain
Brooks Foothills
Brooks Range
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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.
Data Source: BLM GIS 2018, Nowacki et al GIS. 2001
Print Date: 08/28/2019

Map 3-15

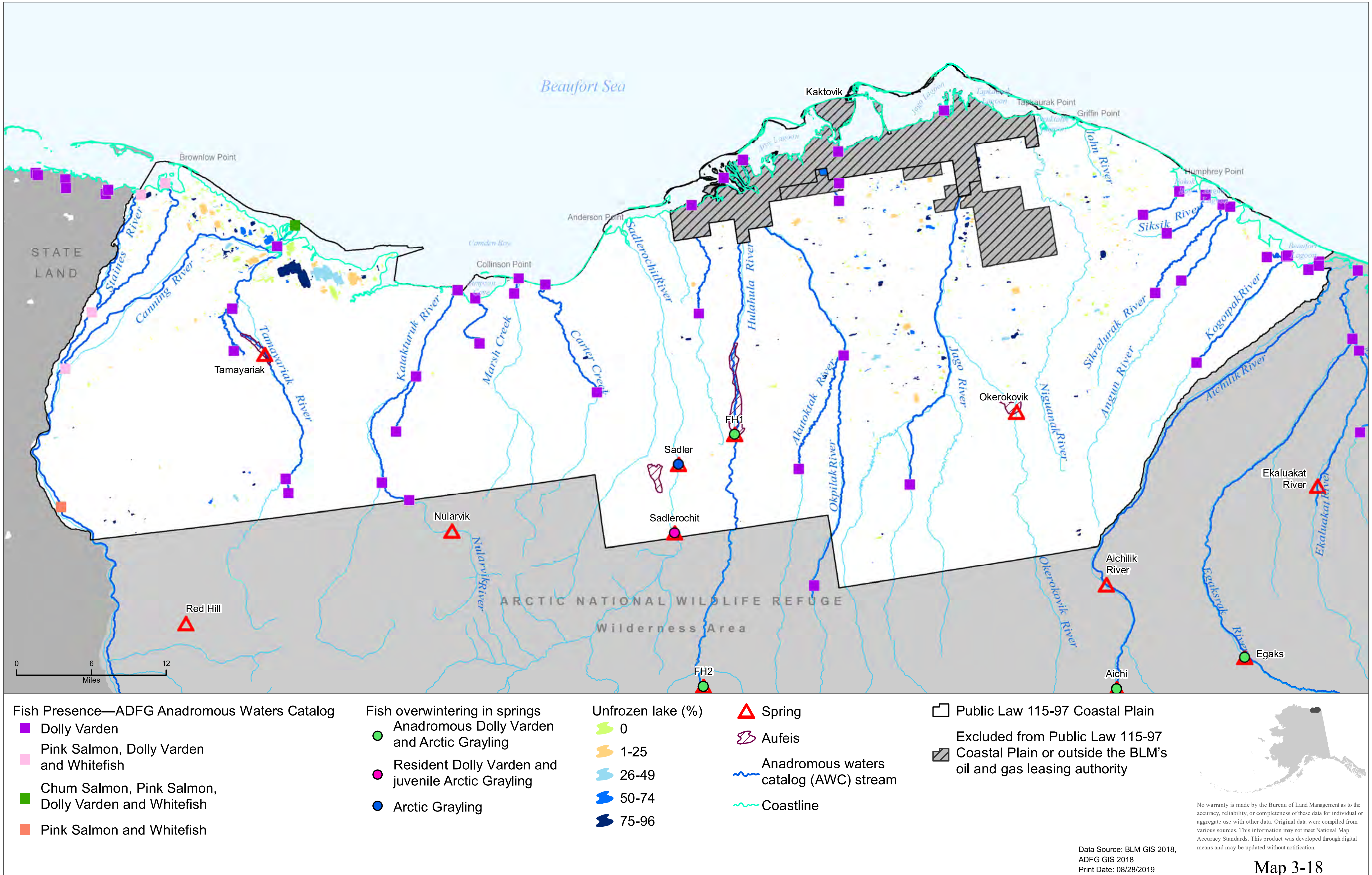


Data Source: BLM GIS 2018, ACCS GIS 2016
Print Date: 08/27/2019

Map 3-16


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Tapkaurak Point
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
John River
Nularvik River
Okerokovik River
Egaksrak River
Ekaluakat River
0 6 12
Miles
Major river
Estuarine and marine deepwater
Lake
Freshwater pond
Riverine
Estuarine and marine wetland
Freshwater emergent wetland
Freshwater forested/shrub wetland
Missing data
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, NWI GIS 2018
Print Date: 08/27/2019
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.

Map 3-17


Beaufort Sea
Kaktovik
Tapkaurak Point
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Collinson Point
STATE LAND
Staines River
Canning River
Tamayariak River
Tamayariak
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Okerokovik
Niguanak River
Angun River
Sikrelurak River
Siksik River
Kogotpak River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
FH1
Sadler
Sadlerochit
Nularvik
Red Hill
FH2
Aichilik River
Aichi
Egaks
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Fish Presence—ADFG Anadromous Waters Catalog
Dolly Varden
Pink Salmon, Dolly Varden and Whitefish
Chum Salmon, Pink Salmon, Dolly Varden and Whitefish
Pink Salmon and Whitefish
Fish overwintering in springs
Anadromous Dolly Varden and Arctic Grayling
Resident Dolly Varden and juvenile Arctic Grayling
Arctic Grayling
Unfrozen lake (%)
0
1-25
26-49
50-74
75-96
Spring
Aufeis
Anadromous waters catalog (AWC) stream
Coastline
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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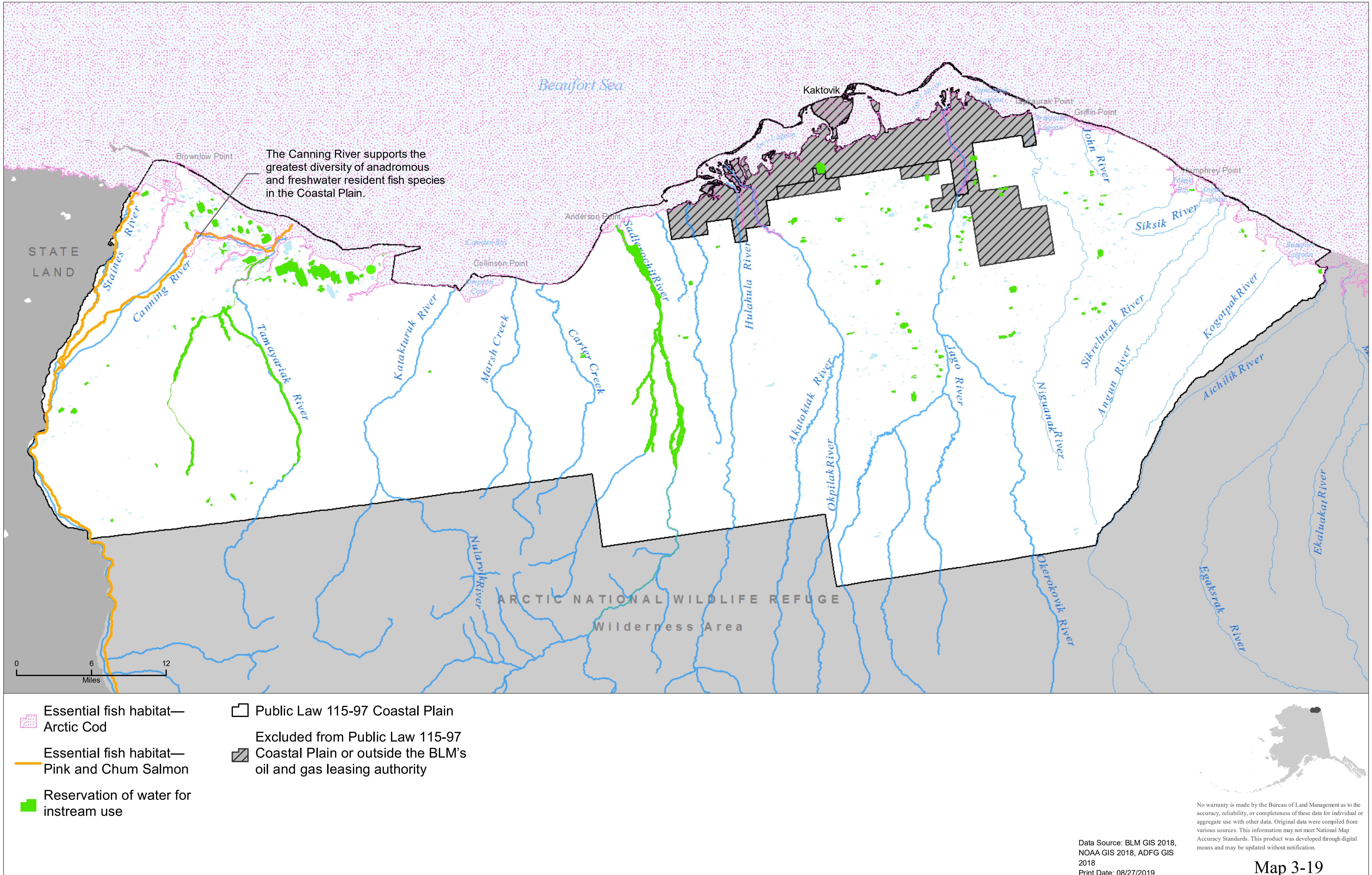
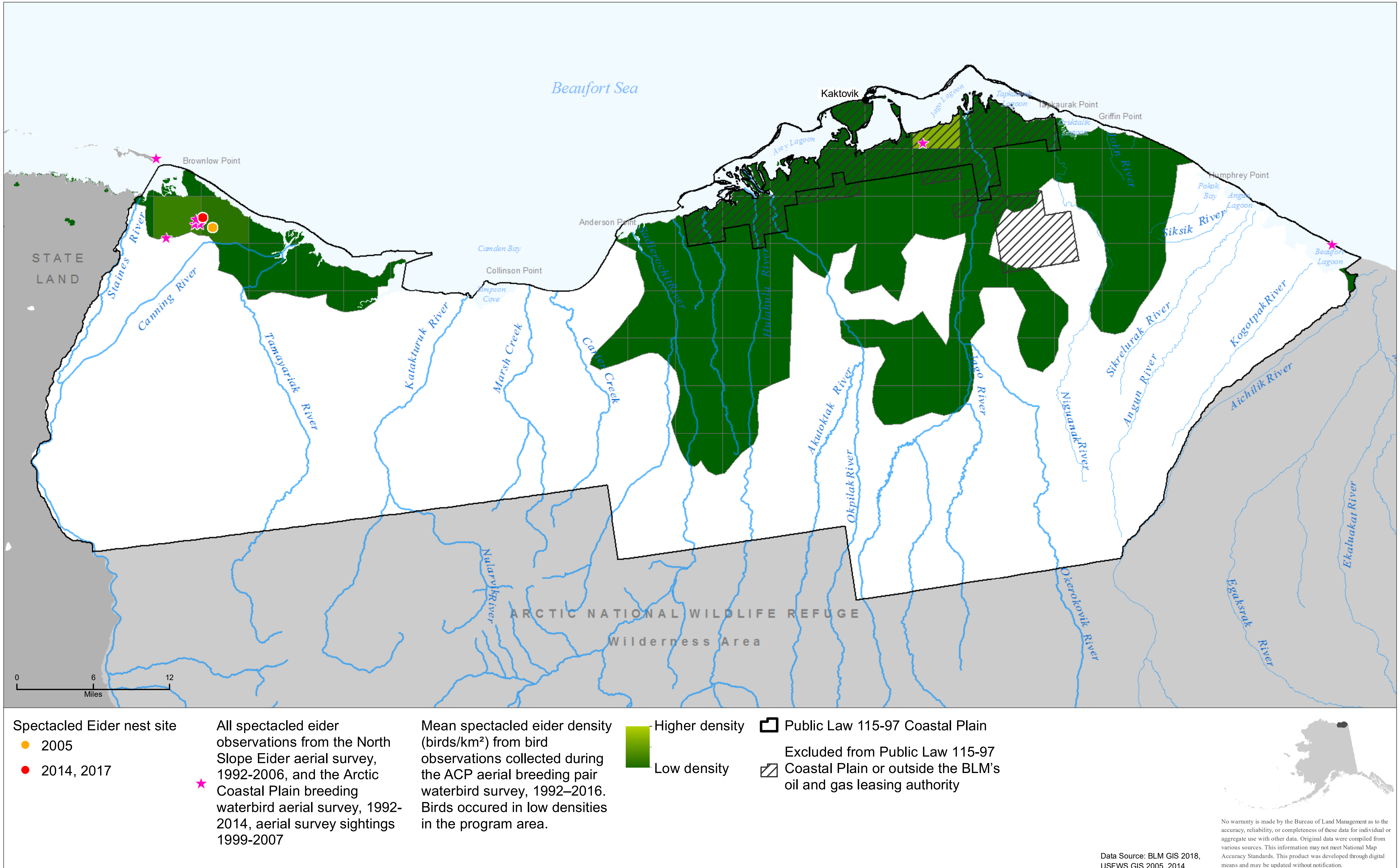
Data Source: BLM GIS 2018, ADFG GIS 2018
Print Date: 08/28/2019

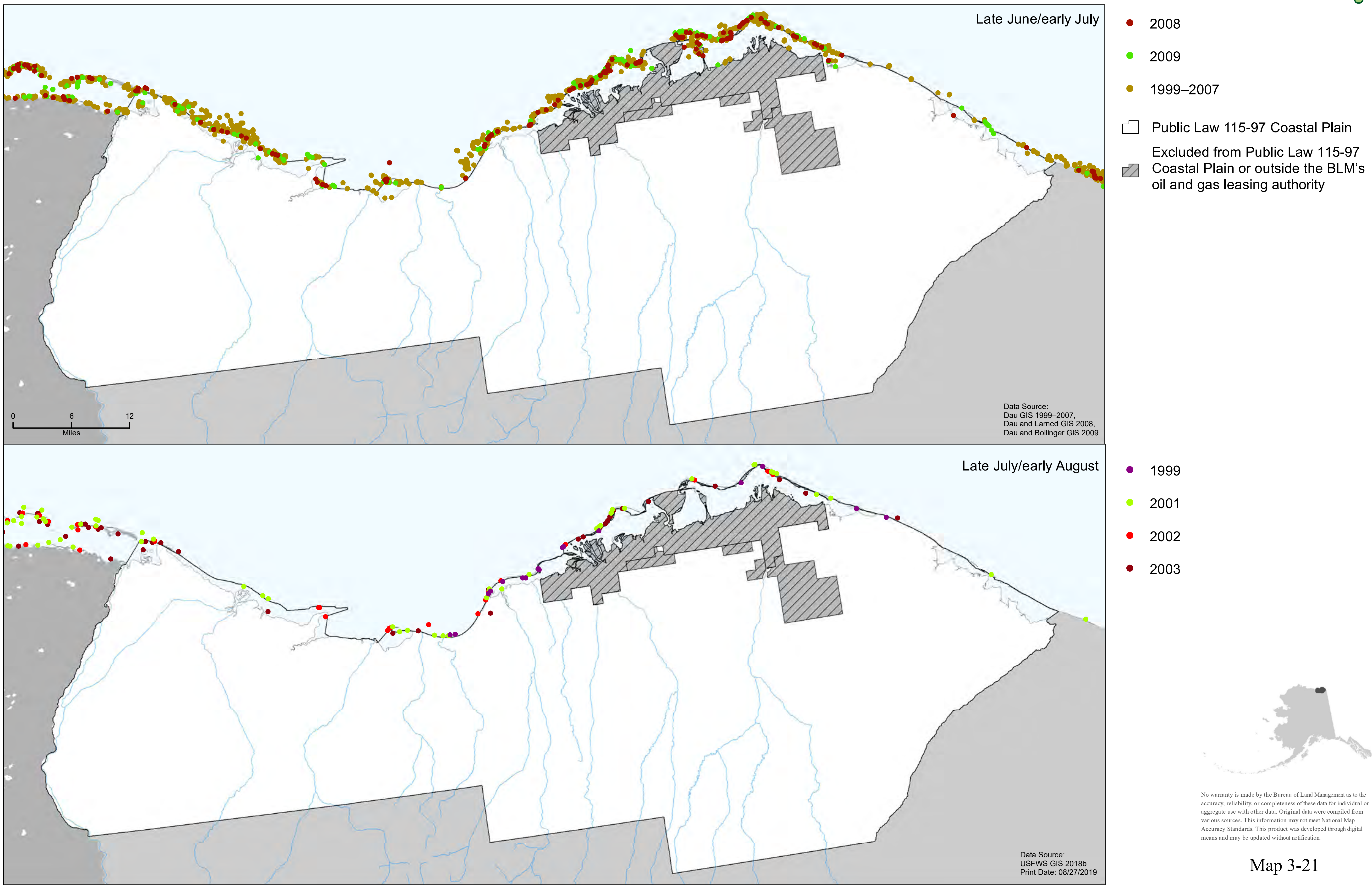
Map 3-18


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Griffin Point
Humphrey Point
The Canning River supports the greatest diversity of anadromous and freshwater resident fish species in the Coastal Plain.
STATE LAND
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
John River
Siksik River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0
6
12
Miles
Essential fish habitat—Arctic Cod
Essential fish habitat—Pink and Chum Salmon
Reservation of water for instream use
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, NOAA GIS 2018, ADFG GIS 2018
Print Date: 08/27/2019
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.

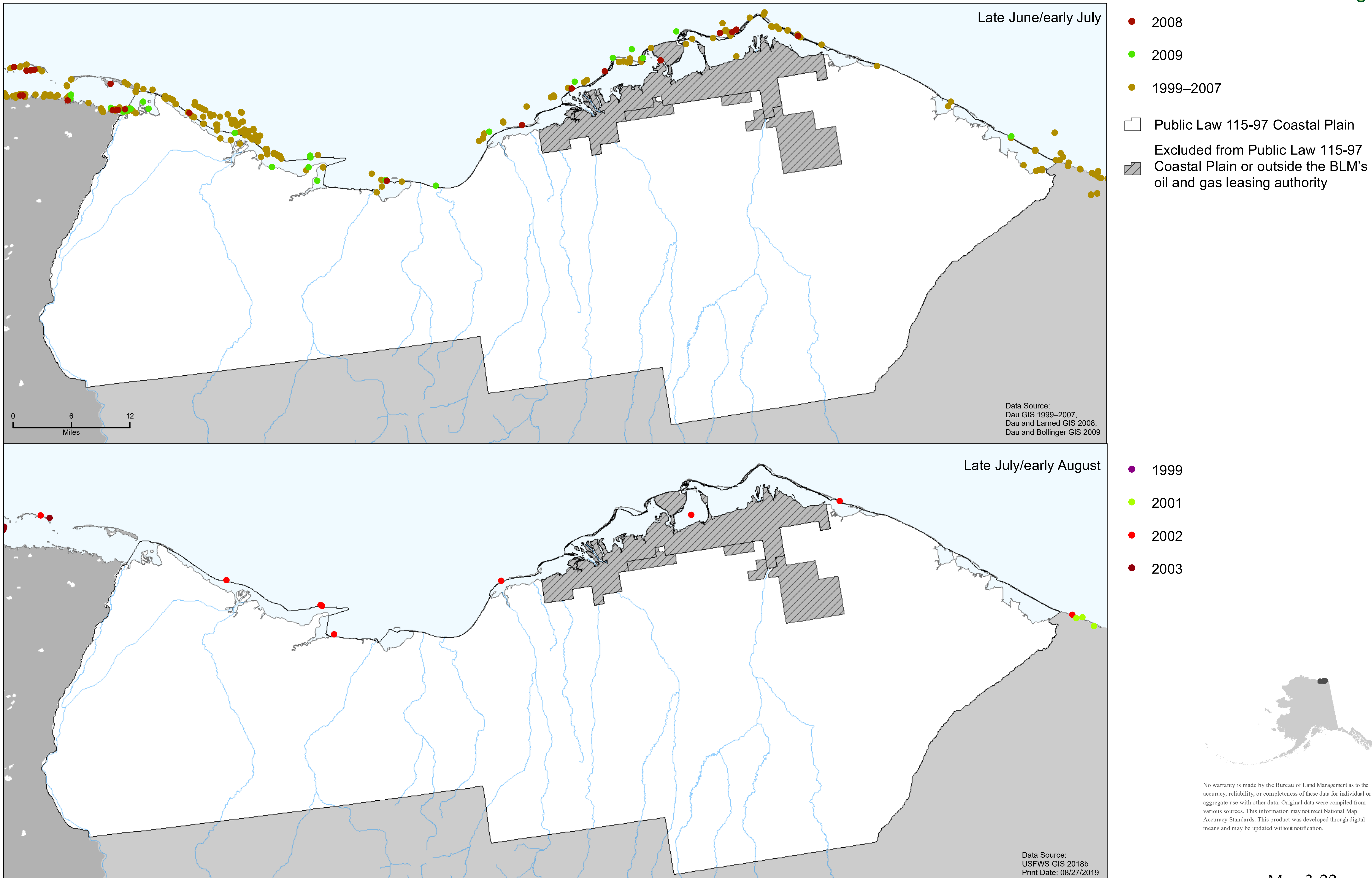
Map 3-19


Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Collinson Point
Camden Bay
Griffin Point
Humphrey Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Canning River
Staines River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Hulahula River
Akutoktak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Aichilik River
Siksik River
Okerokovik River
Egaksrak River
Ekaluakat River
Nularvik River
0 6 12
Miles
Spectacled Eider nest site
2005
2014, 2017
All spectacled eider observations from the North Slope Eider aerial survey, 1992-2006, and the Arctic Coastal Plain breeding waterbird aerial survey, 1992-2014, aerial survey sightings 1999-2007
Mean spectacled eider density (birds/km²) from bird observations collected during the ACP aerial breeding pair waterbird survey, 1992–2016. Birds occured in low densities in the program area.
Higher density
Low density
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, USFWS GIS 2005, 2014, 2017, USFWS GIS 2019
Print Date: 08/27/2019

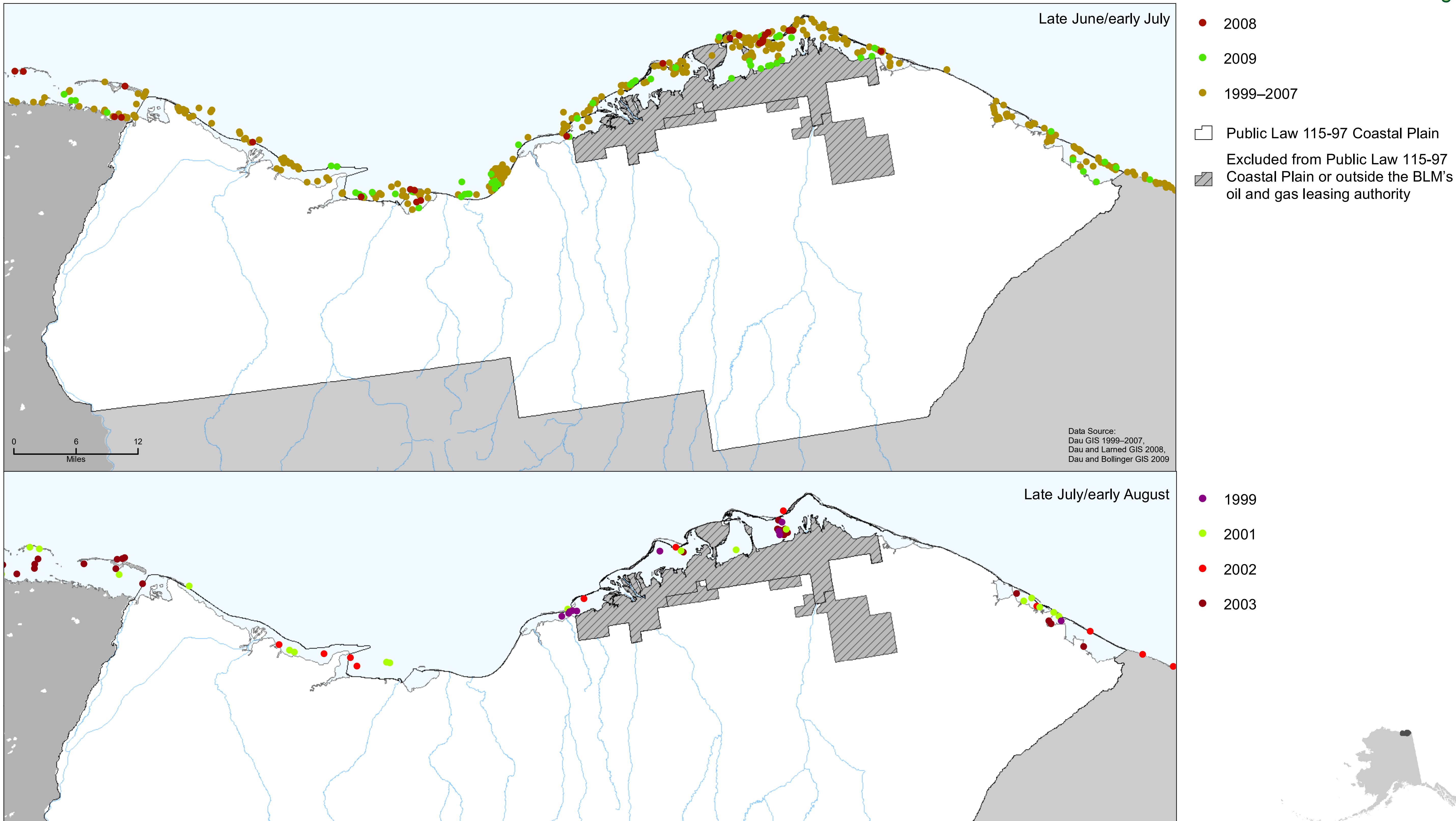
Map 3-20


Late June/early July
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
0
6
12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
Late July/early August
1999
2001
2002
2003
Data Source:
USFWS GIS 2018b
Print Date: 08/27/2019
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.

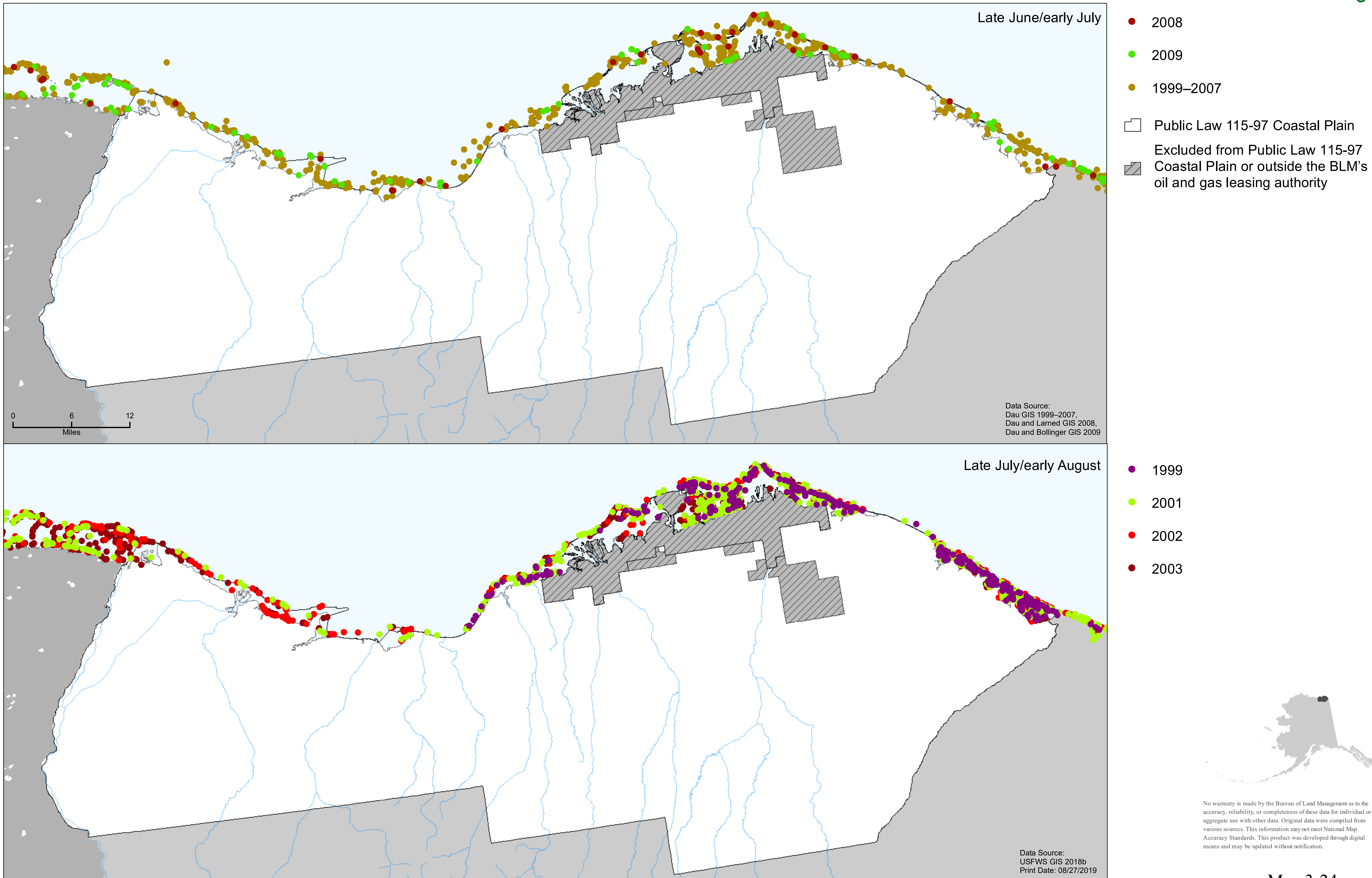
Map 3-21


Late June/early July
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
0
6
12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
Late July/early August
1999
2001
2002
2003
Data Source:
USFWS GIS 2018b
Print Date: 08/27/2019

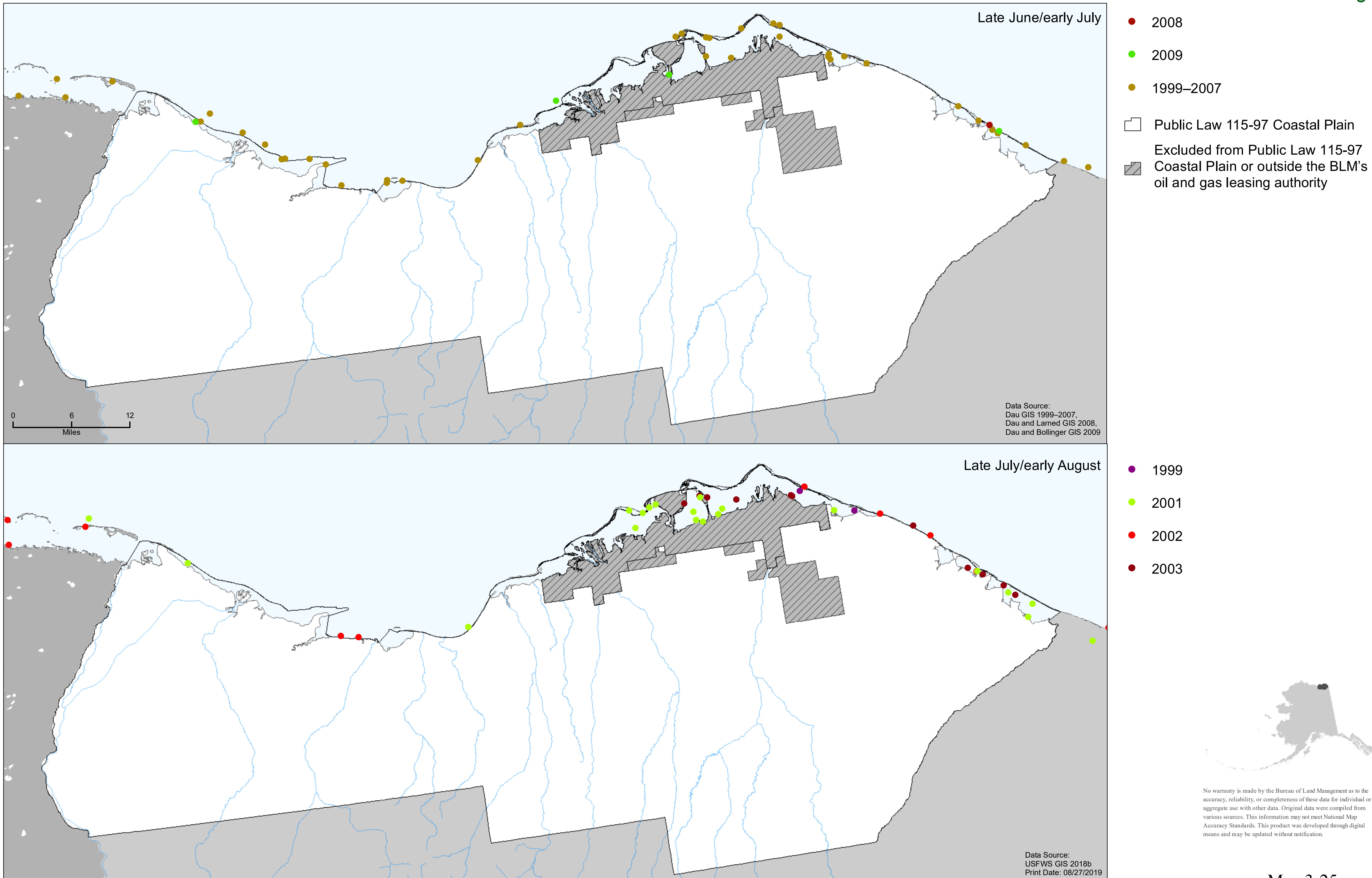
Map 3-22


Late June/early July
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
0
6
12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
Late July/early August
1999
2001
2002
2003
Data Source:
USFWS GIS 2018b
Print Date: 08/27/2019

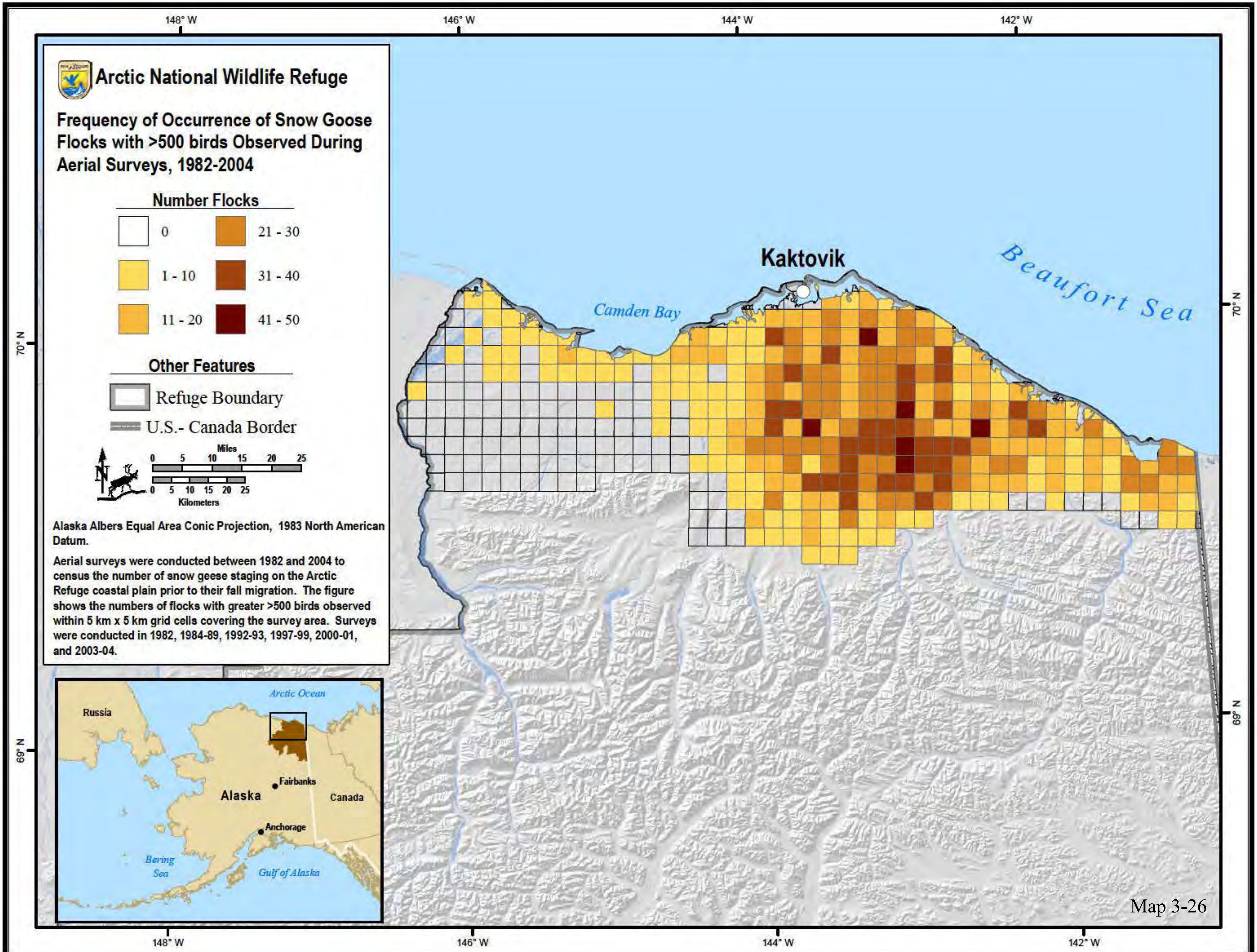
Map 3-23


Late June/early July
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
0
6
12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
Late July/early August
1999
2001
2002
2003
Data Source:
USFWS GIS 2018b
Print Date: 08/27/2019
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.

Map 3-24


Late June/early July
2008
2009
1999–2007
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
0
6
12
Miles
Data Source:
Dau GIS 1999–2007,
Dau and Larned GIS 2008,
Dau and Bollinger GIS 2009
Late July/early August
1999
2001
2002
2003
Data Source:
USFWS GIS 2018b
Print Date: 08/27/2019
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.

Map 3-25


148° W
146° W
144° W
142° W
70° N
69° N
Arctic National Wildlife Refuge
Frequency of Occurrence of Snow Goose Flocks with >500 birds Observed During Aerial Surveys, 1982-2004
Number Flocks
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
Other Features
Refuge Boundary
U.S.- Canada Border
Miles
0 5 10 15 20 25
Kilometers
0 5 10 15 20 25
Alaska Albers Equal Area Conic Projection, 1983 North American Datum.
Aerial surveys were conducted between 1982 and 2004 to census the number of snow geese staging on the Arctic Refuge coastal plain prior to their fall migration. The figure shows the numbers of flocks with greater >500 birds observed within 5 km x 5 km grid cells covering the survey area. Surveys were conducted in 1982, 1984-89, 1992-93, 1997-99, 2000-01, and 2003-04.
Kaktovik
Camden Bay
Beaufort Sea
Arctic Ocean
Russia
Alaska
Fairbanks
Anchorage
Canada
Bering Sea
Gulf of Alaska
Map 3-26

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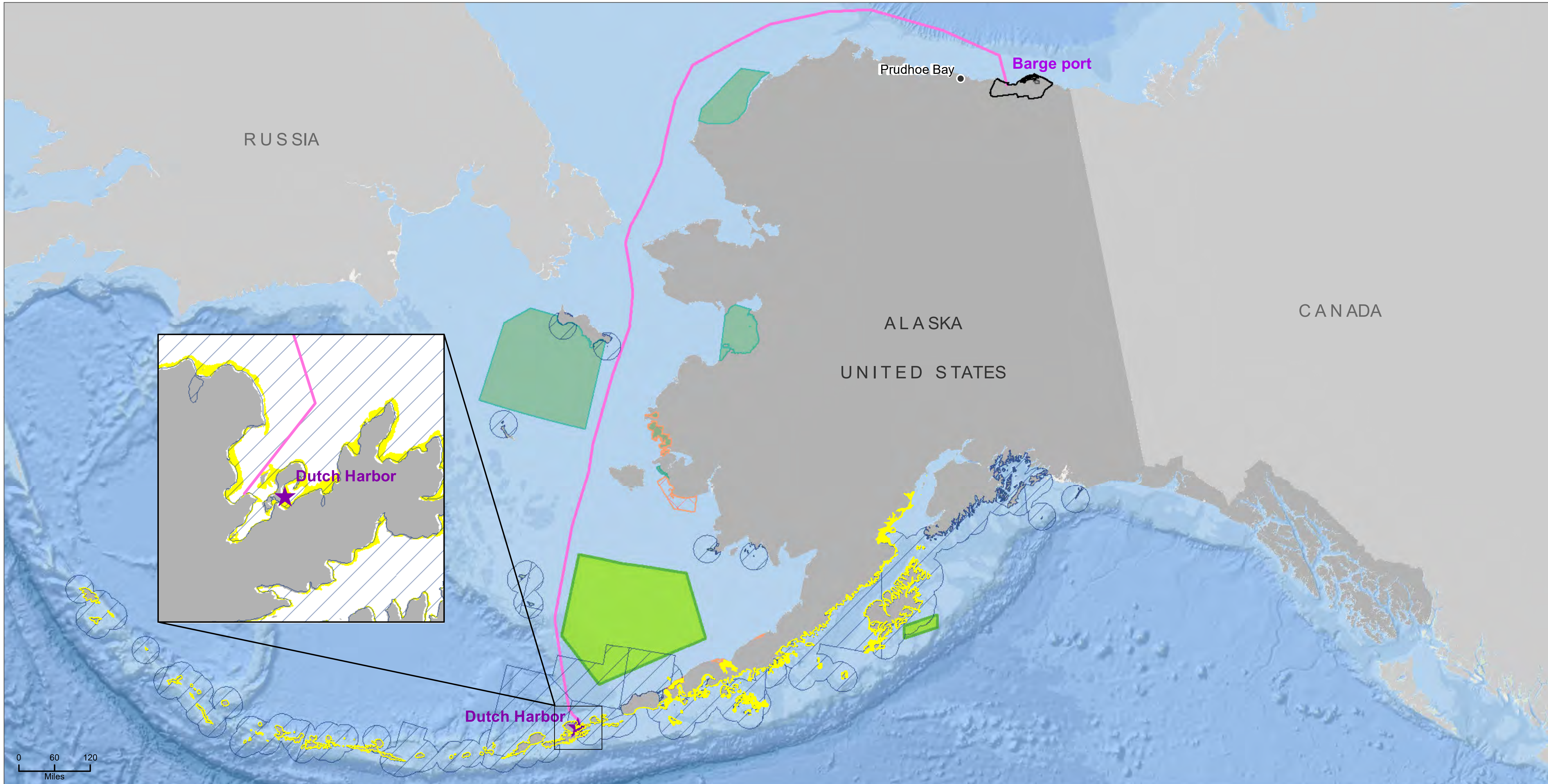


Sea otter critical habitat

Steller's sea lion critical habitat (foraging area and 20 nautical mile aquatic zone)

North pacific right whale critical habitat

Steller's eider critical habitat

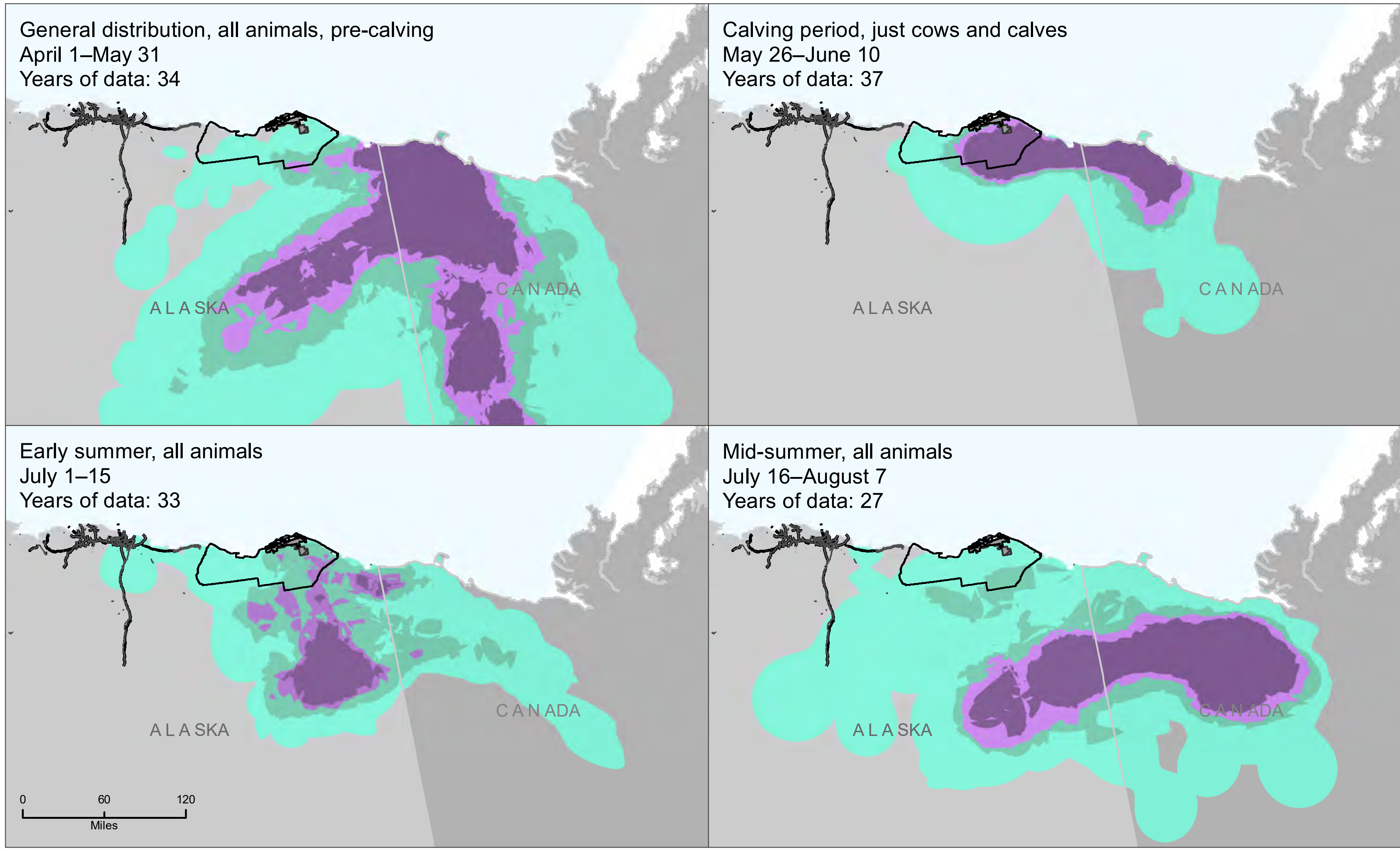
Spectacled eider critical habitat

Potential marine vessel transportation route

Public Law 115-97 Coastal Plain

Data Source: BLM GIS 2018
Print Date: 08/27/2019

Map 3-27



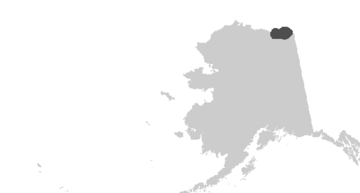
Environment Yukon used data from radio collars deployed on caribou from the Porcupine Caribou Herd to calculate the area used by caribou in each season for every year with a minimum of 30 caribou locations using Kernel Density Estimation. The resulting annual distributions were then used to calculate the percentage of years an area was used during each season. Calculations were based on the 95% contour from kernel density estimates (e.g., an area estimated to contain approximately 95% of the caribou) calculated using Geospatial Modelling Environment software. The plug-in bandwidth estimator was used when sample size was ≥50 and the likelihood cross-validation bandwidth estimator was used when sample size was <50.

Percent of years that caribou are present
- <20%
- 20–30%
- 30–40%
- ≥40%

Existing oil and gas roads or pipelines

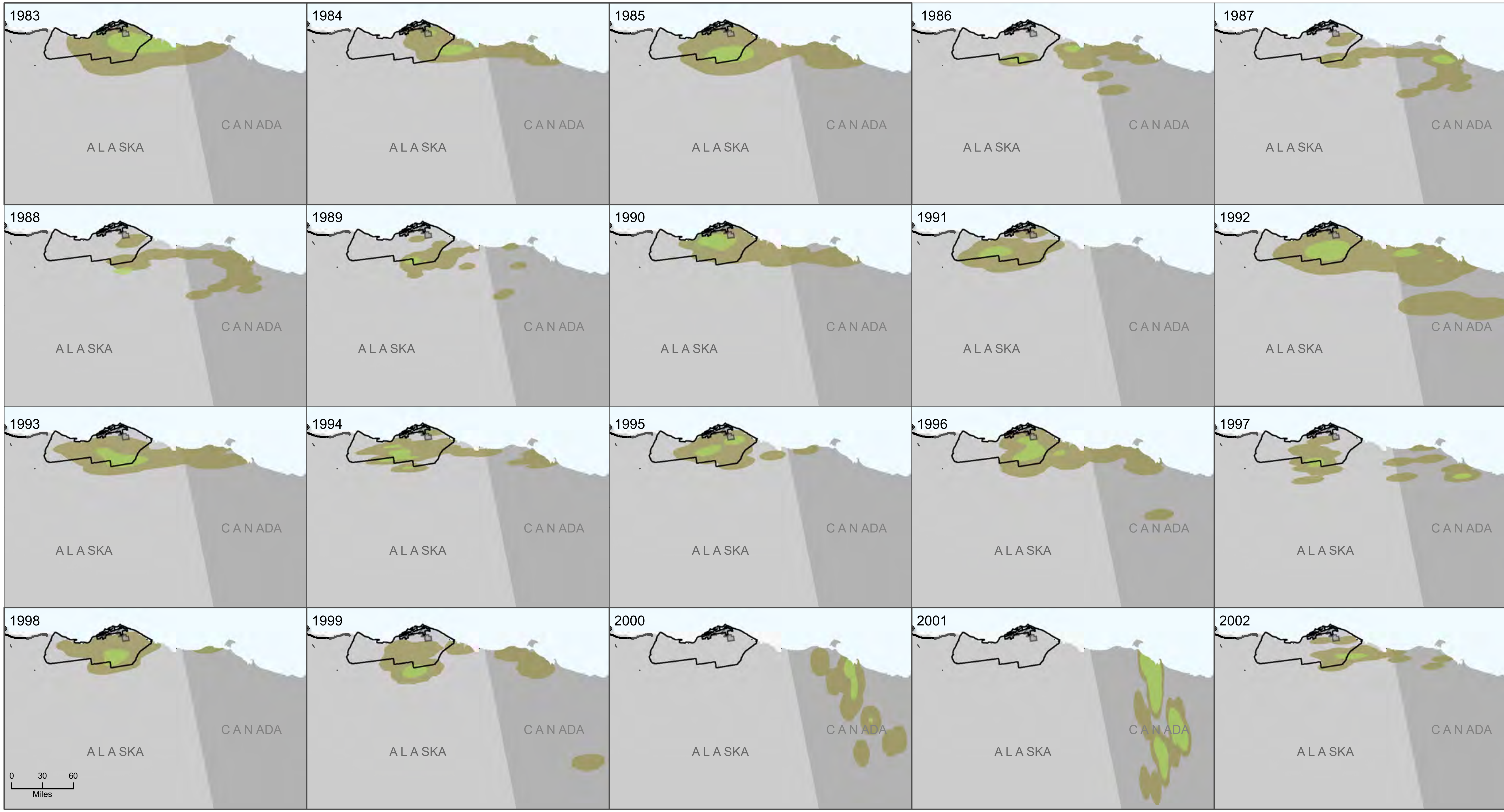
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority



Data Source: BLM GIS 2018, Environment Yukon GIS 2018
Print Date: 08/28/2019

Map 3-28



- Concentrated calving area
- Annual calving ground
- Existing oil and gas roads or pipelines
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Concentrated calving areas were defined as the annual kernel density contour that included areas with greater than average calving density and annual calving grounds were defined as the 99% kernel density utilization distributions obtained from annual calving sites (Griffith et al. 2002, USFWS 2015). GIS layers were created by Alaska Department of Fish and Game following methods of Griffith et al. (2002). No concentrated calving area data for 2014, 2015, 2016. Annual calving ground data for 2010, 2012, 2013, 2014, 2015, 2016, 2017 were calculated as 95% kernel density utilization distributions of female caribou by Environment Yukon.

Data Source: BLM GIS 2018, ADFG GIS 2019 and Environment Yukon GIS 2019
Print Date: 08/28/2019

Map 3-29

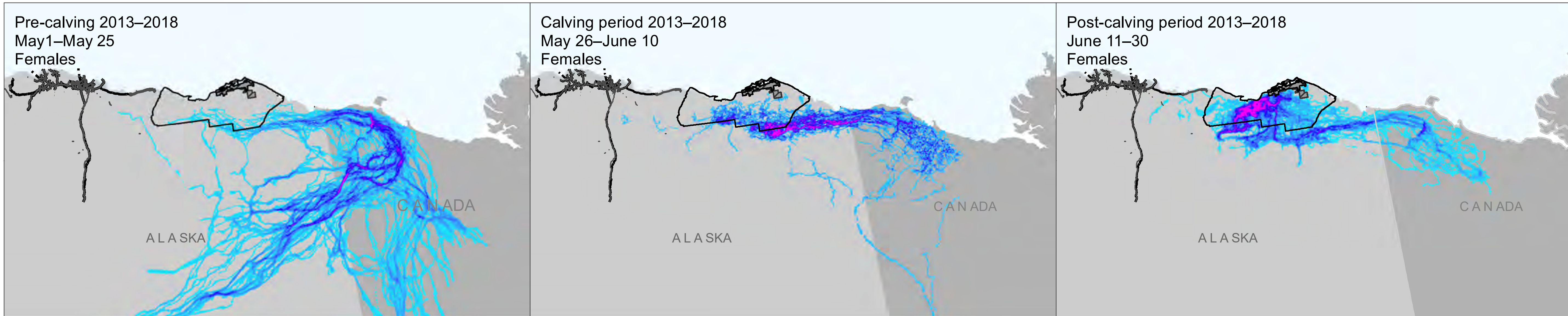
- Concentrated calving area
- Annual calving ground
- Existing oil and gas roads or pipelines
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

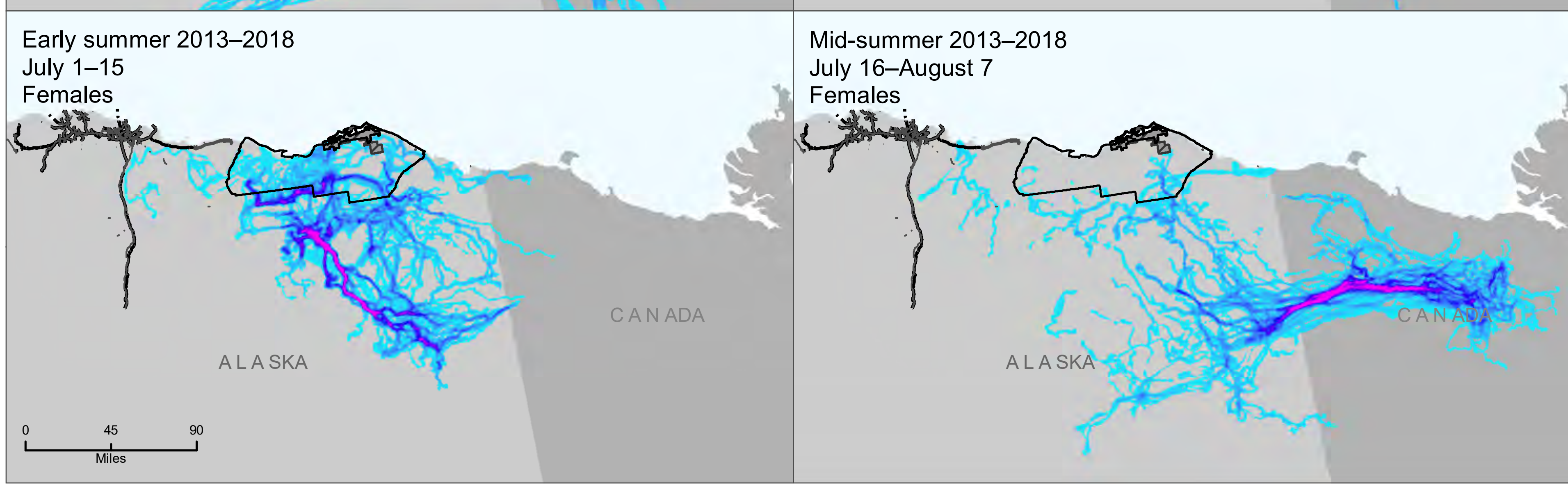
Concentrated calving areas were defined as the annual kernel density contour that included areas with greater than average calving density and annual calving grounds were defined as the 99% kernel density utilization distributions obtained from annual calving sites (Griffith et al. 2002, USFWS 2015). GIS layers were created by Alaska Department of Fish and Game following methods of Griffith et al. (2002). No concentrated calving area data for 2014, 2015, 2016. Annual calving ground data for 2010, 2012, 2013, 2014, 2015, 2016, 2017 were calculated as 95% kernel density utilization distributions of female caribou by Environment Yukon.

Data Source: BLM GIS 2018, ADFG GIS 2019 and Environment Yukon GIS 2019
Print Date: 08/28/2019

Map 3-30

Seasonal Movement of the Porcupine Caribou Herd





Percent of collared caribou using an area was calculated using dynamic Brownian Bridge Movement Models run on locations of female caribou outfitted with GPS collars 2013–2018 (telemetry database from Environment Yukon). The 95% utilization distribution was calculated for each individual caribou with at least 30 locations per season. Results for all individuals were overlaid to determine the percent of collared caribou using each pixel.

Percent of collared caribou

Value

>30%

0%

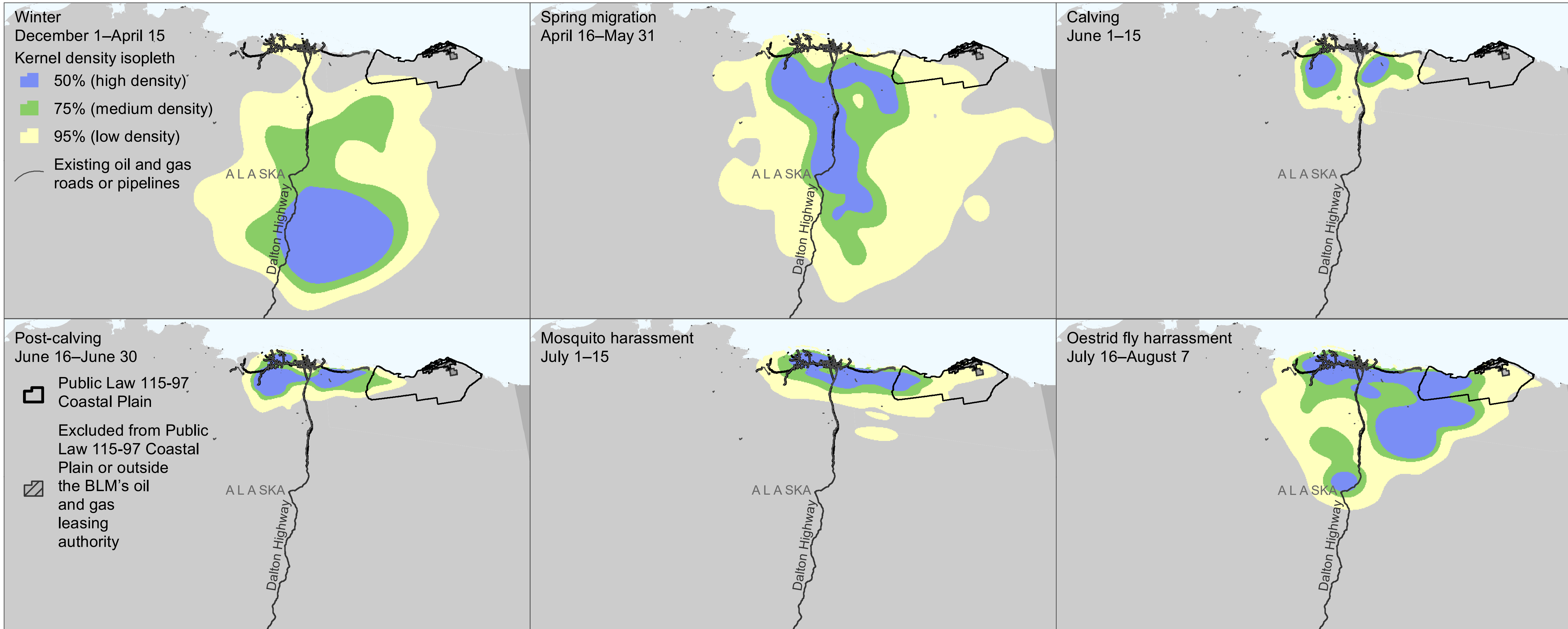
Existing oil and gas roads or pipelines

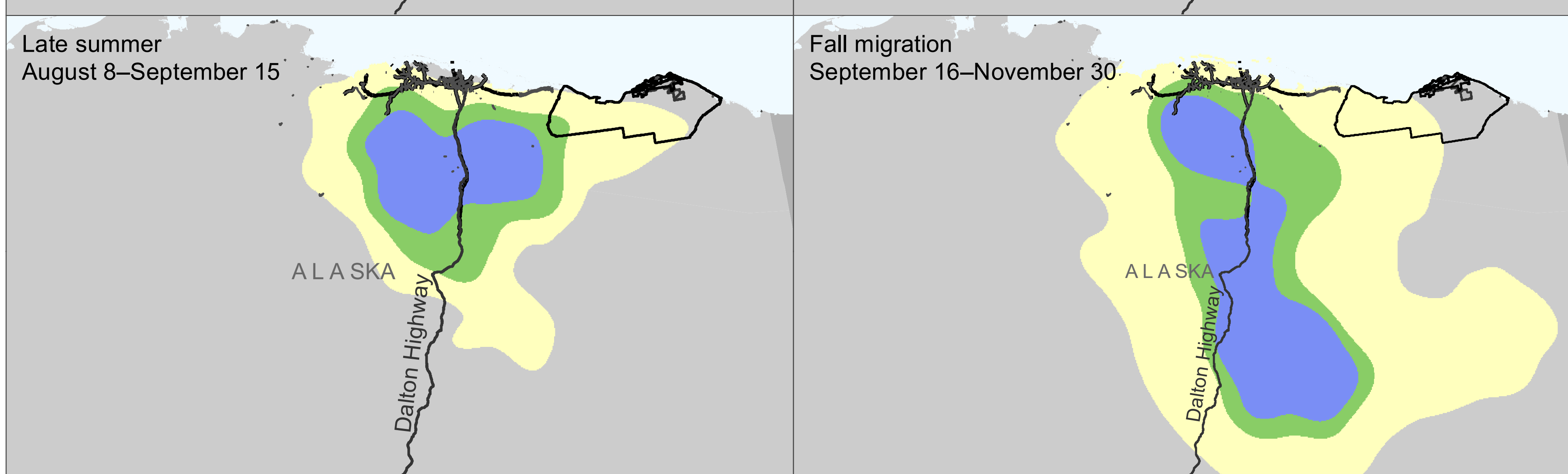
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, Environment Yukon
GIS 2018
Print Date: 08/28/2019

Map 3-31





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 ADFG). 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 ADFG and Conoco Phillips Inc.

0 30 60
Miles

Data Source: BLM GIS 2018, ADFG GIS 2019
Print Date: 08/28/2019

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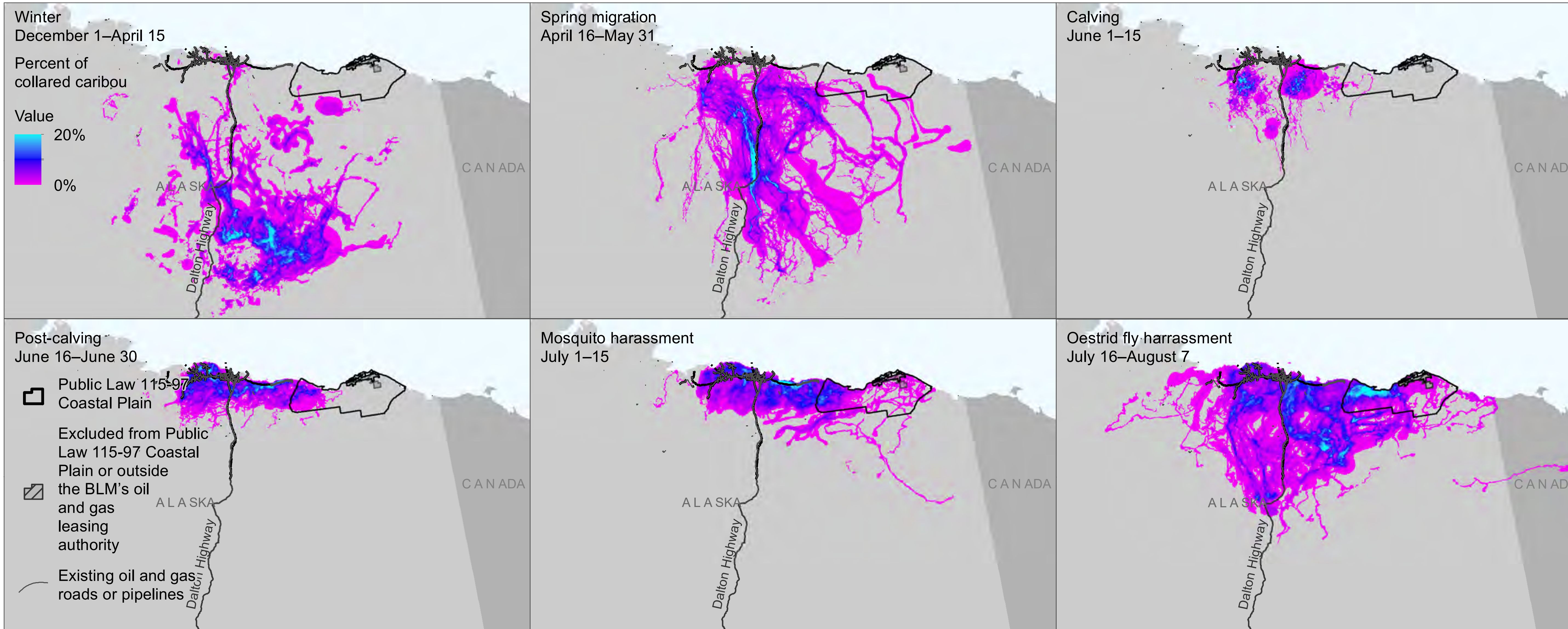
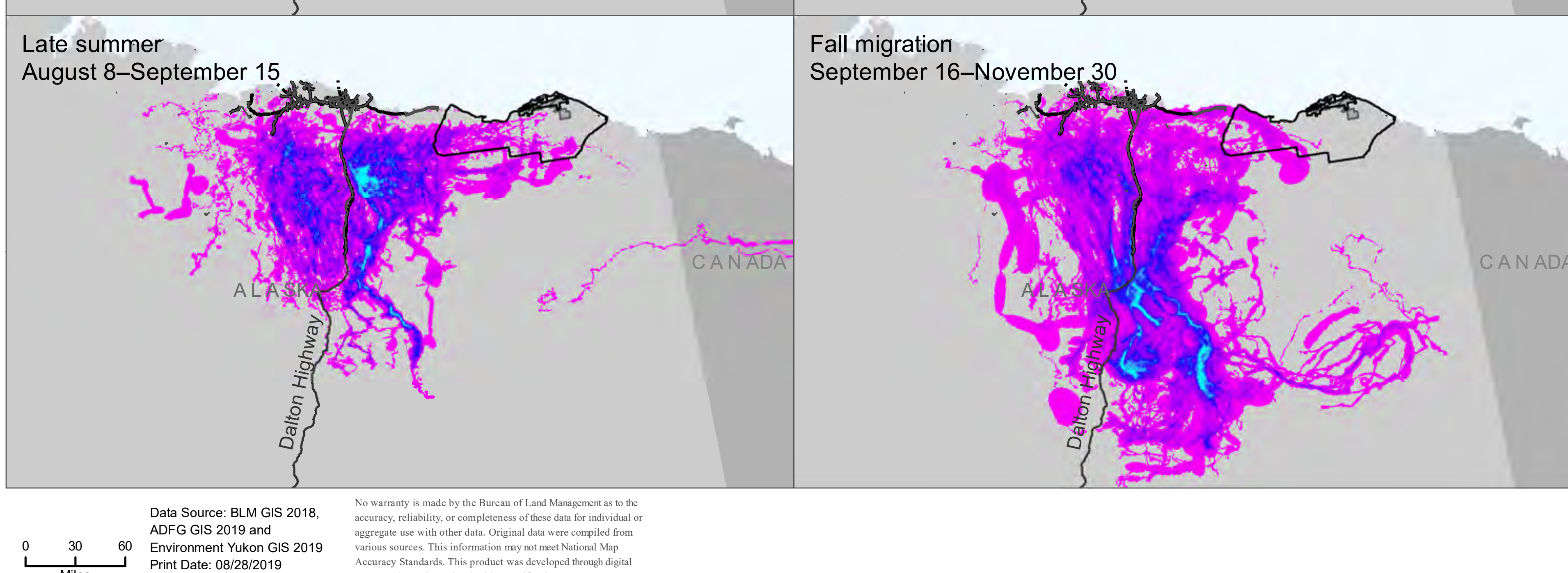
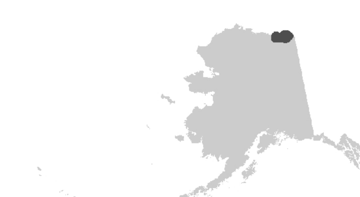
Map 3-32



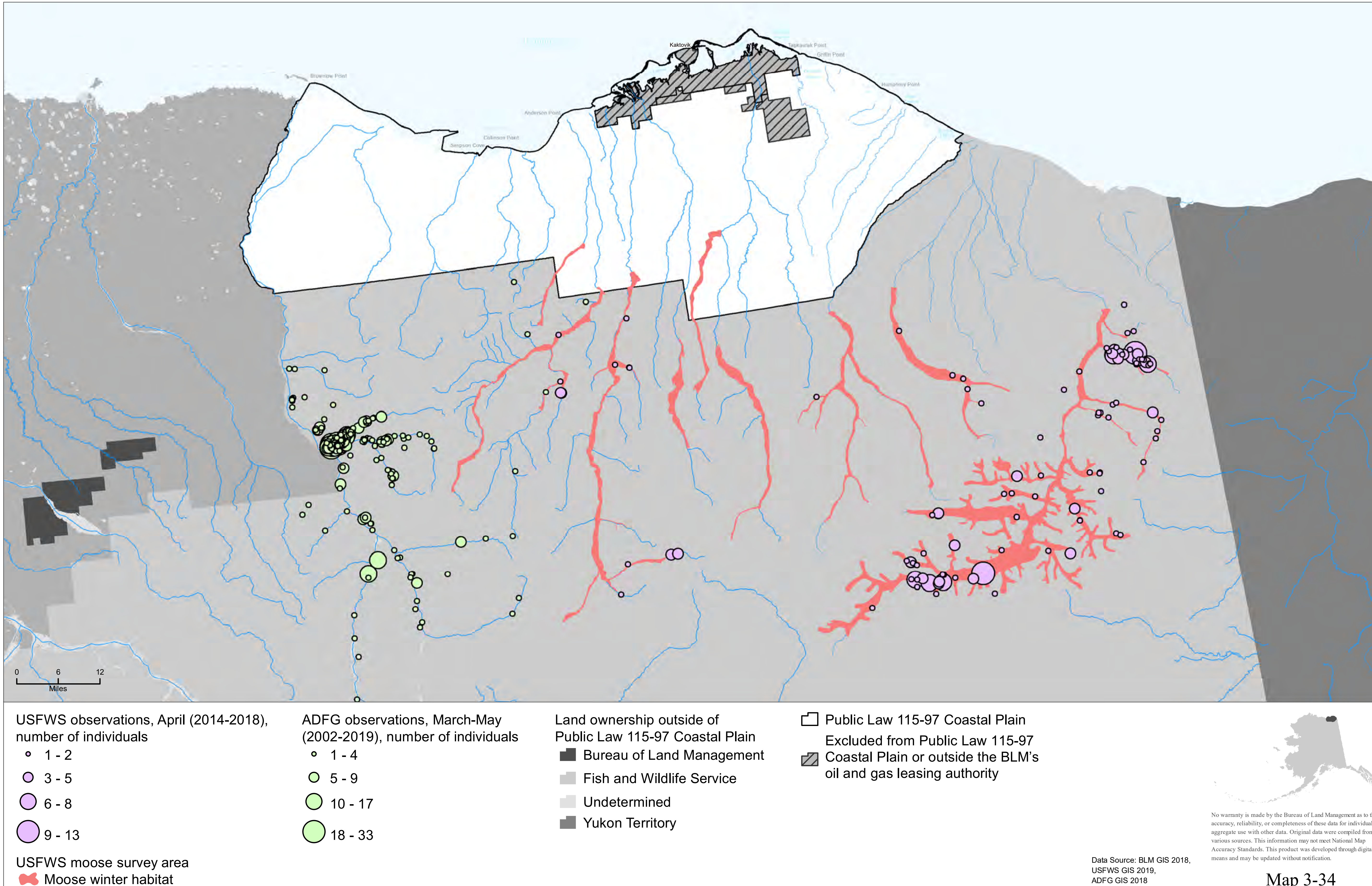


Percent of collared caribou using an area was calculated using dynamic Brownian Bridge Movement Models run on locations of radio-collared female caribou 2001–2018 (telemetry database from ADFG). The 95% utilization distribution was calculated for each individual caribou with at least 30 locations per season. Results for all individuals were overlaid to determine the percent of collared caribou using each pixel.

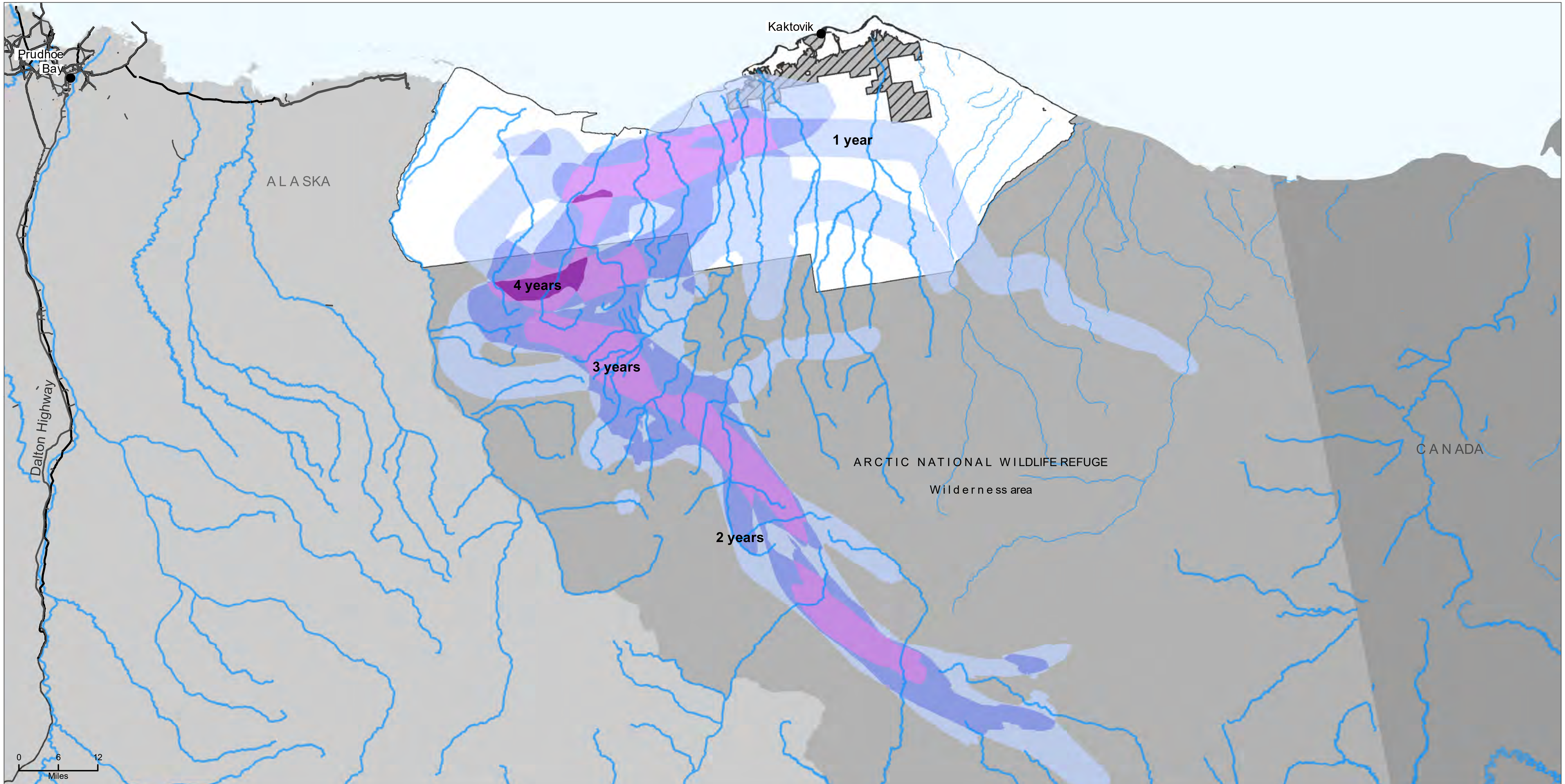


Data Source: BLM GIS 2018, ADFG GIS 2019 and Environment Yukon GIS 2019
Print Date: 08/28/2019

Map 3-33


Kaktovik
0 6 12
Miles
USFWS observations, April (2014-2018), number of individuals
1 - 2
3 - 5
6 - 8
9 - 13
USFWS moose survey area
Moose winter habitat
ADFG observations, March-May (2002-2019), number of individuals
1 - 4
5 - 9
10 - 17
18 - 33
Land ownership outside of Public Law 115-97 Coastal Plain
Bureau of Land Management
Fish and Wildlife Service
Undetermined
Yukon Territory
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, USFWS GIS 2019, ADFG GIS 2018
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 3-34



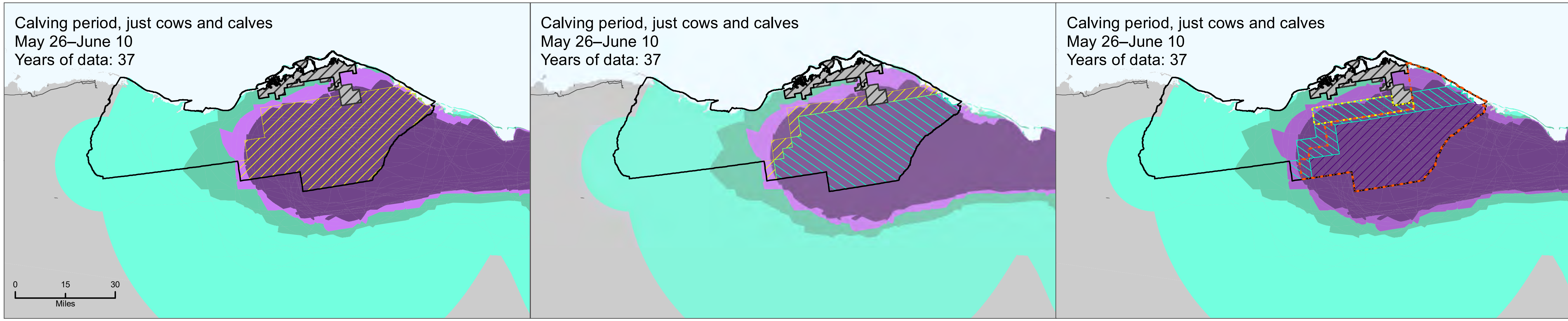
Location of large post-calving aggregations of Porcupine Caribou (estimated to be between 21,000 and 121,000 animals) during 2014–2017 on a scale of 1-4, where 4 indicates large groups were present in all 4 years (remade from Russell and Gunn 2019).

1
2
3
4

Existing oil and gas roads or pipelines
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, Russell, D. and A. Gunn. 2019
Print Date: 08/28/2019

Map 3-35



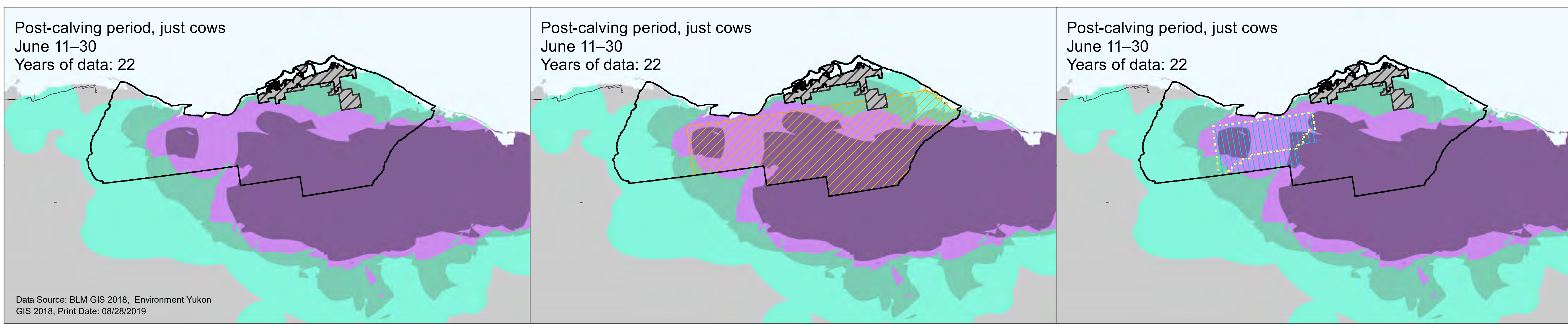
Alternative B:
Lease stipulation 7—Porcupine Caribou calving habitat, timing limitation, May 20-June 20
Existing oil and gas roads or pipelines
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Percent of years that caribou are present
<20%
20–30%
30–40%
≥40%

Alternative C:
Lease stipulation 7—Porcupine Caribou calving habitat, no surface occupancy
Lease stipulation 7—Porcupine Caribou calving habitat, timing limitation, May 20-June 20

Alternative D1 :
Lease stipulation 7—Porcupine Caribou calving habitat, not offered for lease sale
Lease stipulation 7—Porcupine Caribou calving habitat, no surface occupancy

Alternative D2:
Lease stipulation 7—Porcupine Caribou calving habitat, not offered for lease sale
Lease stipulation 7—Porcupine Caribou calving habitat, no surface occupancy



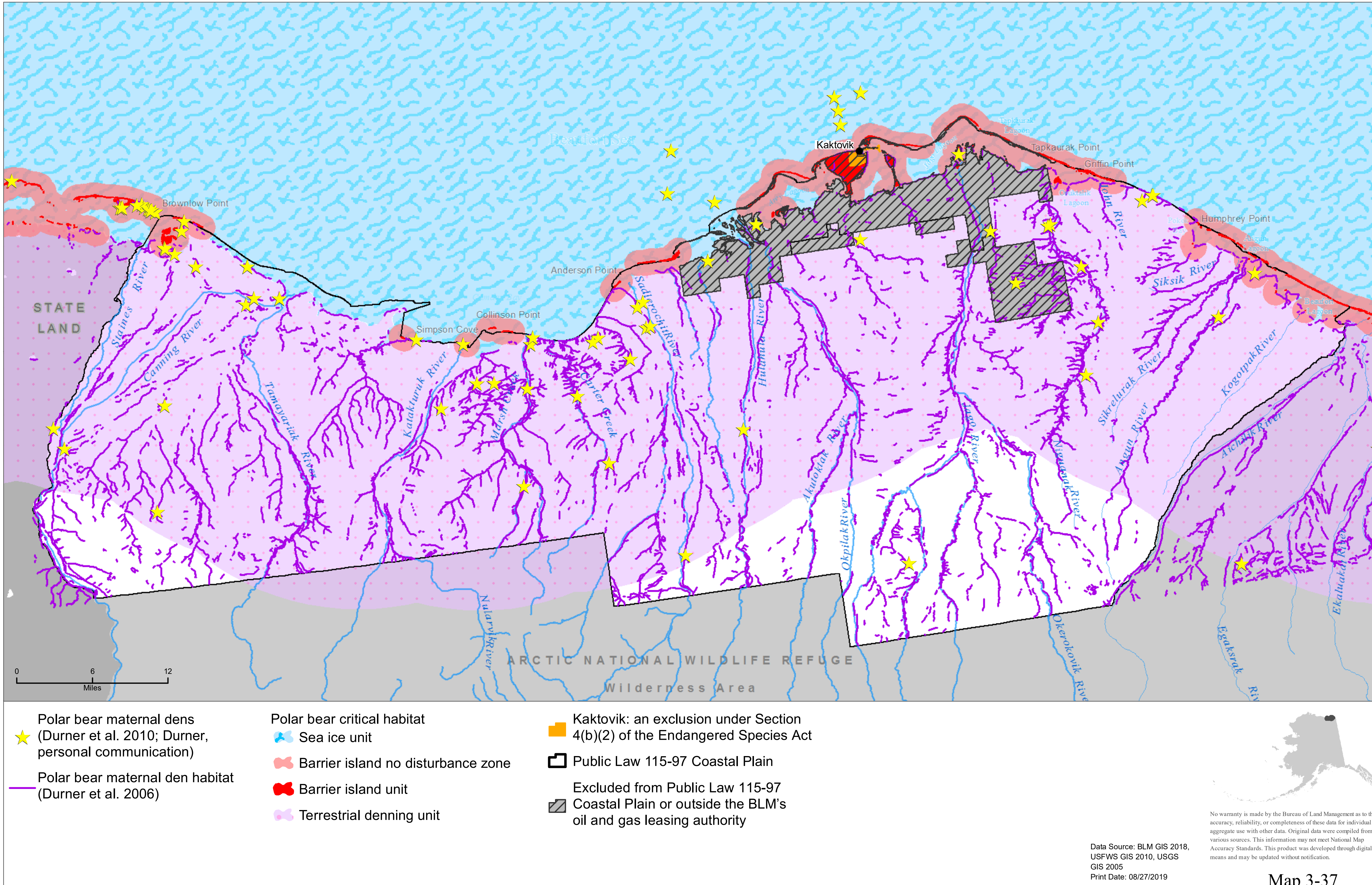
Alternative B:
Lease stipulation 8—Porcupine Caribou post-calving habitat, required operating procedure 23

Alternative C:
Lease stipulation 8—Porcupine Caribou post-calving habitat, timing limitation, June 15-July 20

Alternative D1:
Lease stipulation 8—Porcupine Caribou post-calving habitat, controlled surface use and timing limitation, June 15-July 20

Alternative D2:
Lease stipulation 8—same

Map 3-36


Beaufort Sea
Kaktovik
Tapkaurak Point
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Collinson Point
Simpson Cove
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
Staines River
Canning River
Tamayariak River
Katakturuk River
Marsh Creek
Carter Creek
Sadlerochit River
Hulahula River
Akutoakak River
Okpilak River
Jago River
Niguanak River
Sikrelurak River
Angun River
Kogotpak River
Siksik River
Aichilik River
Ekaluakat River
Egaksrak River
Okerokovik River
Nularvik River
Jago River
0 6 12
Miles
Polar bear maternal dens (Durner et al. 2010; Durner, personal communication)
Polar bear maternal den habitat (Durner et al. 2006)
Polar bear critical habitat
Sea ice unit
Barrier island no disturbance zone
Barrier island unit
Terrestrial denning unit
Kaktovik: an exclusion under Section 4(b)(2) of the Endangered Species Act
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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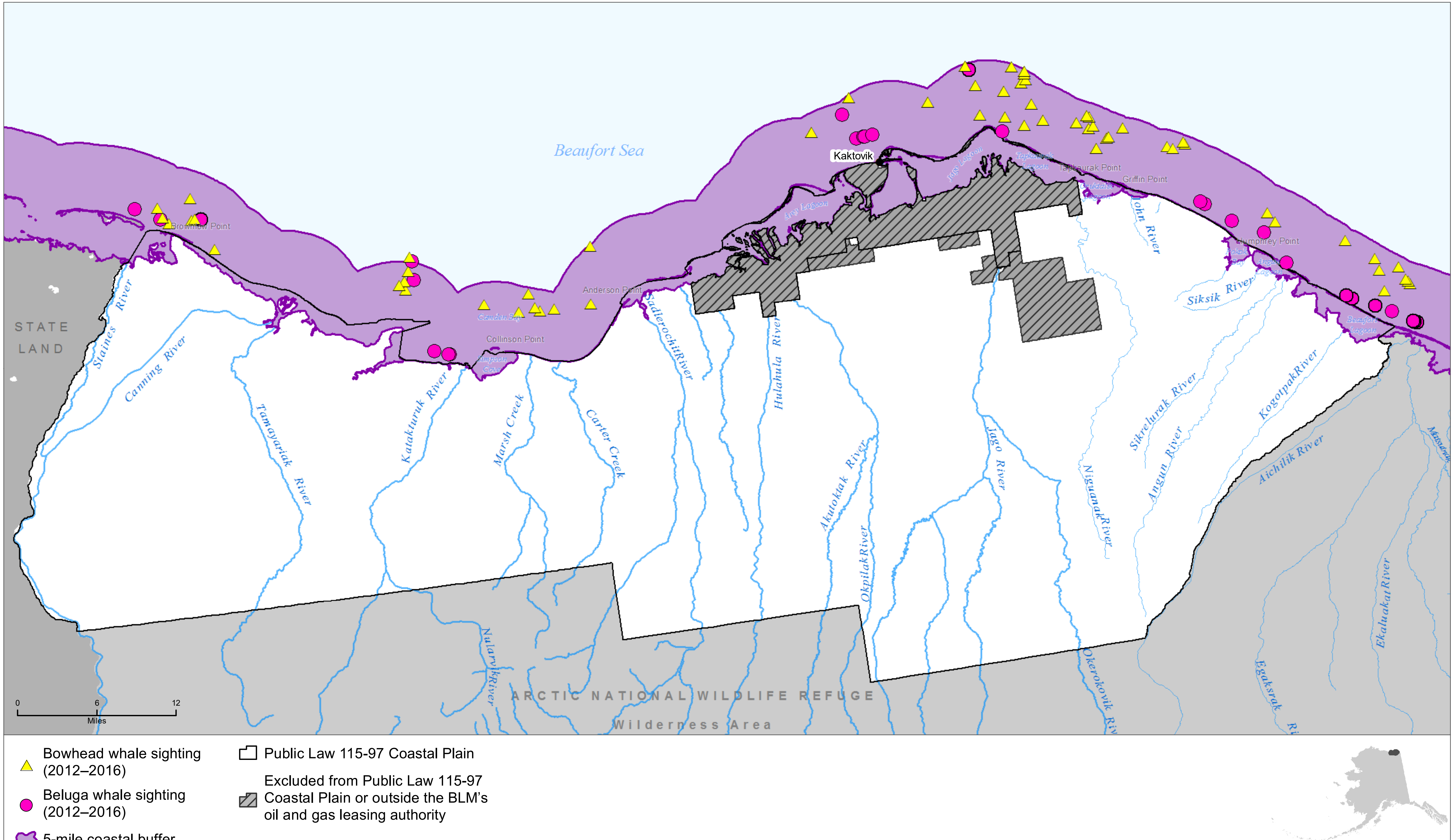
Data Source: BLM GIS 2018, USFWS GIS 2010, USGS GIS 2005
Print Date: 08/27/2019

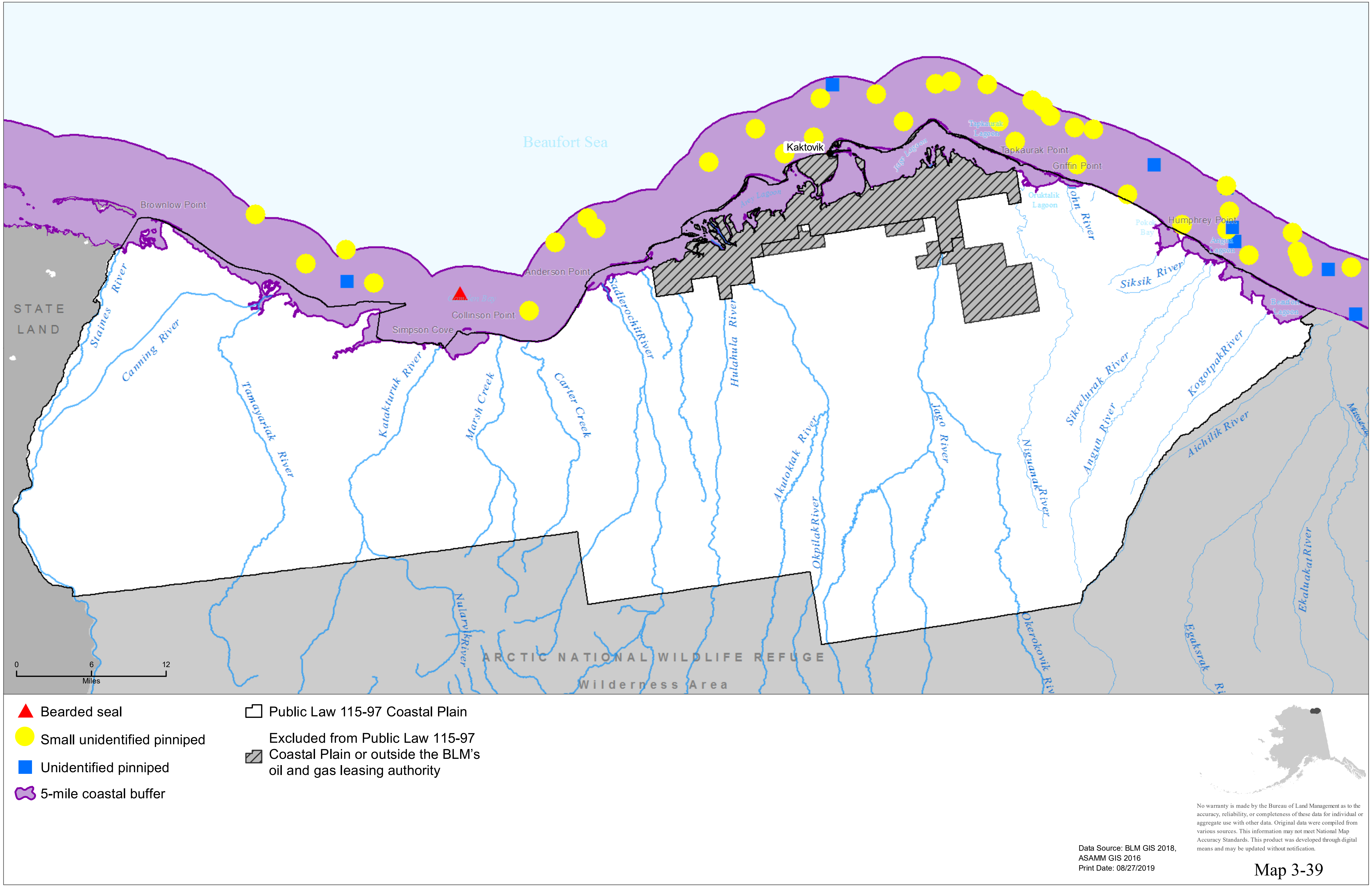
Map 3-37



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.

Data Source: BLM GIS 2018, ASAMM GIS 2016
Print Date: 08/27/2019

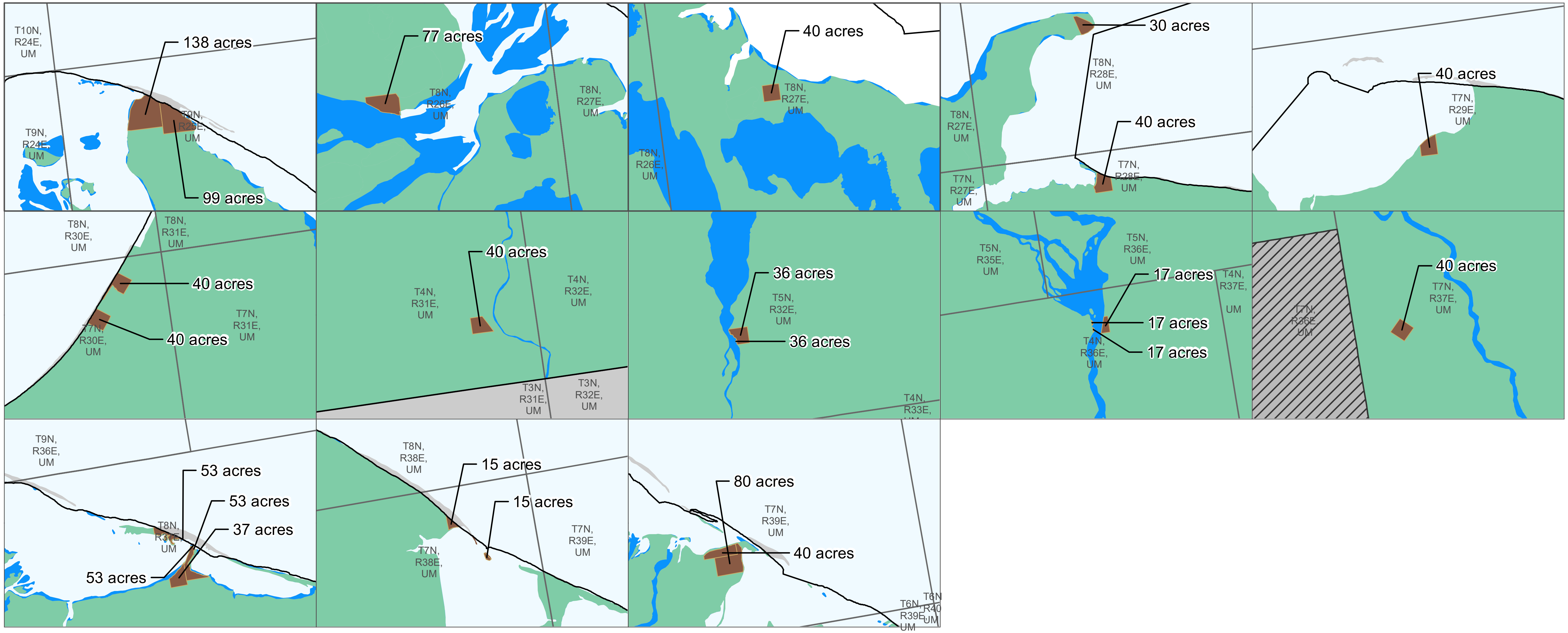
Map 3-38



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.

Data Source: BLM GIS 2018, ASAMM GIS 2016
Print Date: 08/27/2019

Map 3-39



0 0.5 1
Miles

U.S. Fish and Wildlife Service
Native Lands (patented or interim conveyed)
Native Allotment

Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

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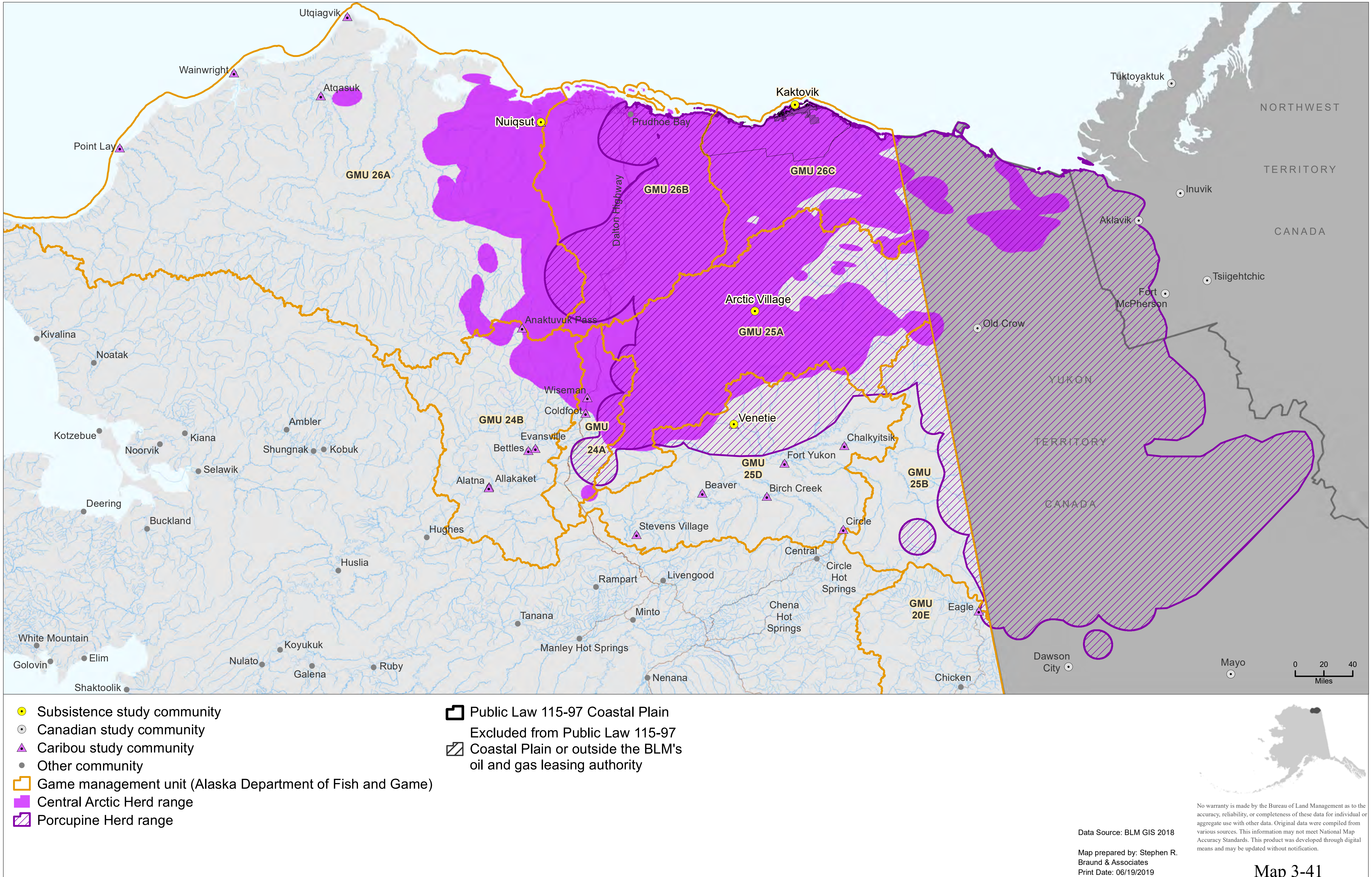
Data Source: BLM GIS 2018
Print Date: 08/28/2019

Map 3-40


Utqiagvik
Wainwright
Atqasuk
Point Lay
GMU 26A
Nuiqsut
Prudhoe Bay
Kaktovik
GMU 26B
GMU 26C
Dalton Highway
Tuktoyaktuk
NORTHWEST
TERRITORY
CANADA
Inuvik
Aklavik
Tsiigehtchic
Fort McPherson
Arctic Village
GMU 25A
Old Crow
Anaktuvuk Pass
Kivalina
Noatak
YUKON
TERRITORY
CANADA
Wiseman
Coldfoot
GMU 24B
GMU 24A
Venetie
Evansville
Bettles
Chalkyitsik
Fort Yukon
Kotzebue
Kiana
Ambler
Noorvik
Shungnak
Kobuk
Selawik
GMU 25D
GMU 25B
Alatna
Allakaket
Beaver
Birch Creek
Deering
Buckland
Hughes
Stevens Village
Circle
Central
Huslia
Rampart
Livengood
Circle Hot Springs
Chena Hot Springs
GMU 20E
Eagle
Tanana
Minto
Manley Hot Springs
White Mountain
Elim
Golovin
Koyukuk
Nulato
Galena
Ruby
Shaktoolik
Nenana
Dawson City
Chicken
Mayo
0 20 40
Miles
Subsistence study community
Canadian study community
Caribou study community
Other community
Game management unit (Alaska Department of Fish and Game)
Central Arctic Herd range
Porcupine Herd range
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018
Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019
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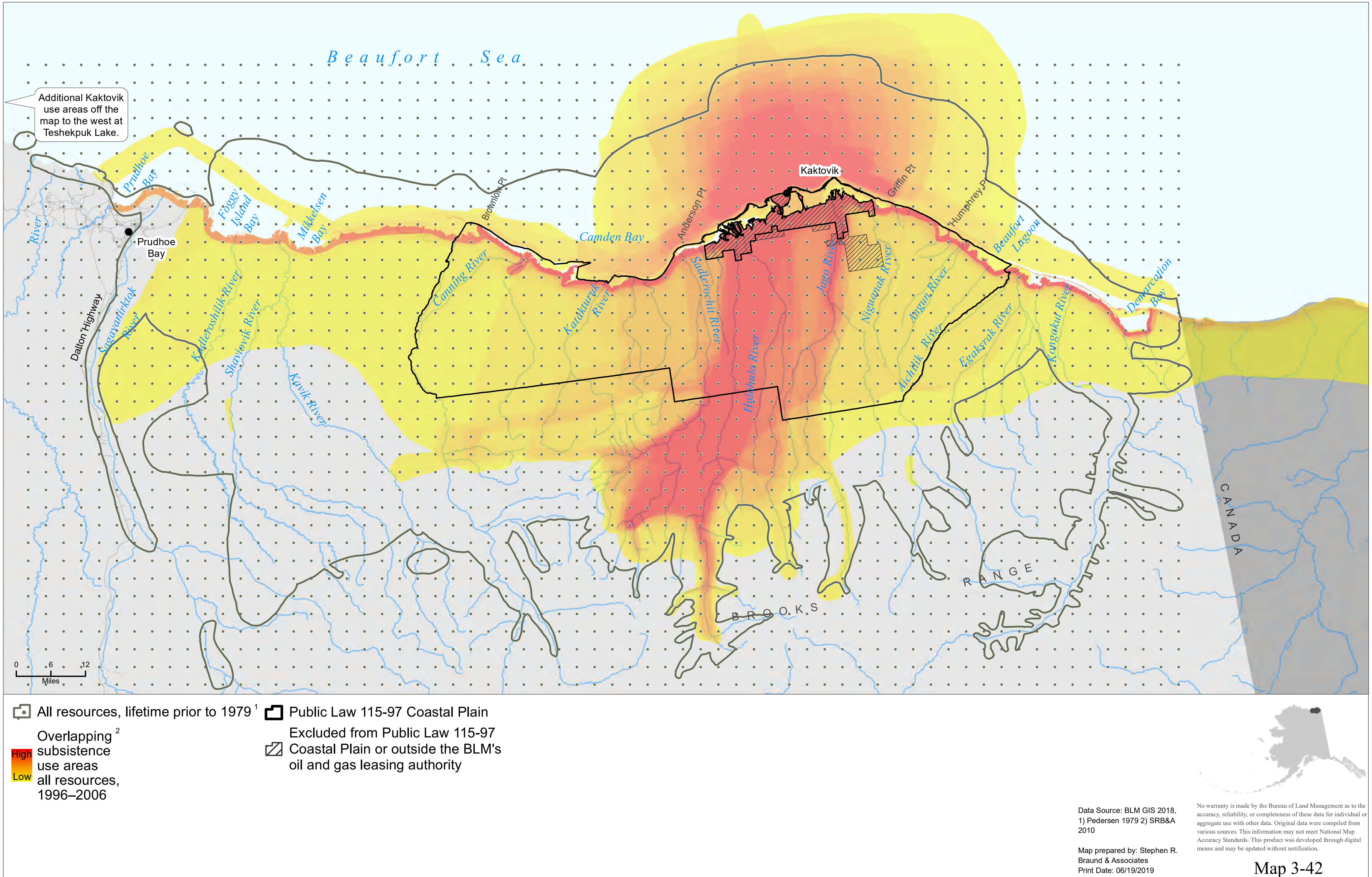
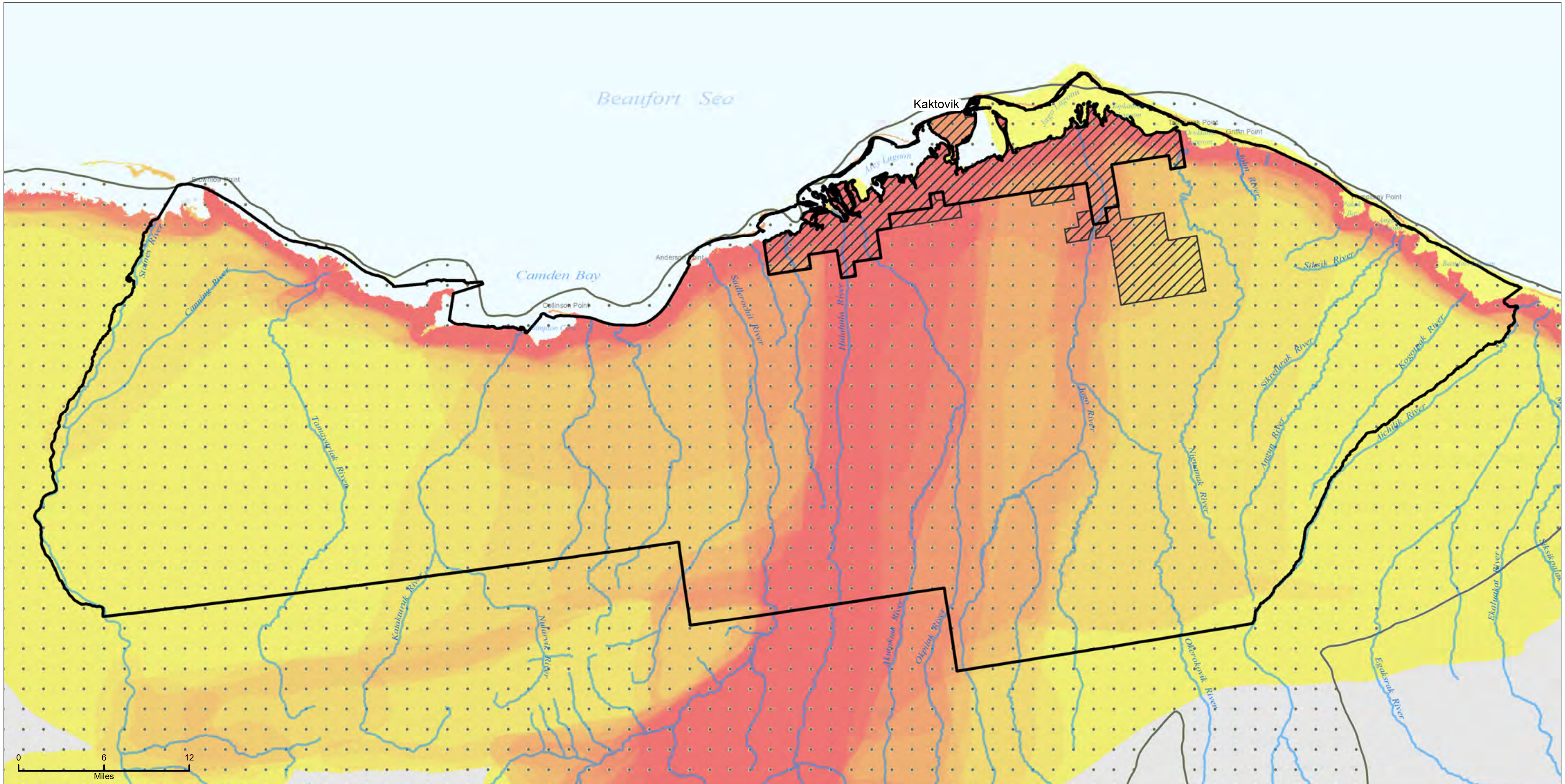
Map 3-41



Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-42



Caribou, lifetime prior to 1979 [1]

Overlapping [2] subsistence use areas caribou, 1996–2006

High

Low

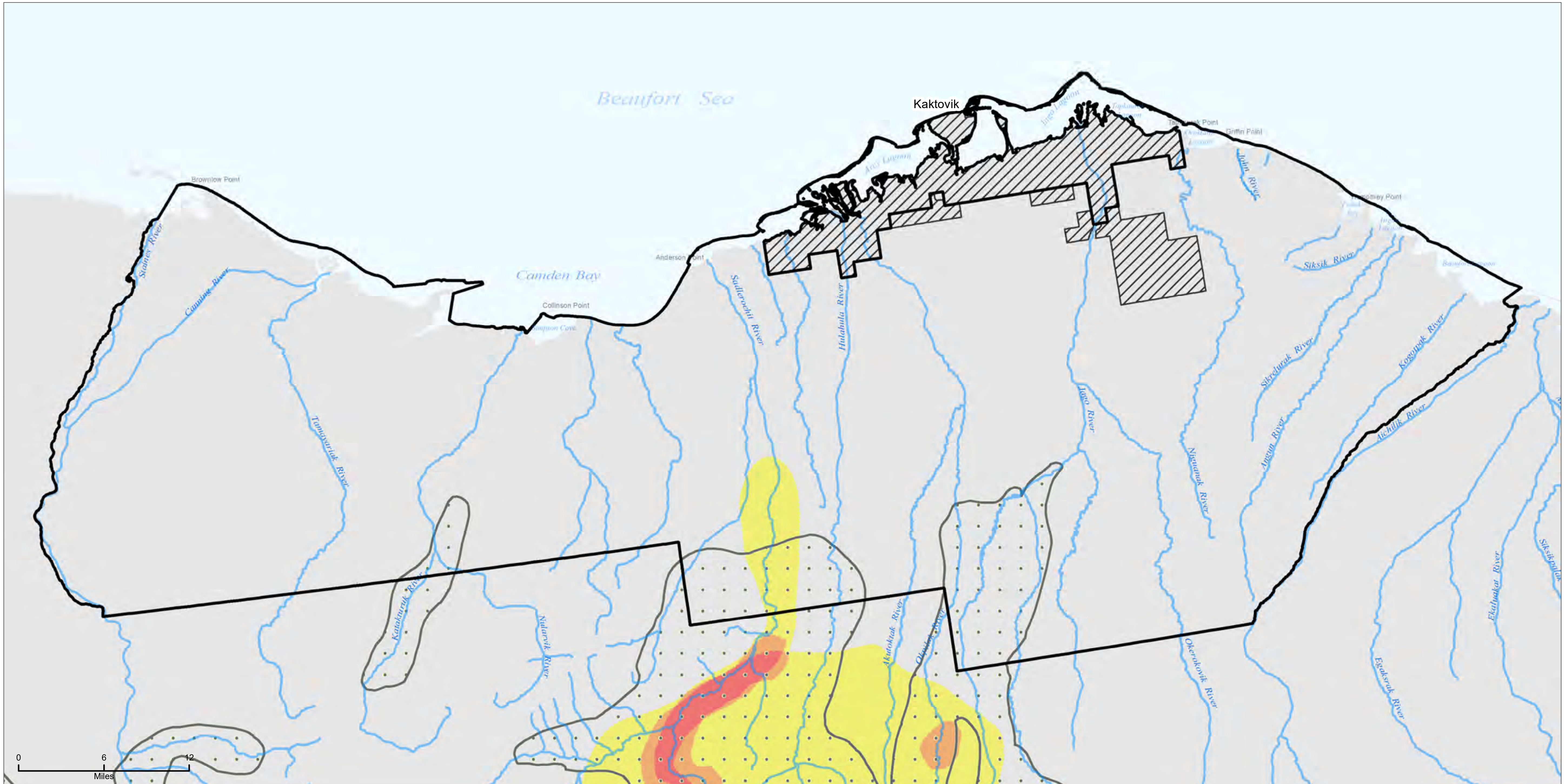
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-43



Moose, lifetime prior to 1979 [1]

Overlapping [2] subsistence use areas moose, 1996–2006

High

Low

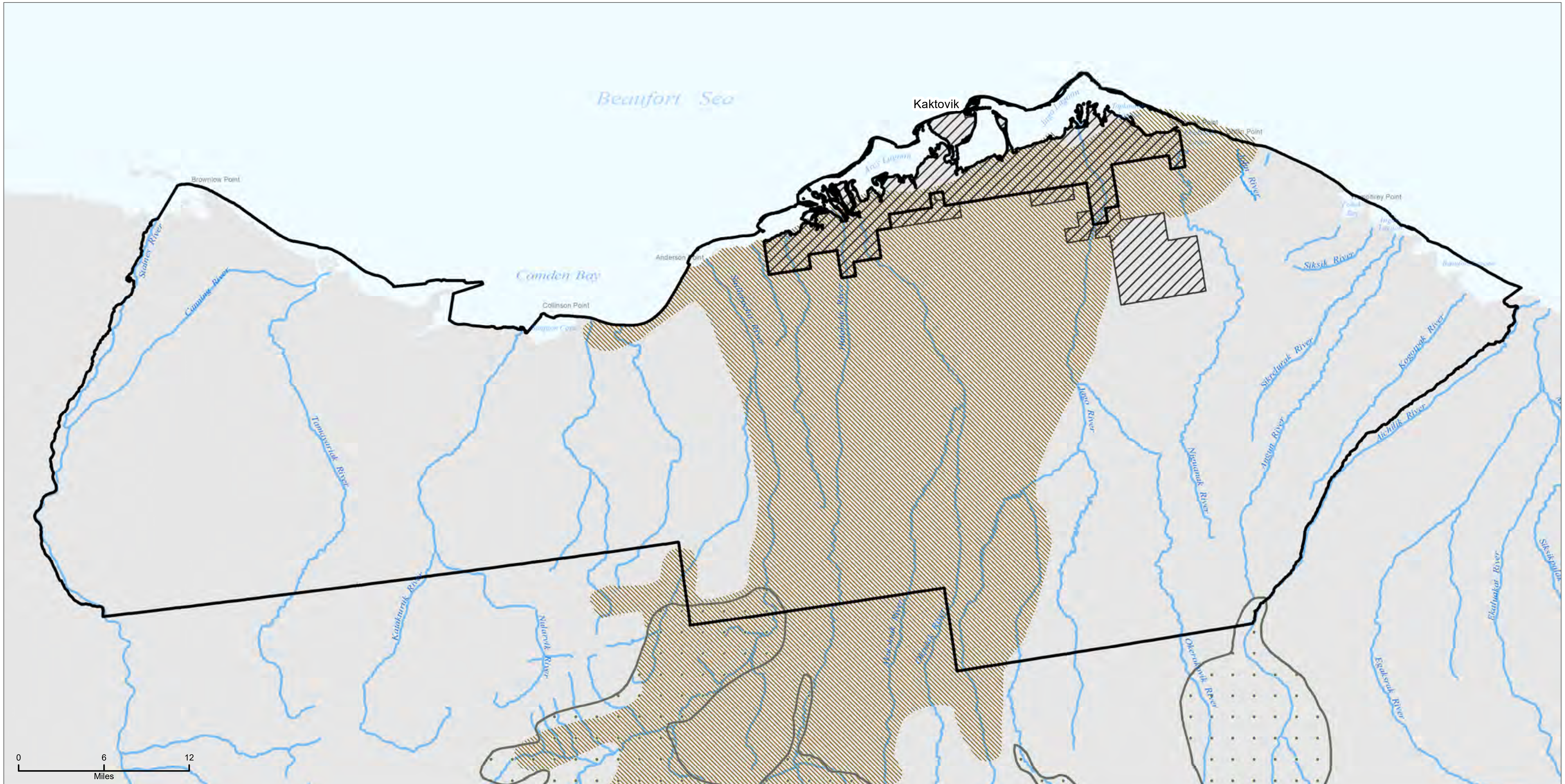
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-44

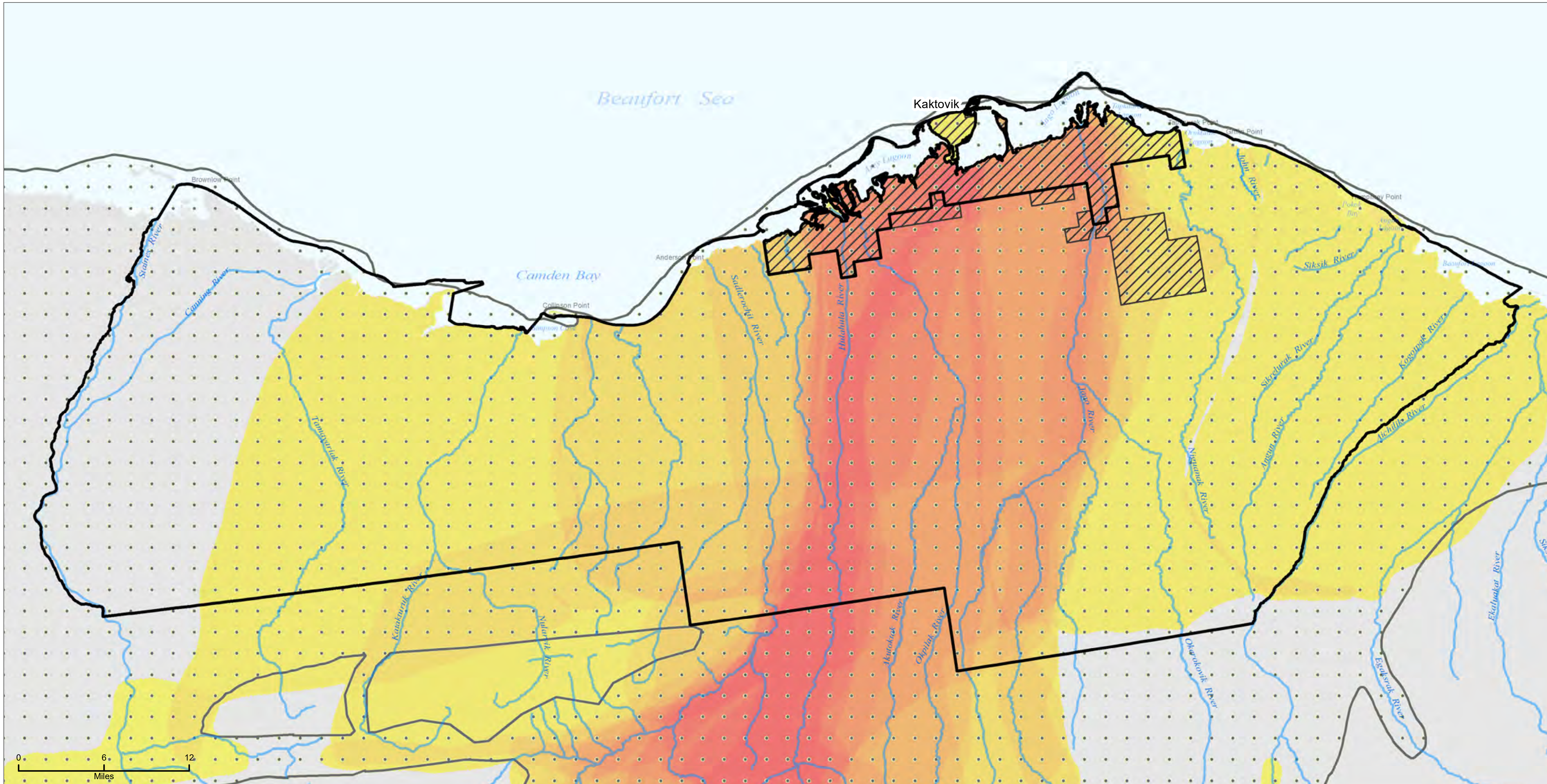


Sheep, lifetime prior to 1979[1]
Grizzly, lifetime prior to 1979[1]
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-45



Furbearer Hunting, Circa 1923-1983 [1]

Overlapping [2] subsistence use areas wolf and wolverine, 1996–2006

High

Low

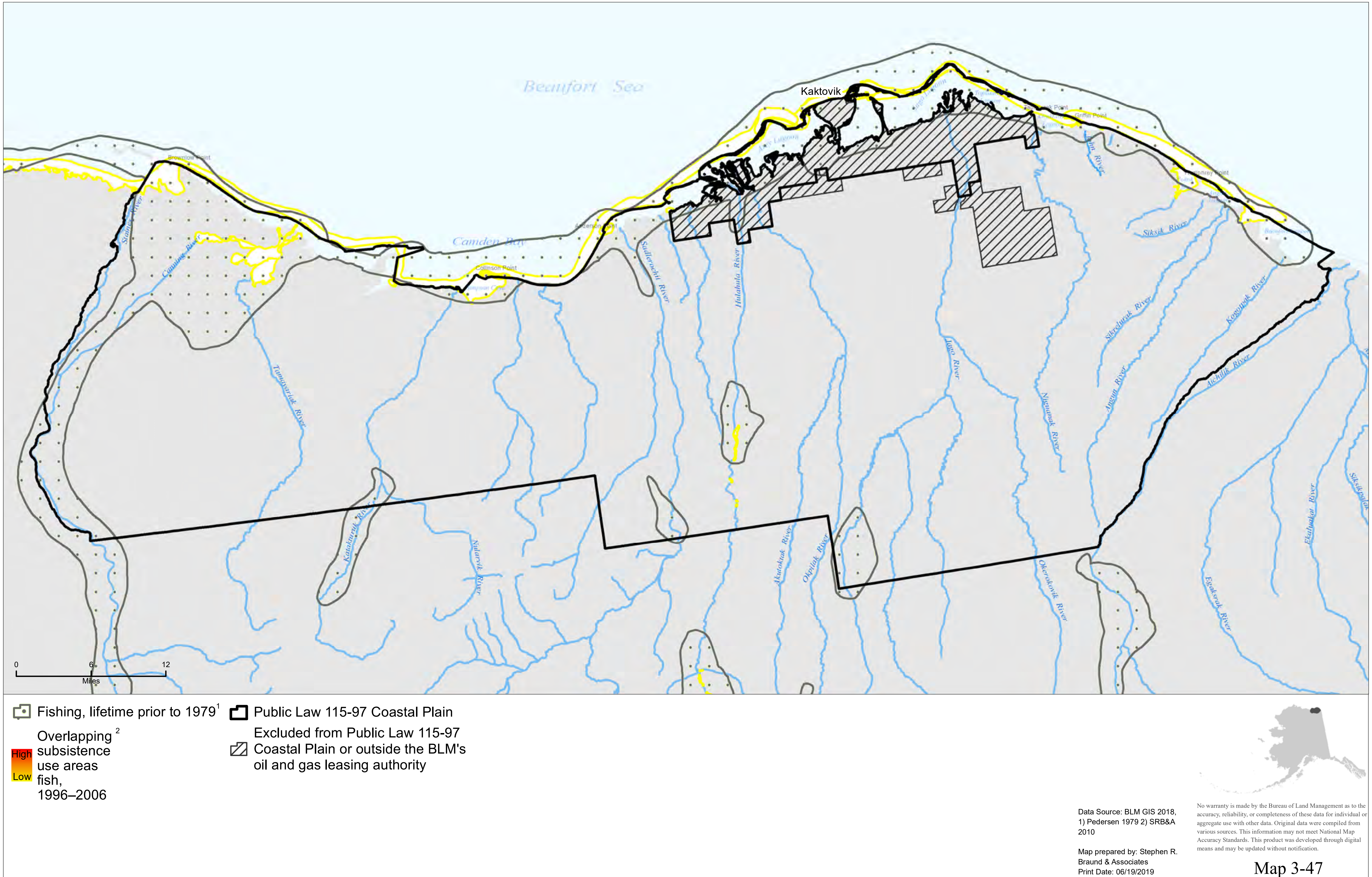
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen, Coffing and Thompson 1985 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

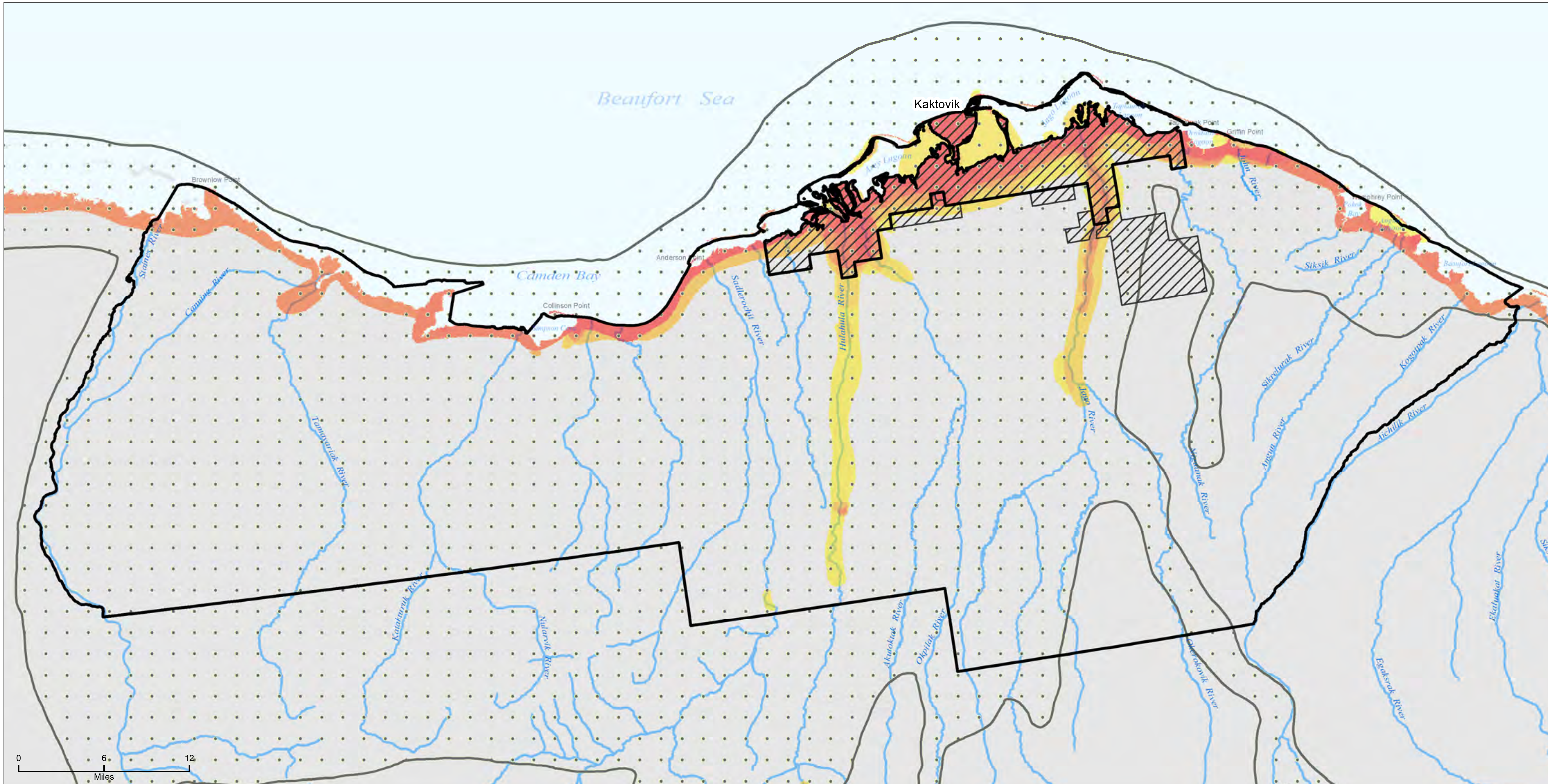
Map 3-46



Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-47



Wildfowl, lifetime prior to 1979[1]

Overlapping[2] subsistence use areas eider and goose, 1996–2006

High

Low

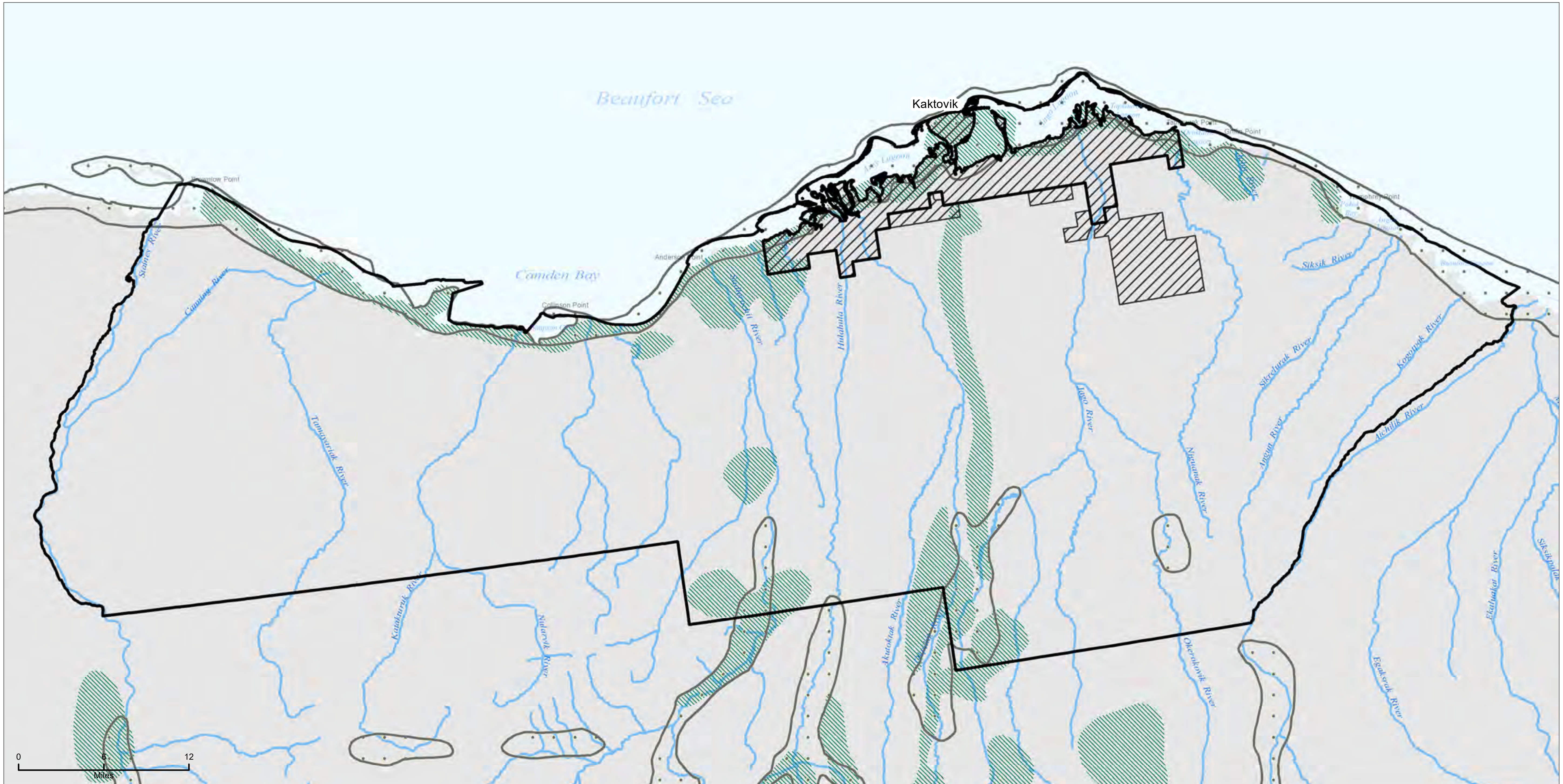
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-48



- Vegetation, lifetime prior to 1979[1]
- Wood, lifetime prior to 1979[1]
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018,
1) Pedersen 1979

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

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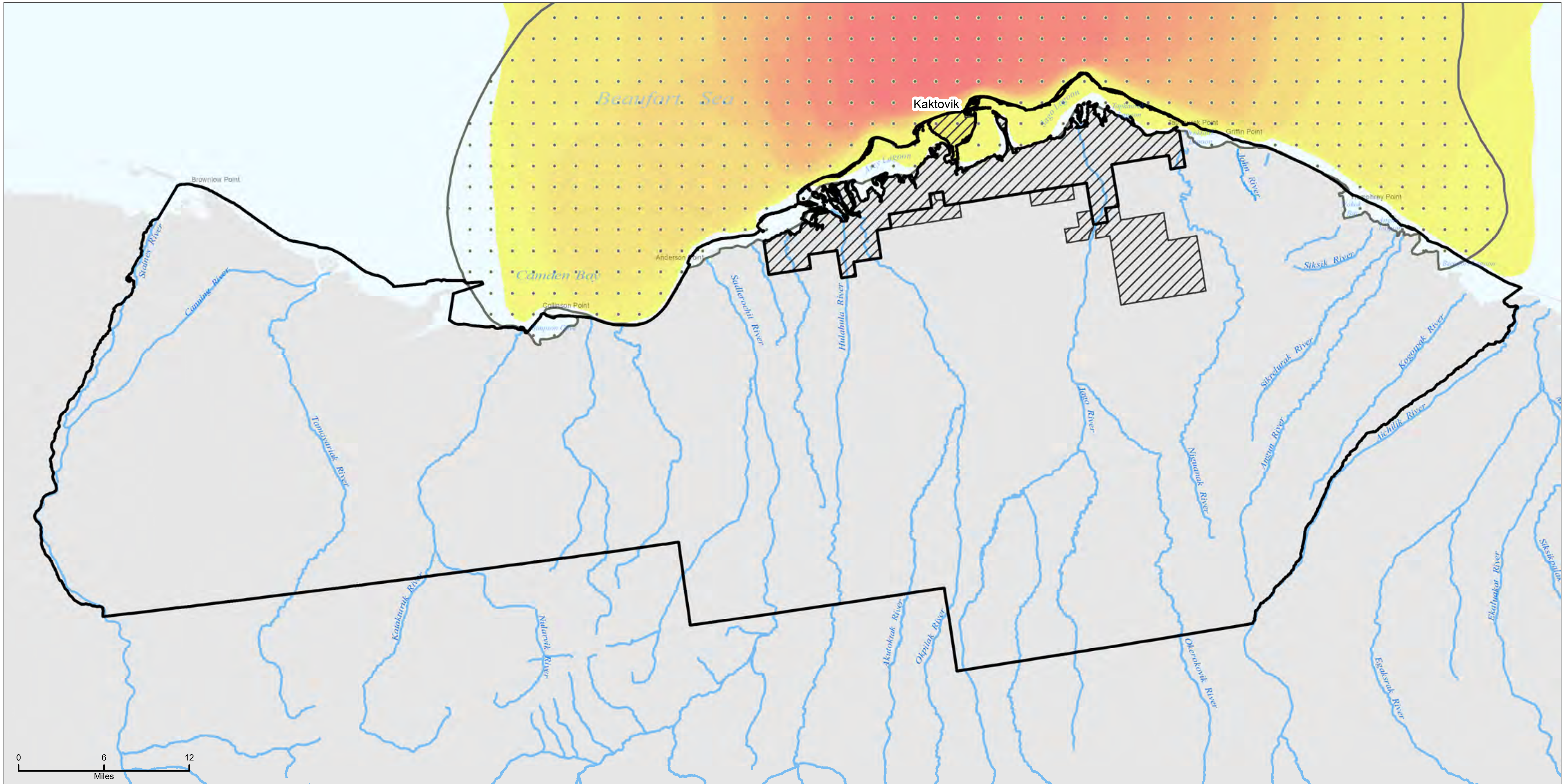
Map 3-49



Whale, lifetime prior to 1979 [1]

Overlapping [2] subsistence use areas bowhead, 1996–2006

High

Low

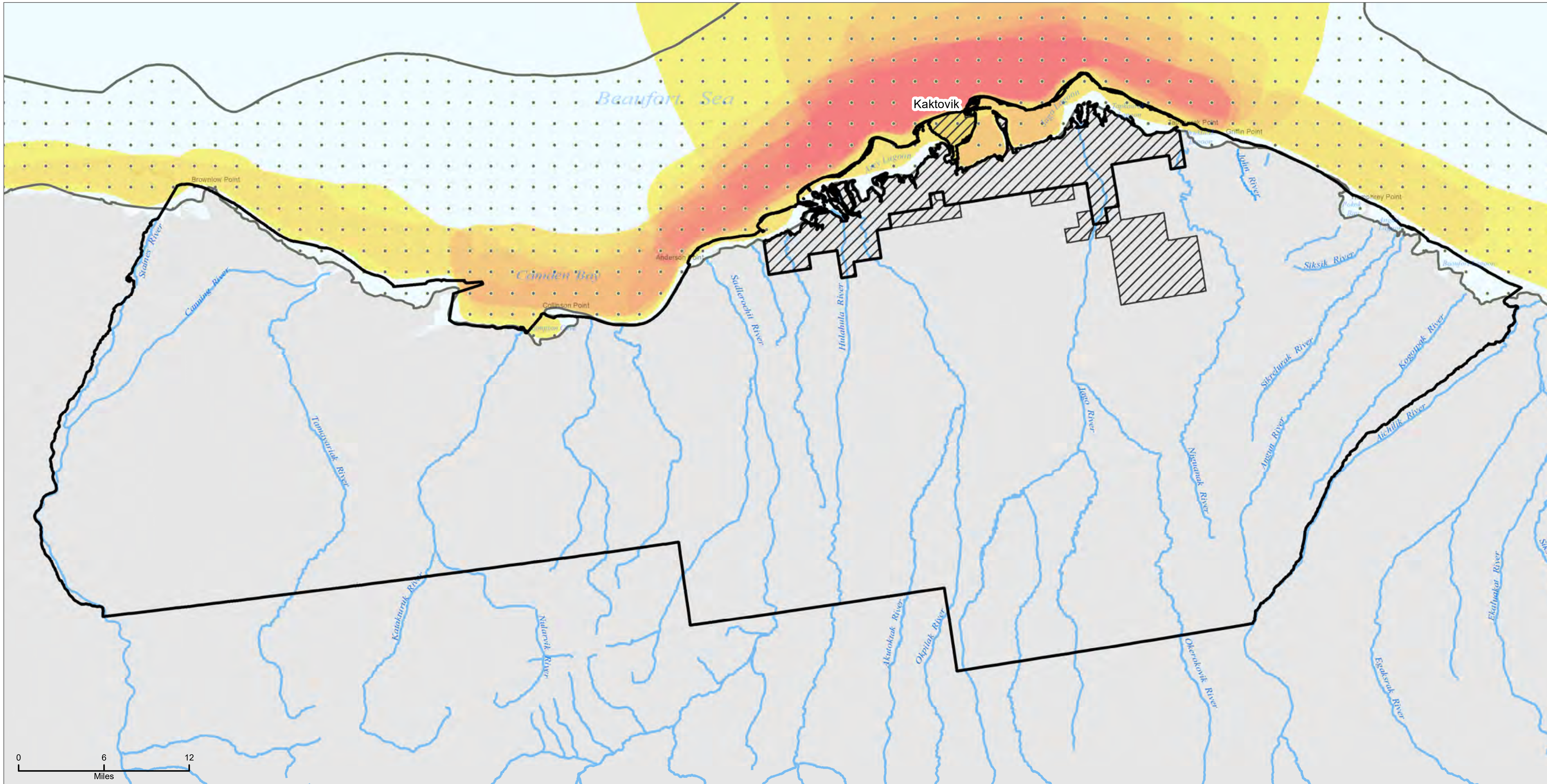
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-50



Seal, lifetime prior to 1979[1]

Overlapping[2] subsistence use areas seal, 1996–2006

High

Low

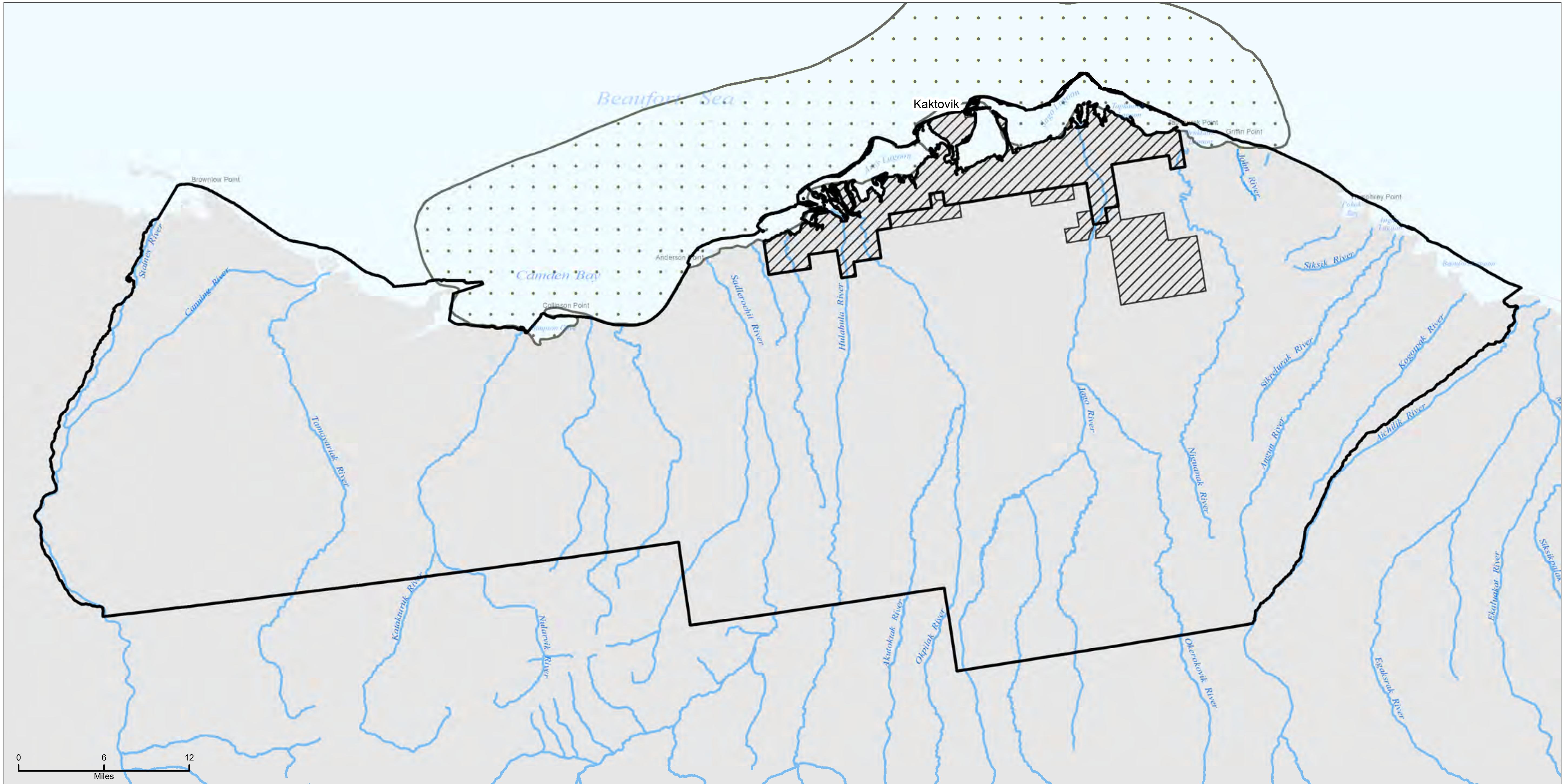
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-51



Walrus, lifetime prior to 1979 [1]

Overlapping [2] subsistence use areas walrus, 1996–2006

High

Low

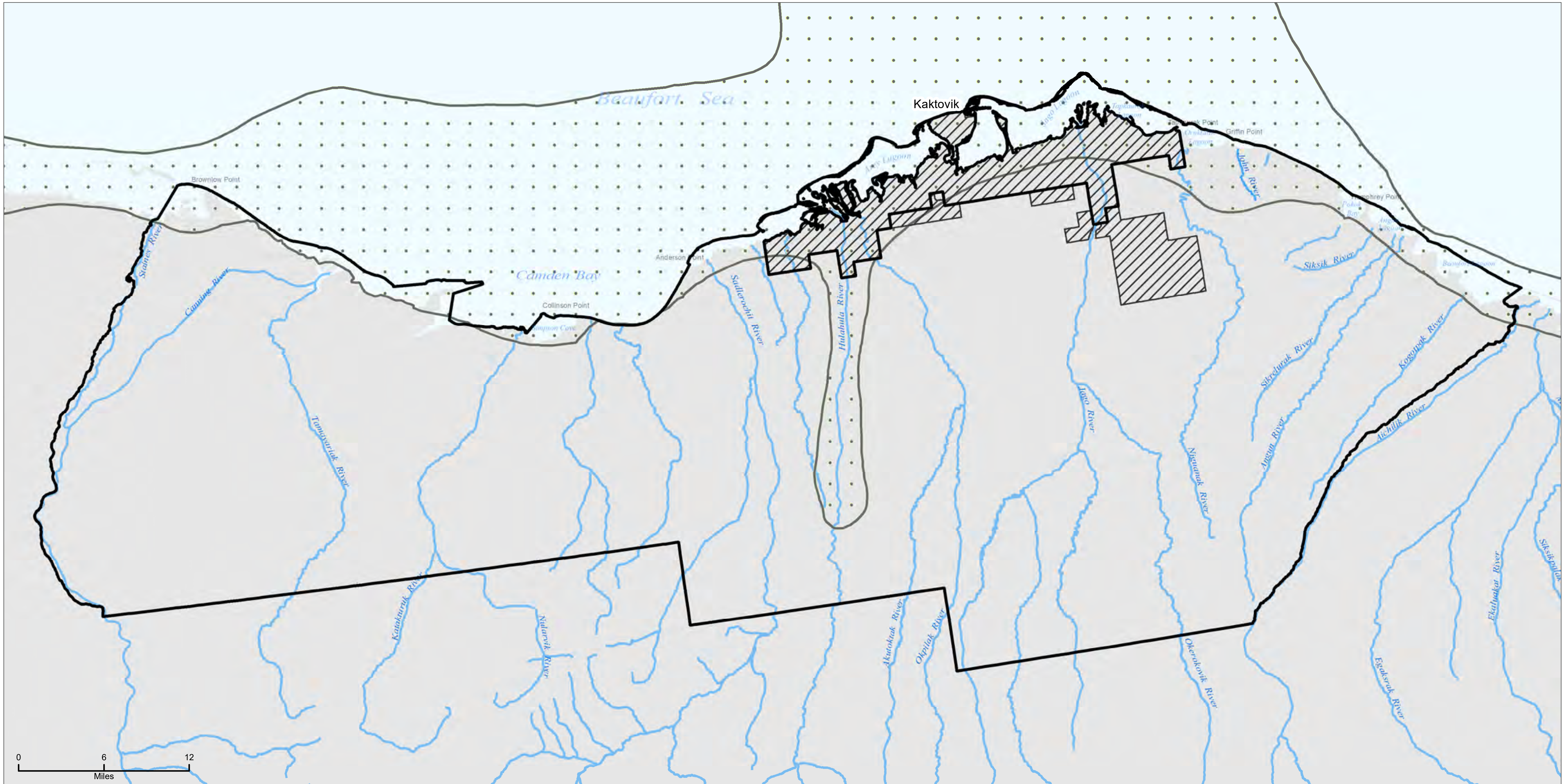
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1979 2) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-52



Polar bear, lifetime prior to 1979 [1]

Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018,
1) Pedersen 1979

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

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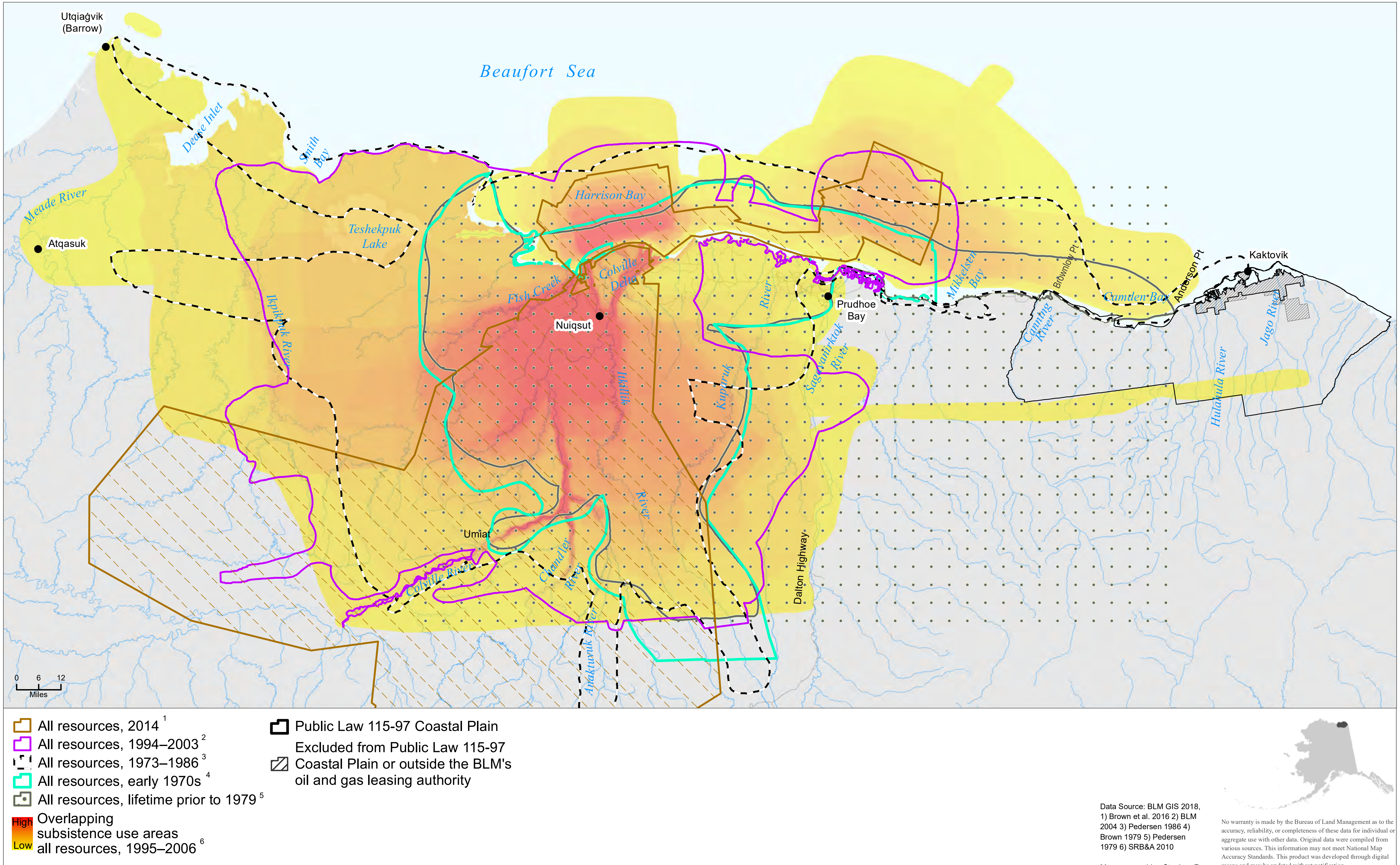
Map 3-53


Utqiaġvik
(Barrow)
Beaufort Sea
Dease Inlet
Smith Bay
Meade River
Atqasuk
Teshekpuk Lake
Harrison Bay
Ikpikpuk River
Fish Creek
Colville Delta
Nuiqsut
Itkillik River
Kuparuk River
Prudhoe Bay
Sagavanirktok River
Mikkelsen Bay
Brownlow Pt
Canning River
Camden Bay
Anderson Pt
Kaktovik
Jago River
Hulahula River
Umiat
Chandler River
Colville River
Anaktuvuk River
Dalton Highway
0 6 12
Miles
All resources, 2014 1
All resources, 1994–2003 2
All resources, 1973–1986 3
All resources, early 1970s 4
All resources, lifetime prior to 1979 5
High
Low
Overlapping subsistence use areas all resources, 1995–2006 6
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, 1) Brown et al. 2016 2) BLM 2004 3) Pedersen 1986 4) Brown 1979 5) Pedersen 1979 6) SRB&A 2010
Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019
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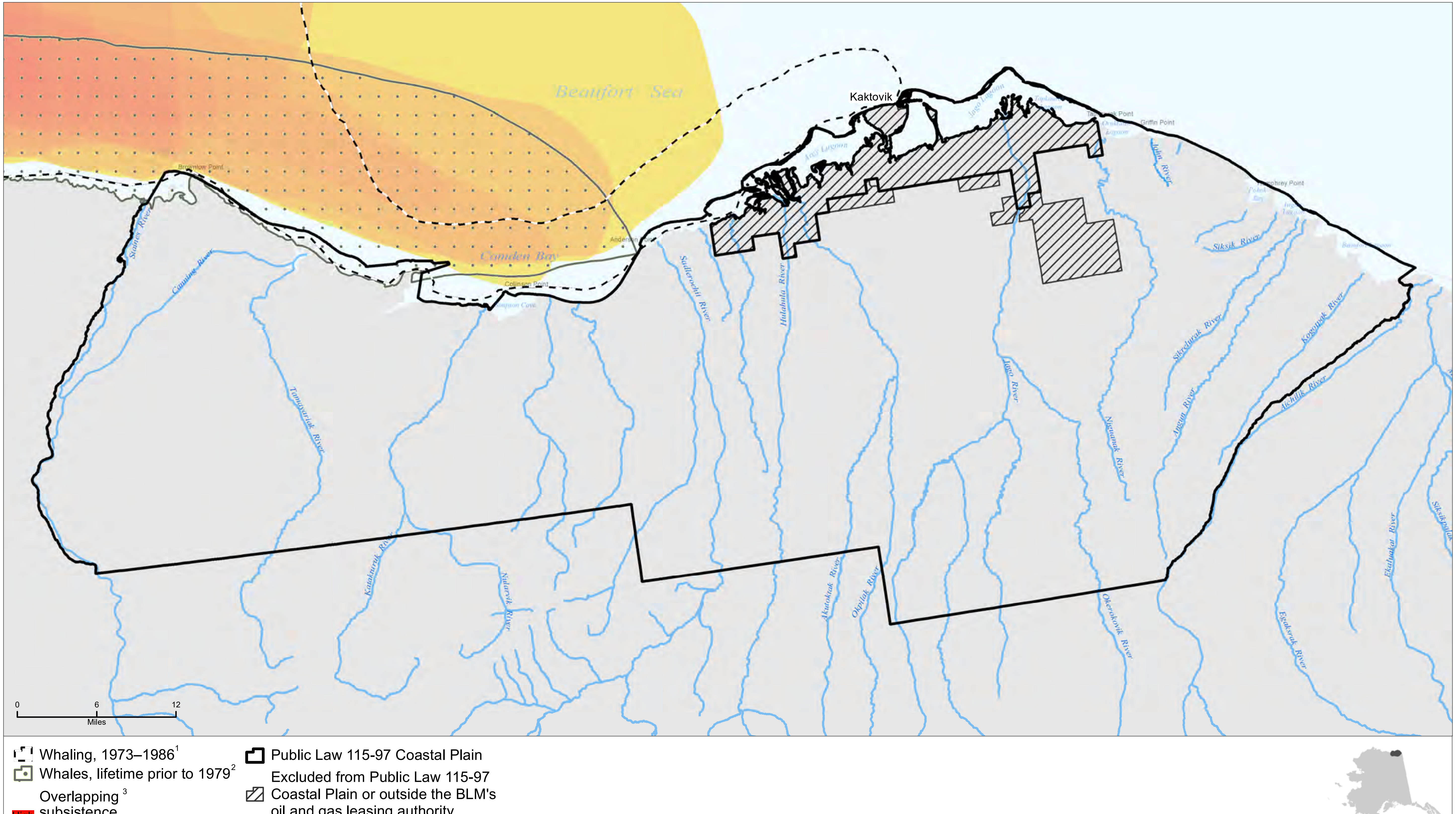
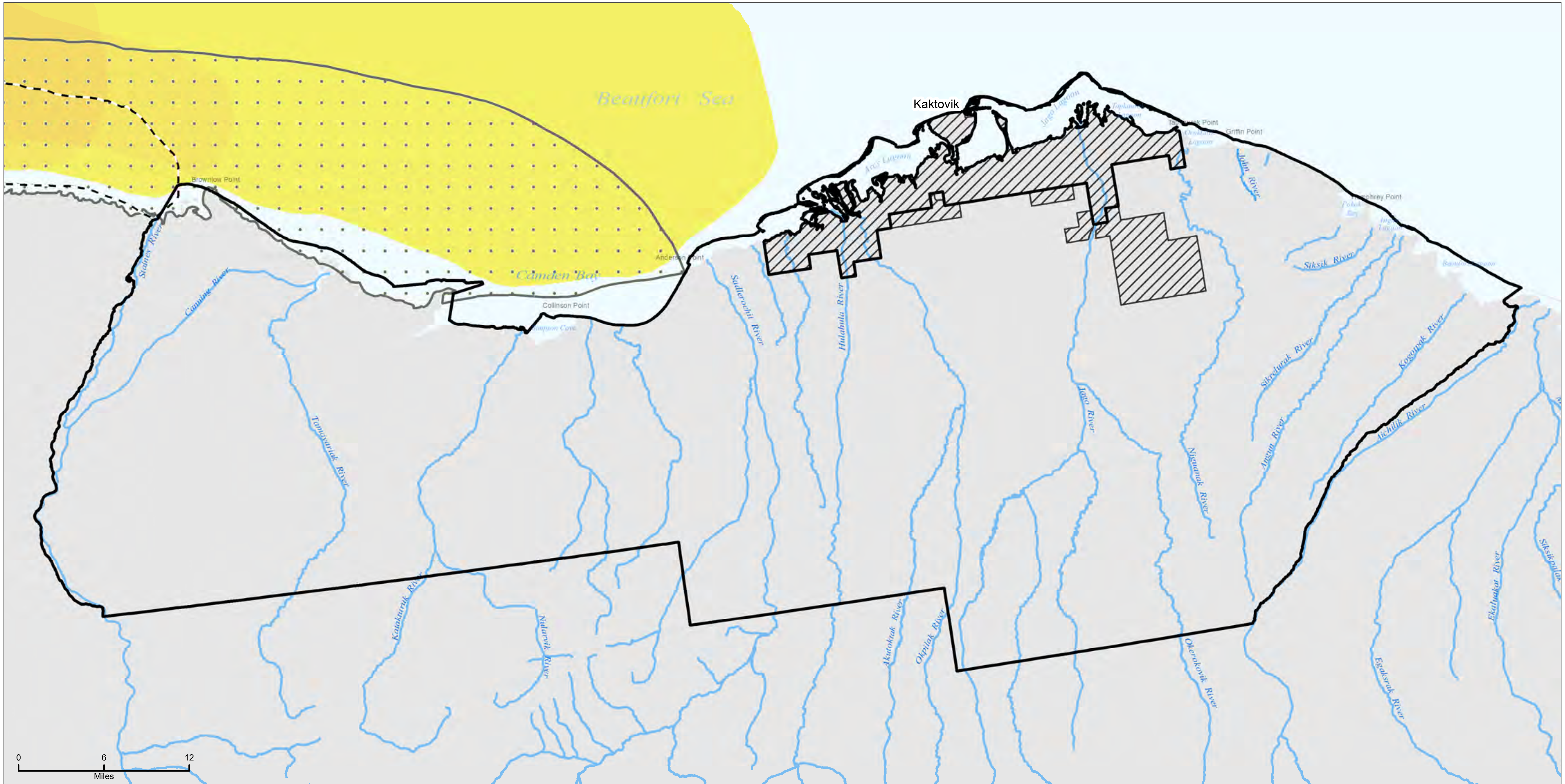
Map 3-54



Data Source: BLM GIS 2018, 1) Pedersen 1986 2) Pedersen 1979 3) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-55



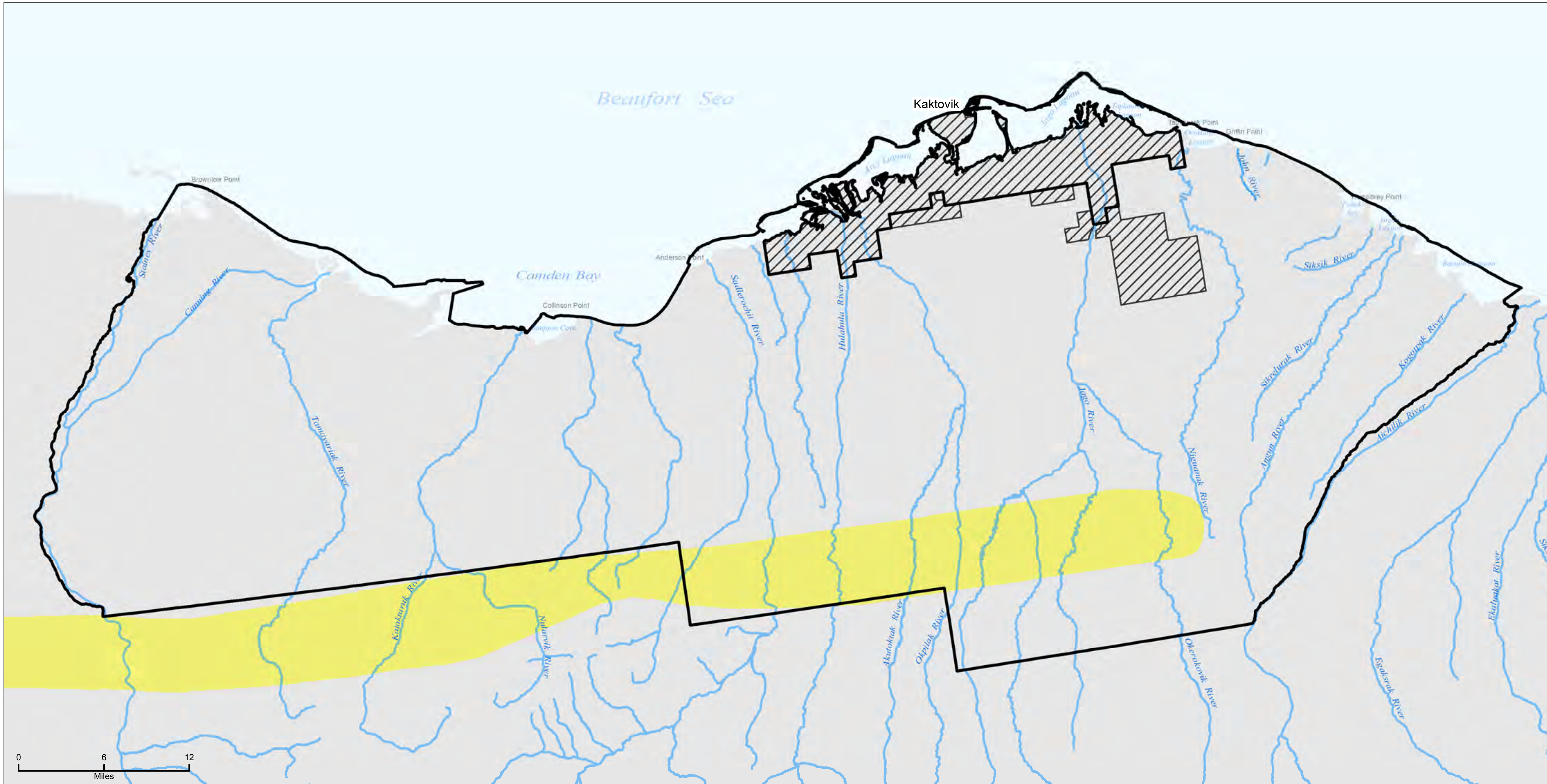
- Seal, 1973–1986[1]
- Seal, lifetime prior to 1979[2]
- Overlapping[3] subsistence use areas seal, 1995–2006 (High – Low)
- Public Law 115-97 Coastal Plain
- Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Pedersen 1986 2) Pedersen 1979 3) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

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.

Map 3-56



Overlapping subsistence use areas wolf and wolverine, 1995–2006 [1]

High

Low

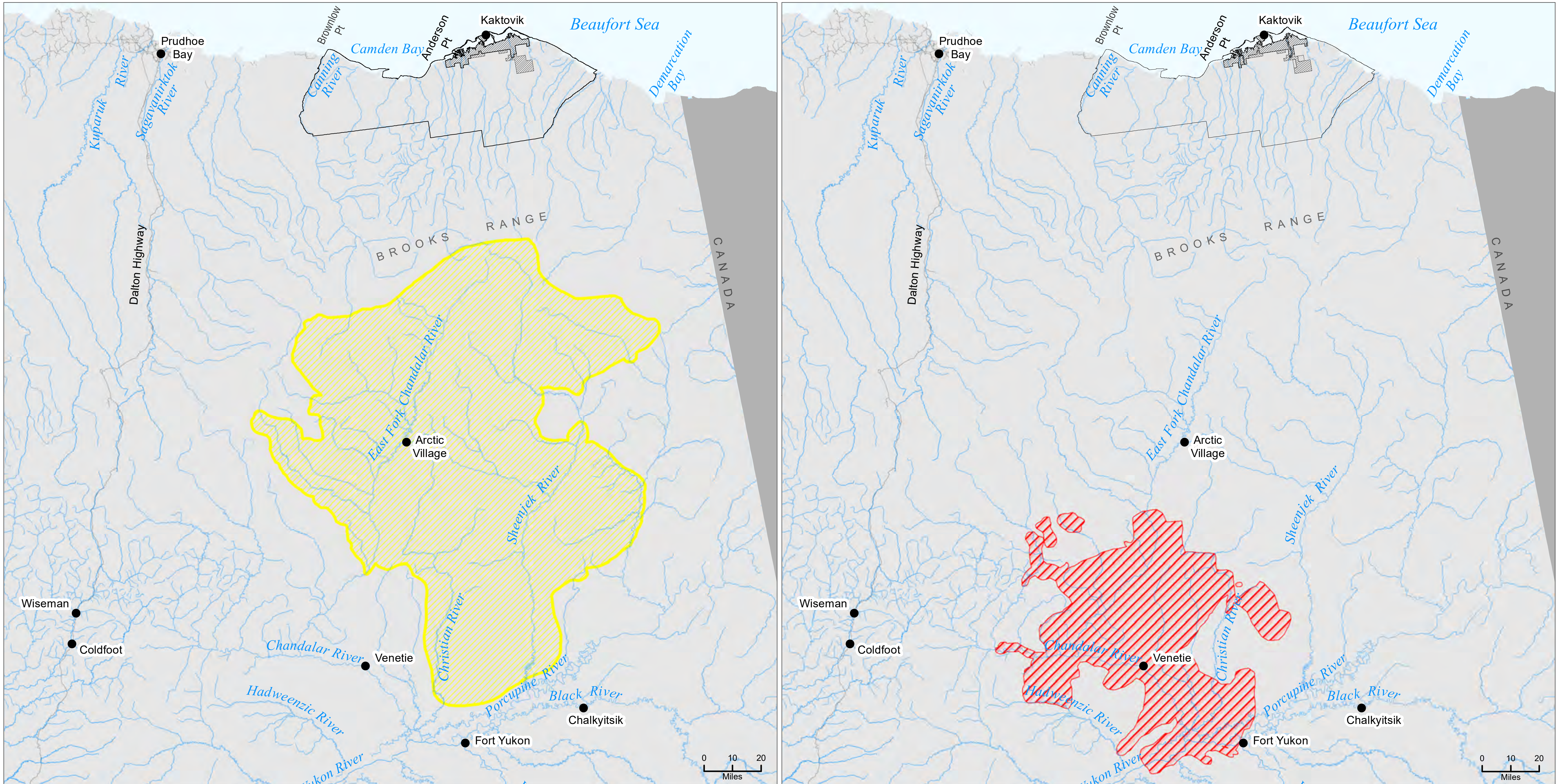
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018,
1) SRB&A 2010

Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-57



Arctic Village, all resources, lifetime prior to 1980 [1]

Venetie, all resources, lifetime prior to 1981 [1]

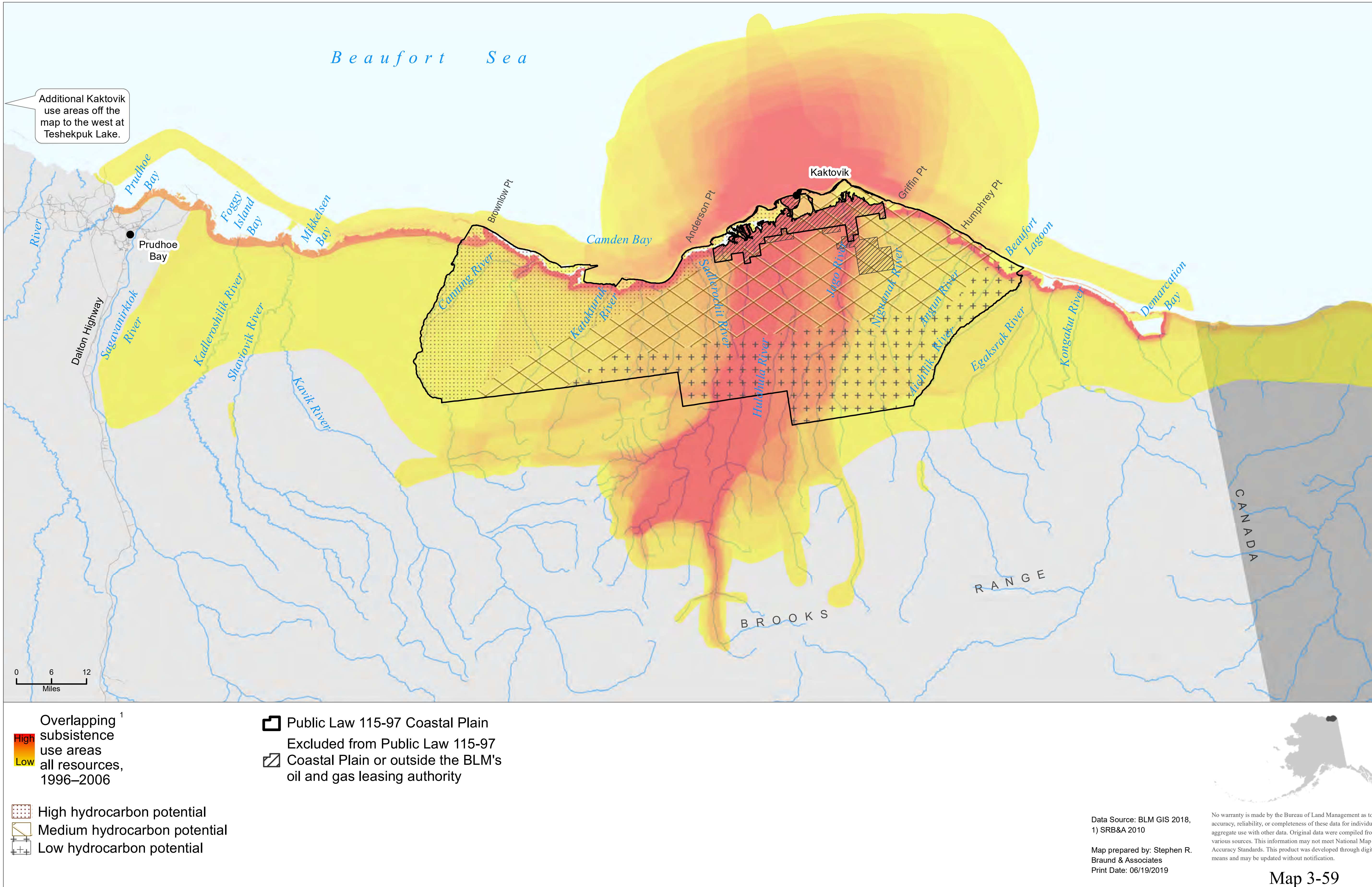
Public Law 115-97 Coastal Plain

Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority

Data Source: BLM GIS 2018, 1) Caulfield 1983

Map Prepared By: Stephen R. Braund & Associates
Print Date: 06/19/2019

Map 3-58


Beaufort Sea
Additional Kaktovik use areas off the map to the west at Teshekpuk Lake.
Prudhoe Bay
Prudhoe Bay
Foggy Island Bay
Mikkelsen Bay
Brownlow Pt
Camden Bay
Anderson Pt
Kaktovik
Griffin Pt
Humphrey Pt
Beaufort Lagoon
Demarcation Bay
River
Dalton Highway
Sagavanirktok River
Kadleroshilik River
Shaviovik River
Kavik River
Canning River
Katakturuk River
Sadlerochit River
Hulahula River
Jago River
Niguanak River
Aichilik River
Egaksrak River
Kongakut River
Angun River
BROOKS RANGE
CANADA
0 6 12
Miles
Overlapping [1] subsistence use areas all resources, 1996–2006
High
Low
High hydrocarbon potential
Medium hydrocarbon potential
Low hydrocarbon potential
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, 1) SRB&A 2010
Map prepared by: Stephen R. Braund & Associates
Print Date: 06/19/2019
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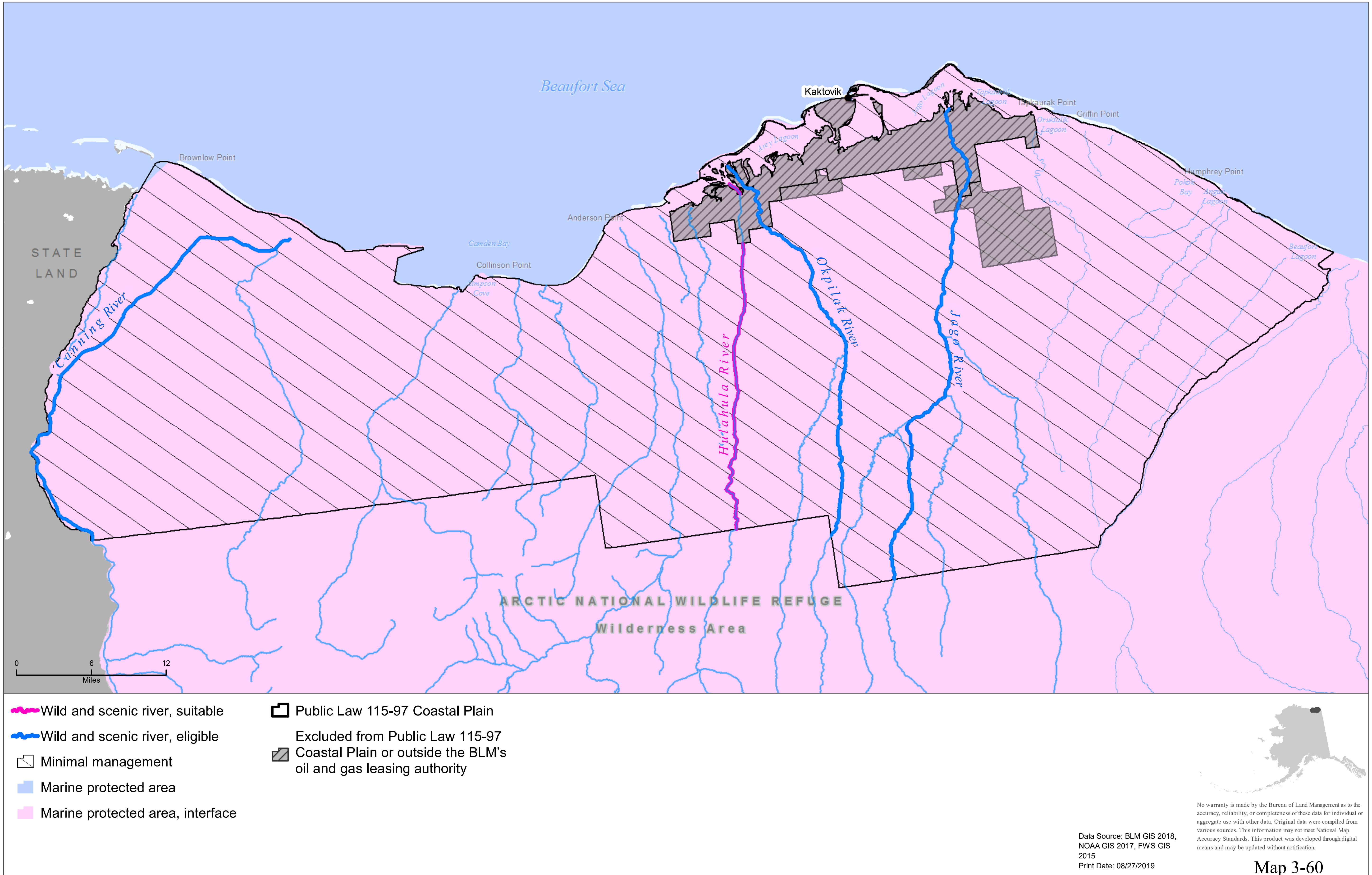
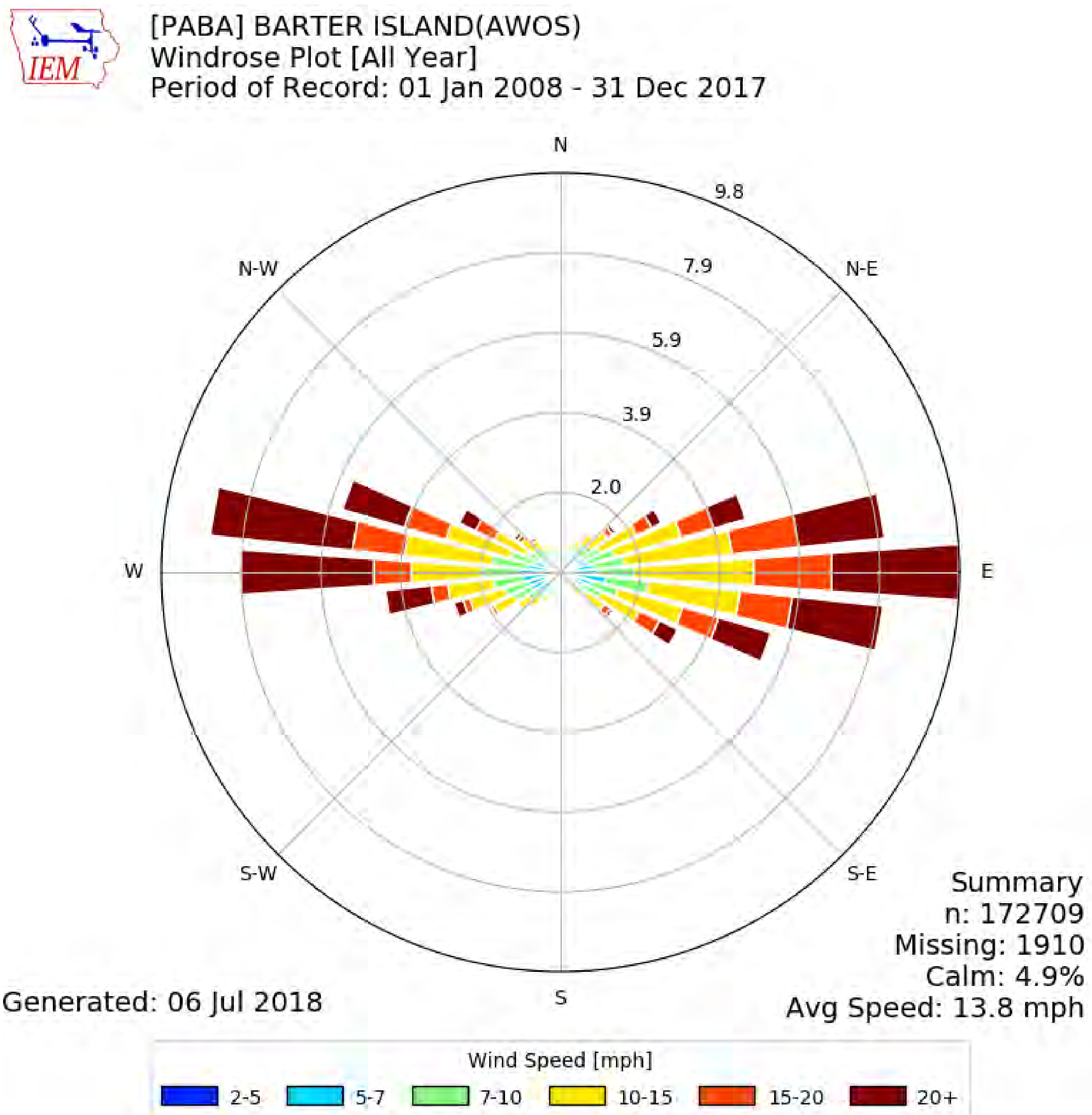
Map 3-59

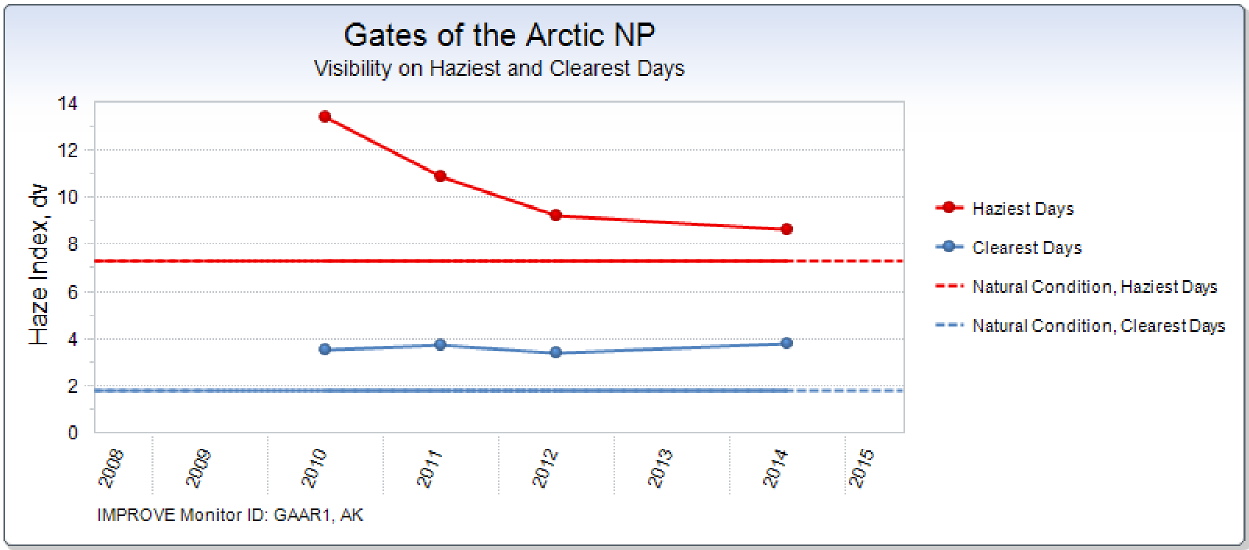

Beaufort Sea
Kaktovik
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
Simpson Cove
Tapkaurak Point
Griffin Point
Humphrey Point
Jago Lagoon
Arey Lagoon
Oruktalik Lagoon
Beaufort Lagoon
STATE LAND
Canning River
Hulahula River
Okpilak River
Jago River
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
0 6 12
Miles
Wild and scenic river, suitable
Wild and scenic river, eligible
Minimal management
Marine protected area
Marine protected area, interface
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
Data Source: BLM GIS 2018, NOAA GIS 2017, FWS GIS 2015
Print Date: 08/27/2019
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.

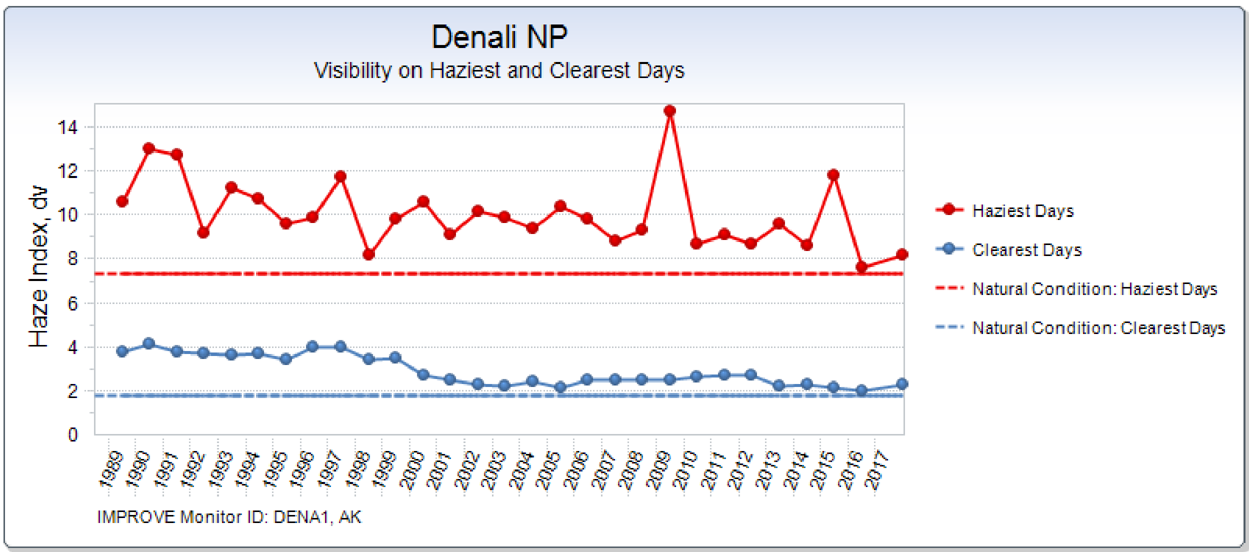
Map 3-60



Source: Iowa State University (copyright: used with permission), Iowa Environmental Mesonet (IEM) website: http://mesonet.agron.iastate.edu/

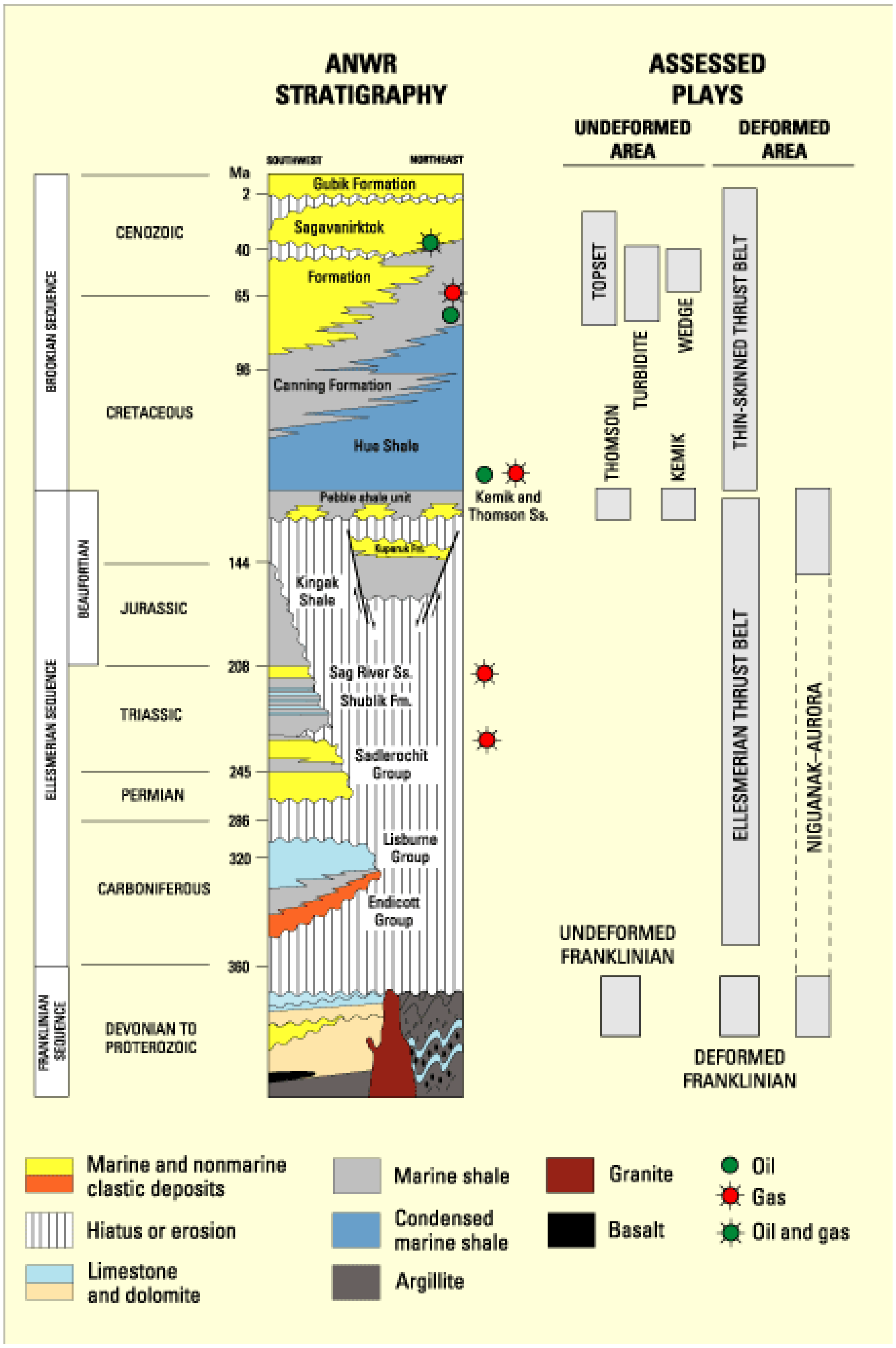
Figure 3-1: Wind Rose Plot for Barter Island, Kaktovik, Alaska





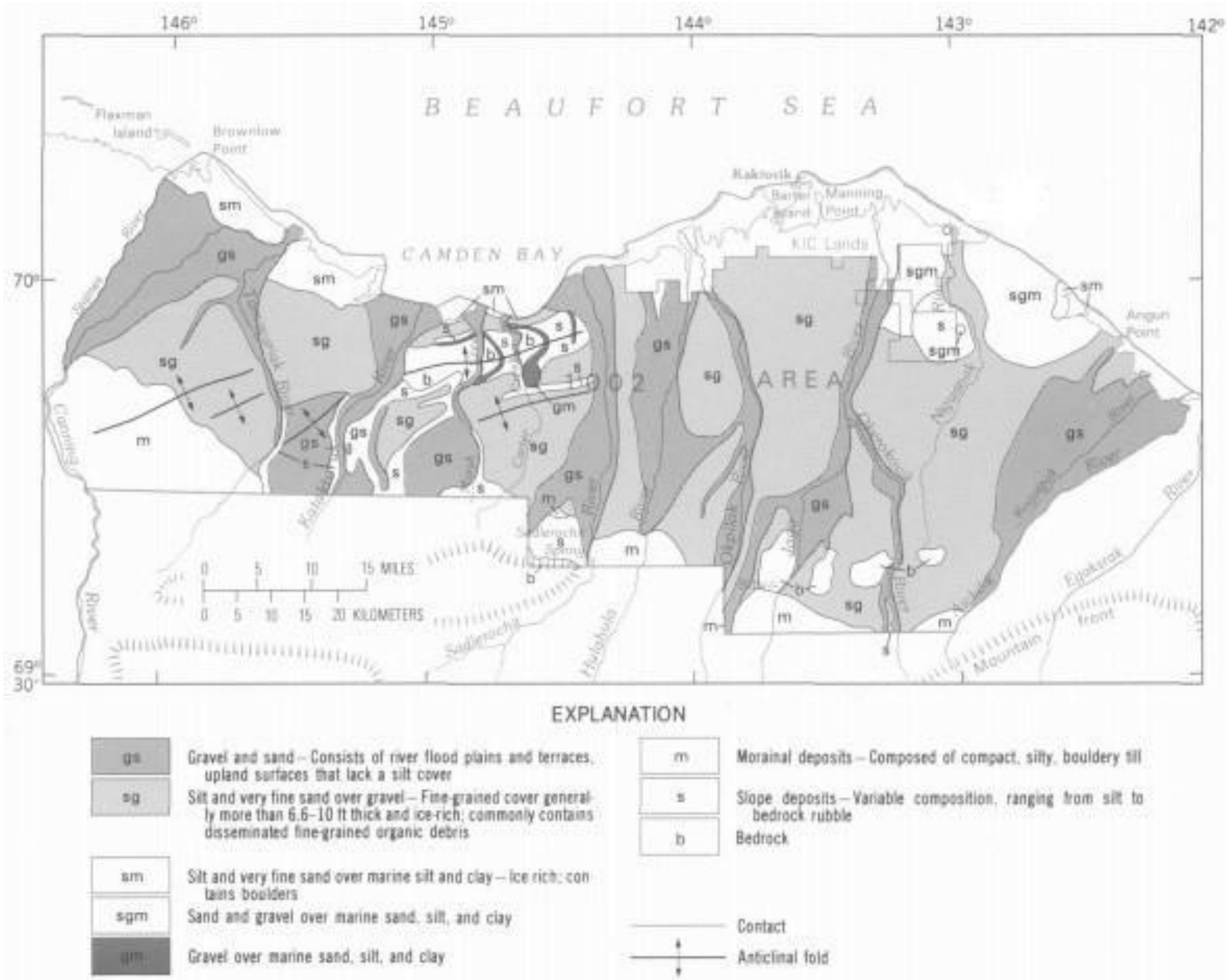
Source: IMPROVE 2018a

Figure 3-2: Visibility Data for Gates of the Arctic National Park and Denali National Park



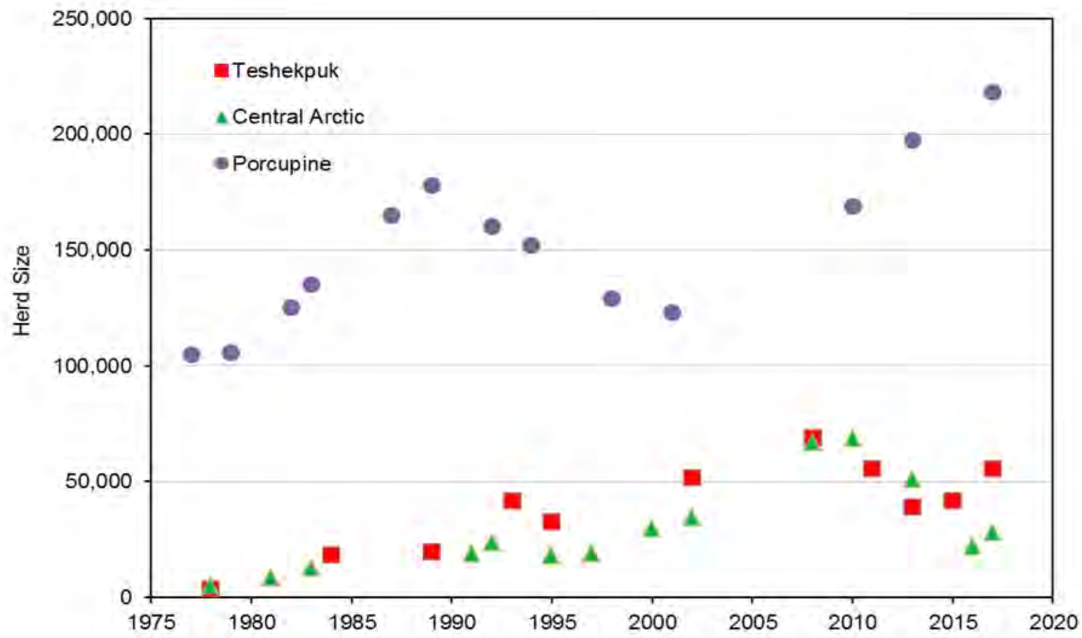
Source: US Geological Survey (USGS 1998b) Fact Sheet 0028-02 Figure 3

Figure 3-3: Stratigraphy of the Coastal Plain



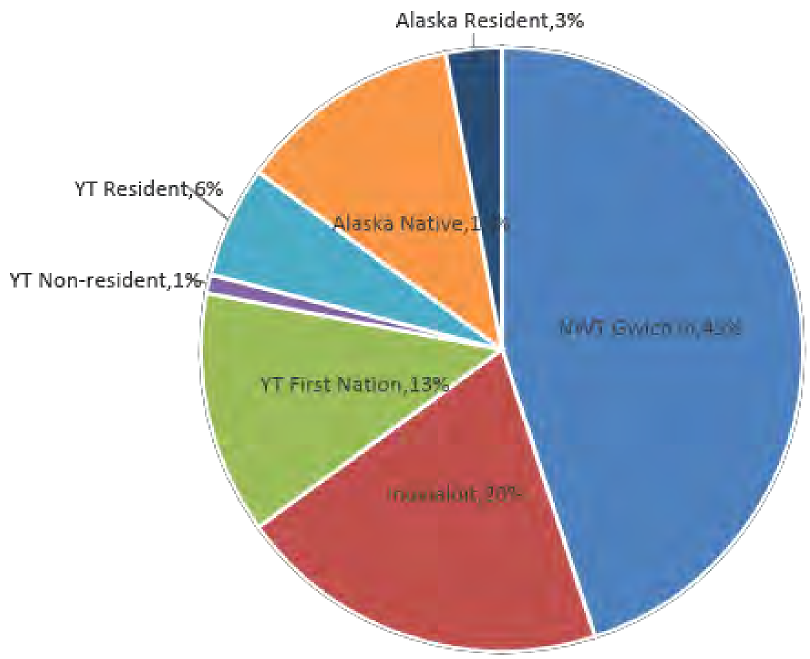
Source: Clough et al. 1987

Figure 3-4: Generalized Surficial Deposits of the Coastal Plain Area



Source: Lenart 2018

Figure 3-5: Population Size of Three Caribou Herds in Arctic Alaska, 1977-2017



Source: Porcupine Caribou Management Board 2010

Figure 3-6: Average Portion of Harvest of Porcupine Caribou Herd Between the US and Canada (1992-1994)

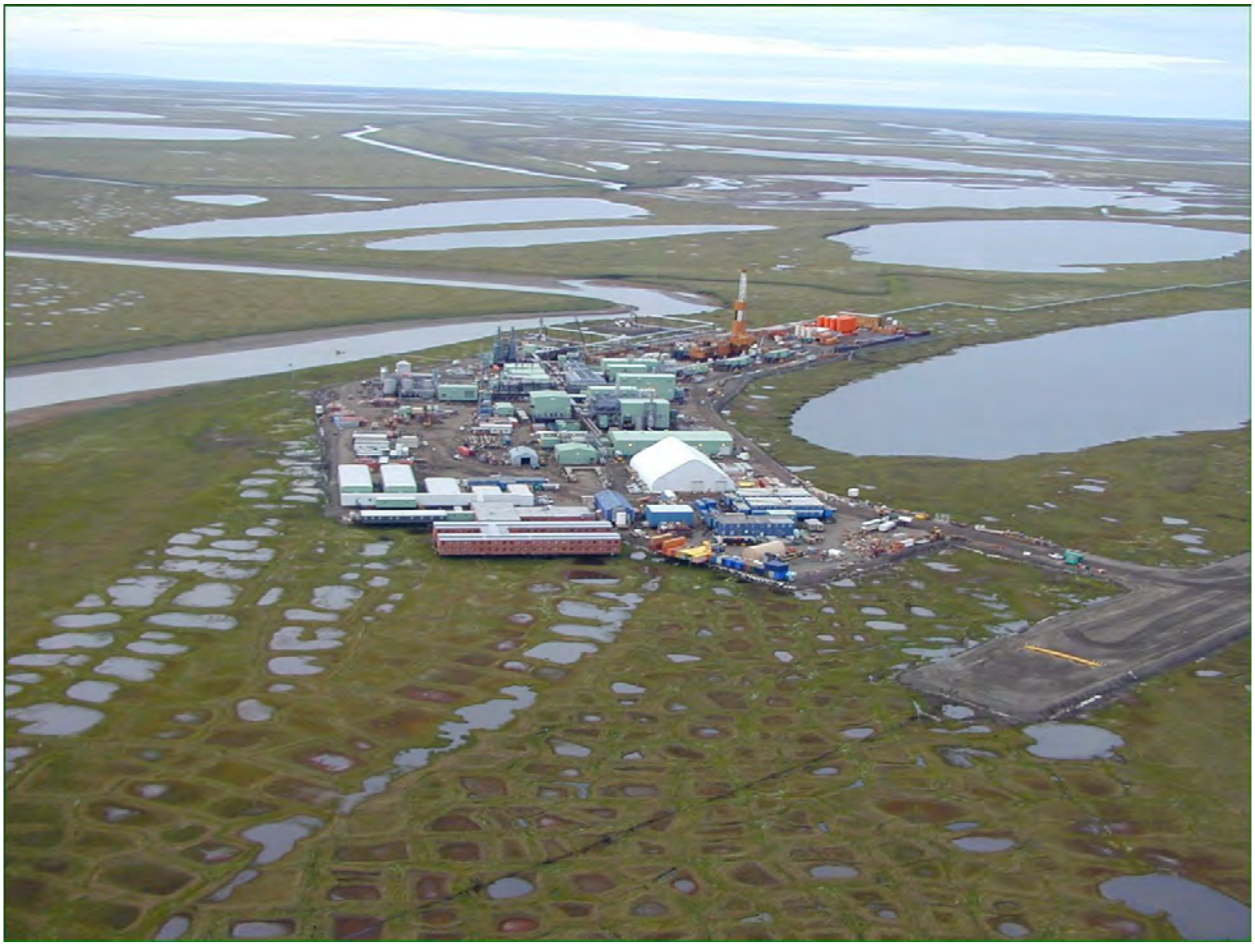


Figure 3-7: Visual Resources Photo 1

Typical layout for central processing facility with airstrip and pipeline (Alpine CPF on State land).

Figure 3-8: Visual Resources Photo 2

Typical layout for exploration well with ice pad and ice road (Stony Hill well site in NPR-A).

Appendix B

Reasonably Foreseeable Development Scenario for Oil and Gas Resources in the Public Law 115-97 Coastal Plain, Alaska

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ACRONYMS AND ABBREVIATIONS

Acronym	Full Phrase
3D	three-dimensional
ADEC	Alaska Department of Environmental Conservation
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act of 1980
Arctic Refuge	Arctic National Wildlife Refuge
BBO	billion barrels of oil
CFR	Code of Federal Regulations
Coastal Plain	Public Law 115-97 Coastal Plain
CPF	central processing facility
EIA	Energy Information Administration
EIS	environmental impact statement
EOR	enhanced oil recovery
Leasing EIS	Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement
NEPA	National Environmental Policy Act
NPR-A	National Petroleum Reserve Alaska
PL	Public Law
ROD	Record of Decision
TAPS	Trans-Alaska Pipeline System
TCF	trillion cubic feet
USGS	United States Geological Survey
VSM	vertical support member

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Appendix B. Reasonably Foreseeable Development Scenario for Oil and Gas Resources in the Public Law 115-97 Coastal Plain, Alaska

B.1 Summary

This hypothetical development scenario represents a good faith effort to project reasonably foreseeable oil and gas exploration, development, production, and abandonment in accordance with the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (Dec. 22, 2017) (PL 115-97) Coastal Plain (Coastal Plain), and 40 Code of Federal Regulations (CFR) 1508.8(b). Estimating the level of future oil and gas activity in this area is difficult at best. Timing and location of future commercially viable discoveries cannot be more accurately projected until these undiscovered resources are explored. The hypothetical unconstrained scenario projects development under standard lease terms and encompasses restrictions in the enacting legislation. Scenarios by alternative incorporate the leasing stipulations and required operating procedures in the Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) into the hypothetical projections.

The Coastal Plain encompasses approximately 1,563,500 acres of federal land in the northernmost end of the Arctic National Wildlife Refuge (Arctic Refuge). Alaska Native Claims Settlement Act (ANCSA) corporation lands that are patented or interim conveyed are excluded from the program area.

Very little oil and gas exploration has occurred in this area, and there are no proven plays[1] at this point. The United States Geological Survey (USGS) estimated that there is a 95 percent probability that the federal lands in the 1002 Area (as defined by ANILCA) of the Arctic Refuge[2] contain a technically recoverable volume of least 4.25 billion barrels of oil (BBO). There is a 5 percent probability that the technically recoverable volume of oil could exceed 11.80 BBO. The mean estimate of technically recoverable oil for the federal lands in the ANILCA 1002 Area of the Arctic Refuge is 7.69 BBO. Of this, a mean of 7.14 BBO was estimated to be economically recoverable at $55 per barrel (2005 dollars, approximately $70 in 2018 dollars; Attanasi 2005). Alaska North Slope crude is currently priced around $65 per barrel (ycharts.com 2018), and the US Energy Information Administration (EIA) projects that crude oil prices will continue to rise in the next 20 years (EIA 2018). More recent estimates published by the EIA estimate mean oil production in the Coastal Plain at 3.4 BBO produced by 2050 (Van Wagner 2018).

Technically recoverable associated and unassociated natural gas resources are estimated at 7.04 trillion cubic feet (TCF; Attanasi 2005). Proposed gas pipelines connecting the North Slope to potential markets would first connect to better understood and established fields before connecting to the Coastal Plain. There are estimated to be 225 million barrels of natural gas liquids in the program area; some amount of natural gas liquids would be produced as a byproduct of oil production in some formations.

[1]A play is a group of oil fields or prospects in the same region that are controlled by the same set of geological circumstances.
[2]Similar in area and boundary, but not identical to the Coastal Plain program area boundary.

Crude oil and natural gas resource assessments often use different classifications to describe estimated oil and natural gas resource volumes that might be produced at some time in the future. Such classifications generally range, in order of decreasing volume, from original oil in place, to technically recoverable resources, to economically recoverable resources, and finally to proved reserves. For a thorough description of each of these categories, and useful visual aids, the reader is referred to the U.S. Energy Information Administration (EIA) at https://www.eia.gov/todayinenergy/detail.php?id=17151.

According to the EIA, the "volumes of oil and natural gas that ultimately will be produced cannot be known ahead of time. Resource estimates change as extraction technologies improve, as markets evolve, and as oil and natural gas are produced. Consequently, the oil and gas industry, researchers, and government agencies spend considerable time and effort defining and quantifying oil and natural gas resources" (EIA, 2019) For instance, the United States Geological Survey often conducts resource estimates under the Technically Recoverable Resources classification, while the Securities and Exchange Commission (SEC) maintains a definition of Proved Oil and Gas Reserves for oil and gas reporting disclosures to assist investors in a more meaningful and comprehensive understanding of the oil and gas industry. The definition of proved reserves has been established by SEC rulemaking at 17 CFR 210.4-10, which can be read at https://www.sec.gov/rules/final/2008/33-8995.pdf (SEC, 2010). All of these classifications of resource estimates, as described above and as used herein, involve speculation and uncertainty.

In addition, it is noted that the projections of oil and gas reserves across the North Slope as cited herein, and predictions of likely future production levels resulting from those reserves, are necessarily highly speculative. For instance, USGS has repeatedly revised their prior assessments of producible oil and gas for the NPR-A and surrounding areas, as new information has become available and additional analysis has been conducted. These assessments have proven to fluctuate significantly over time, as evidenced by the fact that the assessments of technically recoverable reserves for NPR-A and surrounding areas were projected by USGS to be 10.5 billion barrels of oil and 61 trillion cubic feet of gas in 2002, then were revised to be 896 million barrels of oil and 53 trillion cubic feet of gas in 2010, and again were revised to be 8.7 billion barrels of oil and 25 trillion cubic feet of gas in 2017 (USGS 2002, 2010, and 2017). Future studies and assessments, whether by the USGS or others, will likely continue to evolve and shift based on advancements in geophysical assessment and drilling technology. They also may include new methods of development not currently contemplated on the North Slope, such as methane hydrates. A 2008 USGS resource assessment of methane hydrate potential for the North Slope, including areas of the Coastal Plain, are estimated to contain up to 590 trillion cubic feet of in-place methane hydrate gas (USGS 2008) though the study acknowledges that "the production potential of the known and seismically inferred gas-hydrate accumulations in northern Alaska has not been adequately field tested". To date, there is no known commercial production of natural gas from gas hydrate formations, and the Department of Energy stipulates that "the commercial viability of gas hydrate reservoirs is not yet known" (DOE 2019). In some cases, whether in the Coastal Plain or elsewhere on the North Slope, future estimates may change drastically based on new discoveries, ongoing exploration activities, and market conditions. Often exploration and development activities are the only sure way to confirm the size and extent of oil and gas reserves.

B.2 INTRODUCTION

This hypothetical development scenario provides an estimate of the levels of petroleum-related activities and associated surface disturbances under an unconstrained scenario. Under the unconstrained scenario, the lessee is bound to the terms and conditions set forth on the standard lease form. The hypothetical development scenario is a discussion of how those projected activities may vary under each alternative. In addition, this document presents a description of the subsurface geology and the oil and gas resource estimates of the Coastal Plain and identifies the assumptions used to develop hypothetical projections.

The petroleum-related activities projected in this hypothetical development scenario is useful only in a general sense. This is because the timing and location of future commercial-sized discoveries cannot be accurately predicted until exploration drilling begins; however, it is reasonable to expect that new technologies and designs developed in the future will augment exploration and development and will enhance the safety and efficiency of operations, while minimizing the effects of oil activity on the environment. The hypothetical scenarios described in this document represent successful discovery and optimistic high-production development scenarios in a situation of favorable market prices. This is to minimize the chance that the resultant impact analysis will understate potential impacts.

Current state-of-the-art technologies, methods, and designs are used to project hypothetical scenarios for future petroleum development. Petroleum-related activities include such major undertakings as conducting seismic operations; constructing ice roads and snow trails for transporting equipment and supplies for winter drilling of exploration wells; drilling exploration and delineation wells; constructing gravel pads, roads connecting production pads to main facilities, and landing strips; drilling production and service wells; installing pipelines; and constructing oil and gas processing facilities. The location and size of any future infrastructure proposed as part of development will be described in future National Environmental Policy Act (NEPA) documentation.

Impacts caused by the extraction of energy resources cannot be assessed without estimating future activity on at least a hypothetical level. A fundamental assumption of these scenarios is that the level of future activities is directly related to the petroleum resource potential made available for leasing and development; however, industry's interest in exploring for new resources is influenced by profit motives, where opportunities for new production in northern Alaska must compete with projects elsewhere. Consequently, future development and associated potential impacts are influenced by several factors, as follows:

- The perceptions of economic potential of the area
- The prospective locations available for leasing
- Industry's ability to identify prospects to drill
- The distance to existing infrastructure
- The competitive interest in exploring for new fields and encumbrances placed on the land

Until a transportation system to move gas to market is constructed, the assumption is that gas produced with oil would be separated and reinjected into the reservoir as part of the enhanced oil recovery (EOR) process.

B.3 DESCRIPTION OF GEOLOGY

Due to a lack of bedrock exposure in outcrops within the majority of the coastal plain, information regarding subsurface geology has been obtained from limited remote sensing, observations in the mountains south of the area, and wells drilled west and north of the area (Bird 1999). As a result, localized geology is not as well understood as it is in most prospective lease areas, where data collected from wells are used to inform geologic understanding.

The geology of the Coastal Plain is split into undeformed and deformed areas, demarcated by the Marsh Creek anticline, which runs northeast-southwest across the Coastal Plain (see **Map B-1**, Hydrocarbon Potential). Northwest of the Marsh Creek anticline, the undeformed area rocks are generally gently dipping to nearly horizontal. Southeast of the anticline, the deformed area rocks show significantly more folding and faulting. Rocks with petroleum potential in the Coastal Plain area are mostly younger than Devonian and are divided into the Ellesmerian sequence of Mississippian to Triassic age, the Beaufortian sequence of Jurassic to Early Cretaceous age, and the Brookian sequence of Early Cretaceous to Cenozoic age (USGS 1998). The Ellesmerian sequence is up to two-thirds of a mile thick, primarily composed of equal amounts of carbonate and clastic rocks. The Brookian sequence consists of up to 4 miles of marine and nonmarine siliciclastic deposits originating from the ancestral Brooks Range (USGS 1998).

Possible petroleum reservoir rocks beneath the Coastal Plain are intra-basement carbonate rocks, Beaufortian sandstone similar to that of the Kemik sandstone or Thomson sand of local usage, and Brookian turbidite sandstone in the Canning Formation or deltaic sandstone in the Sagavanirktok and Jago River Formations. The timing of hydrocarbon generation relative to the formation of traps is judged to be favorable for the retention of oil in the Coastal Plain. Structural traps are believed to have formed before, during, and after oil generation and migration (Bird and Magoon 1987).

B.3.1 Undeformed Area

Approximately 80 percent of petroleum resources are estimated to be in the undeformed northwestern portion of the ANILCA 1002 Area (USGS 1998). The identified potential plays in this area, in order of greatest to least potential, are the Topset play, Turbidite play, Wedge play, Thompson play, Undeformed Franklinian play, and Kemik play. Total undiscovered, technically recoverable resources from these plays are estimated to be 6.420 BBO (Attanasi 2005).

Table B-1, below, gives estimates of recoverable petroleum resources in the undeformed area. Development is expected to begin in the Topset play, which is estimated to contain over half the recoverable undiscovered oil in the program area. Initial interest is expected to be in test wells drilled in areas where seismic data reveals traps or where the formation is particularly thick. Areas where multiple plays overlap are also expected to receive early exploration and development interest.

Table B-1
Estimated Mean Undiscovered Petroleum Resources in the Undeformed ANILCA 1002 Area

Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Topset	4.325	1.193	0.010
Turbidite	1.279	1.12	0.065
Wedge	0.438	0.226	0.005
Thompson	0.246	0.47	0.039
Kemik	0.047	0.116	0.010
Undeformed Franklinian	0.085	0.30	0.029
Total	**6.420**	**3.424**	**0.159**

Source: Attanasi 2005
Note: Totals are technically recoverable amounts.
Note: Totals are for federal lands only.
Note: The ANILCA 1002 Area is similar in area and boundary, but not identical to the Coastal Plain program area boundary.

B.3.2 Deformed Area

Potential plays in the deformed area, in order of greatest to least potential, are the Thin-Skinned Thrust belt play, Niguanak/Aurora play, Deformed Franklinian play, and Ellesmerian Thrust Belt play. Total undiscovered resources from these plays are estimated to be 1.267 BBO (Attanasi 2005). **Table B-2**, below, gives estimates of recoverable petroleum resources in the deformed area. Plays in the deformed area are expected to be developed only in localized areas if seismic data and test wells indicate a promising field.

Table B-2
Estimated Mean Undiscovered Petroleum Resources in the Deformed ANILCA 1002 Area

Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Thin-Skinned Thrust Belt	1.038	1.608	0.017
Ellesmerian Thrust Belt	0.000	0.876	0.018
Deformed Franklinian	0.046	0.86	0.046
Niguanak/Aurora	0.183	0.273	0.016
Total	**1.267**	**3.617**	**0.096**

Source: Attanasi 2005
Note: Totals are estimated technically recoverable amounts.
Note: The ANILCA 1002 Area is similar in area and boundary, but not identical to the Coastal Plain program area boundary.

B.4 Past Oil Exploration

Due to a prohibition on oil and gas leasing until the passage of PL 115-97, very little exploration has occurred in the Coastal Plain. A single oil and gas exploratory well was drilled within the boundary of the Coastal Plain (although it was drilled on Kaktovik Iñupiat Corporation surface estate). Results of the KIC#1 exploration well drilled in 1985/1986 have been maintained strictly confidential by the data owners, which are Chevron, BP, and Arctic Slope Regional Corporation. A two-dimensional seismic survey was conducted by an industry group in the winters of 1984/1985 and 1985/1986 (DOI 1987). The data collected have contributed to every analysis of oil and gas potential in the Coastal Plain since.

B.5 Oil Occurrence and Development Potential

Estimates of oil occurrence and development potential were developed based on the locations of the plays discussed above in *Description of Geology*. Areas where plays with larger estimated undiscovered resources overlap were considered as high occurrence potential, areas where only one or two plays with significant undiscovered resources overlap were considered moderate potential, and areas with only minor plays were considered low potential. Based on these definitions, the highest estimated potential areas are in the western and northern part of the Coastal Plain. See **Map B-1**, below, for a depiction of potential areas.

Since no infrastructure exists in the Coastal Plain, developers are expected to follow oil occurrence potential very closely, rather than trying to build off existing infrastructure, as might occur in a field with existing development; however, the closest infrastructure outside the Coastal Plain is near the northwest border of the area. This coincides with the area of highest occurrence potential. Moving farther from the existing infrastructure near the northwest border of the Coastal Plain, areas would be increasingly less economical to reach; therefore, estimated development potential (which accounts for economic considerations in addition to resource occurrence) coincides with estimated occurrence potential for the Coastal Plain.

B.6 METHOD AND ASSUMPTIONS FOR HYPOTHETICAL DEVELOPMENT SCENARIO PROJECTIONS

There are many uncertainties associated with projecting future petroleum exploration and development. These uncertainties include the amount and location of technically and economically recoverable oil; the timing of oil field discoveries and associated development; the future prices of oil and gas, and, more to the point, the many exploration companies' individual assessment of future prices and other competitive calculations that play into corporate investment decisions; and the ability of industry to find petroleum and to mobilize the requisite technology to exploit it.

To address these uncertainties, the BLM has made reasonable assumptions based on the previous two-dimensional seismic exploration of the Coastal Plain, the history of development in the National Petroleum Reserve-Alaska (NPR-A) and other North Slope developments, its own knowledge of the almost entirely unexplored petroleum endowment of the Coastal Plain and current industry practice, and professional judgment. In making these assumptions, the BLM has striven to minimize the chance that the resultant impact analysis will understate potential impacts; therefore, the hypothetical scenarios are intended to represent optimistic high-production, successful discovery, and development scenarios in a situation of favorable market prices. The amount of infrastructure that would be necessary to develop the projected amount of oil is also estimated at upper, but reasonable, limits. For example, the assumption is that each satellite production pad could disturb approximately 12 acres and contain 30 wells (approximately 2.5 wells per acre); however, as ConocoPhillips develops newer well pads in the Colville River Unit (commonly referred to as Alpine) and the Greater Moose's Tooth Unit, this suggests that, on average, pad sizes for that many wells may be closer to 10 acres (approximately 3.3. wells per acre)[3].

These estimates account for advances in technology that have allowed development on the North Slope to become less impactful on the surrounding environment. For example, the older well pads in Alpine had a ratio of 1.6 to 2.2 wells per acre. Increasing the number of wells per acre on a pad does have some drawbacks. For example, wells spaced too tightly can make it difficult to get a workover rig on a well.

The time frame used for the hypothetical development scenarios is the estimated minimum amount of time in which development of the Coastal Plain could reach the 2,000-acre threshold discussed below. Because there are very little data on and no infrastructure in the Coastal Plain, there would be a lag time between the first lease sale and the beginning of production in the area. The activities that are projected to occur and the estimated timing of those activities are further described in the *Hypothetical Unconstrained Scenario*, below. The minimum time anticipated for all wells to be completed in the Coastal Plain under any hypothetical scenario is approximately 50 years, recognizing the timeframe for production could be more than 50 years given the speculative nature of the development scenarios. Because it is unlikely that all projected wells would be producing at the same time, peak production from the Coastal Plain is anticipated at some point before 50 years, potentially as early as 20 years after the first lease sale. Once peak production is reached, production from a field is anticipated to continue for up to another 35 years, depending on resource production, market forces, and operator financial decisions; therefore, it could be 85 years or more after the first lease sale before all facilities described in the scenarios are abandoned and reclaimed. However, just as development is expected to occur in phases, reclamation would occur in phases. The first field to be developed could be reclaimed long before the last field is abandoned.

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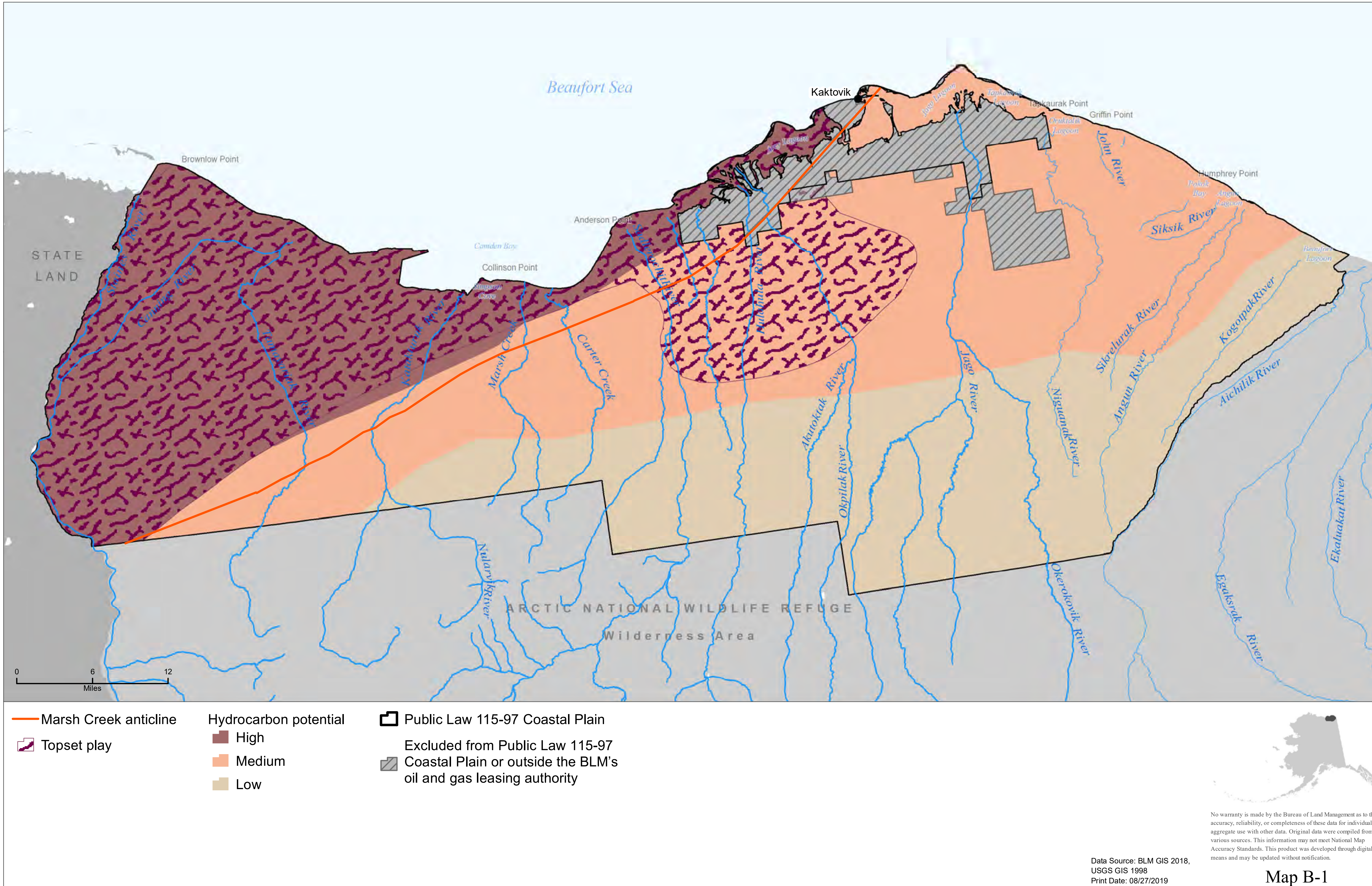
[3]Nanushuk Draft EIS measured 2.75 wells per acre of well pad; Alpine, which is newer development, measures approximately 2.5 wells per acre of well pad (USACE 2017).


Beaufort Sea
Kaktovik
Tapkaurak Point
Griffin Point
Humphrey Point
Brownlow Point
Anderson Point
Camden Bay
Collinson Point
STATE LAND
ARCTIC NATIONAL WILDLIFE REFUGE
Wilderness Area
John River
Siksik River
Sikrelurak River
Kogotpak River
Aichilik River
Angun River
Niguanak River
Jago River
Okerokovik River
Egaksrak River
Ekaluakat River
Okpilak River
Akutoktak River
Carter Creek
Marsh Creek
Nularvik River
0
6
12
Miles
Marsh Creek anticline
Topset play
Hydrocarbon potential
High
Medium
Low
Public Law 115-97 Coastal Plain
Excluded from Public Law 115-97 Coastal Plain or outside the BLM's oil and gas leasing authority
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.
Data Source: BLM GIS 2018, USGS GIS 1998
Print Date: 08/27/2019

Map B-1

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Additional assumptions, some of which also tend to support an optimistic set of hypothetical development scenarios, are as follows:

- Multiple lease sales would be held, with the first sale within first year after the signing of the Record of Decision (ROD).
- Industry would aggressively lease and explore the tracts offered.
- Economic conditions (particularly oil and gas prices) would be high enough to support development in the Coastal Plain.
- Undiscovered oil deposits would be discovered in all potential areas (high, medium, and low).
- Industry groups would independently explore and develop new fields in the Coastal Plain.
- Operators would enter agreements to share road and pipeline infrastructure, where feasible.
- Discoveries could be announced any time during a 10-year period (primary lease term) following lease sale, or during a subsequent 10-year lease renewal period (per 43 CFR 3135.1-6).
- Up to three anchor fields, with a minimum of 400 million barrels of producible reserves in each, would be discovered.
- Future oil production would use existing North Slope infrastructure, including the Trans-Alaska Pipeline System (TAPS).
- If the Coastal Plain is connected to a future natural gas pipeline, the plant for compressing produced natural gas into liquid natural gas would be located outside of the Coastal Plain.
- Production wells would have horizontal wellbores, with the lateral portion coinciding with the target formation.
- Each producing horizontal oil well would require a horizontal injection well.
- Once all wells are online for a field, the projected yield would be approximately 100,000 barrels of oil per day (peak production) for approximately 3 years, with an 8 percent annual production decline.[4]
- The maximum production range from CPF to satellite pads is an approximately 35-mile radius.
- Production activities would continue year-round for approximately 10 to 50 years, depending on field size.
- Production would end when the value of production cannot meet operating expenses.
- Fuel for equipment operation would be hauled overland.
- Gas would be re-injected into the formation to maintain reservoir pressure and enhance oil recovery.

Gas would be flared or vented only in situations where an equipment failure prevents re-injection or there is danger of equipment becoming over-pressurized. Federal operators must use flaring over venting (43 CFR 3179.6(b)).

B.6.1 Surface Development Limitations

Section 1.9.1 of the EIS contains the BLM’s interpretation of Section 20001(c)(3) of PL 115-97, which states the following:

[4]The 100,000 barrels of oil per day represents the minimum for a CPF in the Coastal Plain based on Willow and Pikka Nanushuk on the North Slope, though for any particular development this number may be exceeded. Decline estimate is based on standard decline estimates from the State of Alaska and the estimates used in NPR-A analyses.

> SURFACE DEVELOPMENT—In administering this section, the Secretary shall authorize up to 2,000 surface acres of Federal land on the Coastal Plain to be covered by production and support facilities (including airstrips and any area covered by gravel berms or piers for support of pipelines) during the term of the leases under the oil and gas program under this section.

For the purposes of impact analysis, BLM employs that interpretation as an assumption in each of the action alternatives analyzed in the EIS. See Section S.1.2 of **Appendix S** for a detailed explanation of the basis for the interpretation, including BLM's response to public comments received on the interpretation included in the Draft EIS.

B.7 Hypothetical Unconstrained Scenario

This hypothetical unconstrained scenario projects an estimated projection of activity on federal lands in the Coastal Plain, assuming all potentially productive areas will be open to leasing, subject to standard terms and conditions. The exception is those areas designated as closed to leasing by law, regulation, or executive order. The activities and methods described in the hypothetical unconstrained scenario are based on the activities typically associated with oil and gas operations on the North Slope of Alaska.

For a further description of typical activities and methods in the North Slope, see Section 4.2.1.2 of the National Petroleum Reserve-Alaska Final Integrated Activity Plan/Environmental Impact Statement (IAP/EIS) (BLM 2012).

The hypothetical development scenario is meant to convey the most likely unconstrained development scenario, with no management restrictions except those mandated by law. The hypothetical scenario provides the mechanism to analyze the effects that discretionary management decisions under the Leasing EIS alternatives would have on estimated future oil activity.

Table B-3, below, describes the general time frames in which hypothetical exploration, development, and production might occur in the Coastal Plain. As described in *Method and Assumptions for Hypothetical Development Scenario Projections*, a time lag of at least 8 years is expected between the first lease sale and the beginning of production. As previously discussed, the time frames below represent an optimistic, aggressive hypothetical scenario. Activities projected to occur within 5 years after the first lease sale are considered short term; activities projected to occur more than 5 years after the first lease sale are considered long term.

Table B-3
Estimated Hypothetical Development Time Frames

Project Phase	Estimated Time Frames of Activities	Projected Activities
Initial 3D seismic exploration	Within the next 2 years	Area-wide 3D seismic exploration
Leasing	Within 1 year of ROD	First lease sale
Exploration	Within 2 years after first lease sale (winter)	• First application for permit to drill submitted for exploration well • First exploration well drilled • Assumes discovery with first exploration well

Project Phase	Estimated Time Frames of Activities	Projected Activities
Additional lease-level seismic exploration	Within 3 years after first lease sale (winter)	• Seismic exploration on lease block with discovery to locate future delineation exploration wells • Process seismic data and determine location of delineation wells to be drilled the following winter
Additional exploration wells	4 years after first lease sale (winter)	Drill 3 to 5 additional wells to define the prospect and identify satellite pad locations
Master development plan	5 to 6 years after first lease sale	• Conduct NEPA analysis on master development plan for anchor field • Continue drilling 2 to 3 exploration wells to identify CPF and satellite pad locations
Development	7 years after first lease sale	• Begin laying gravel for anchor pad, begin CPF construction • Continue drilling 2 to 3 exploration wells to identify satellite pad locations • Begin drilling production wells on anchor pad
Production begins	8 years after first lease sale	• First production from anchor pad • Winter gravel and construction on satellite pads
Production increases	9 to 40 years after first lease sale	• All wells completed on anchor pad • All wells completed on satellite pads
Development of additional fields	11 to 85 years after first lease sale	• Construct facilities and drill wells in additional fields • Production continues for approximately 35 years after reaching peak production in each field
Abandonment and reclamation	19 to 85 or more years after first lease sale	• Plug wells that are no longer economically productive • Remove retired equipment, dig up vacant gravel pads and roads and reclaim the area

B.7.1 Leasing

PL 115-97 mandates two lease sales: the first within 4 years and the second within 7 years. Under this hypothetical scenario, the assumption is that the first sale would occur within a year of the publication of the ROD for the Leasing EIS. Another assumption is that industry would lease areas offered and would follow up with an aggressive exploration and development schedule.

B.7.2 Exploration

The BLM estimates that the entire federal Coastal Plain could be subject to a 3D seismic survey. After the first lease sale, operators would likely conduct a smaller scale 3D survey on their own lease block, assuming that seismic information would not be already available. This would require winter travel by vibroseis seismic vehicles and smaller support vehicles. Vibroseis trucks are mounted on rubber tracks to minimize ground pressure. No air-guns or dynamite are expected to be used. Multiple vehicles could be used simultaneously miles apart to conduct vibroseis exploration, or convoys of four to five trucks could travel in a line, which is less common.

It is assumed that cable-less geophone receivers (autonomous recording nodes) would be placed in lines perpendicular to source lines. Source and receiver lines could be 330 to 1,320 feet apart. Seismic operations would be accompanied by ski-mounted camp buildings towed by bulldozers or other tracked vehicles. There could be two to three strings with four to eight modular buildings in each string. Camps are assumed to move weekly. All seismic operations would be conducted in the winter to minimize impacts on the tundra (BLM 2018). During the exploration phase, exploratory drilling would occur on lease, and geophysical exploration could occur both on or off lease. On lease seismic would occur to assist in the location of future delineation wells for hydrocarbon verification. Off lease seismic could occur in frontier areas to inform future leasing.

Exploration wells would be drilled in the winter, and an ice road would be used to transport a drilling rig. These wells would target prospective geologic traps, indicated by seismic results. Initial exploration wells would likely be drilled vertically to the basement (approximately 13,000 feet, or deeper to the east) to define the entire stratigraphic column. Water needed for ice pad construction and drilling muds could be imported, taken from grounded ice in nearby lakes and rivers, or acquired by melting snow; water demand would vary based on the site geology and the density of drilling mud required.

To protect the tundra, ice roads would be used for most exploration activities. Ice roads are constructed seasonally and are used to transport drill rigs, modular units, large or heavy equipment and other supplies. They are constructed by compacting snow using low-ground pressure vehicles (approximately 1 to 2 pounds per square inch). The compacted tracks would capture more snow blown by wind until they are compacted again after a week or two of accumulation.

Once accumulation is complete, larger tracked vehicles with higher ground pressure or wheeled vehicles, such as a water truck or front-end loader, would compact the snow to the desired road width. Water would then be dispersed on the compacted snow to create ice buildup. The rate of ice buildup in cold conditions is approximately 1.5 inches per day. Using ice chips shaved from frozen lakes can increase the buildup rate to 4.5 inches per day and can reduce the amount of water needed by approximately 75 percent. The minimum ice depth for use by full-size vehicles is 6 inches, and roads are typically 35 to 40 feet wide. A typical ice road requires 1 million to 1.5 million gallons of water per mile (North Slope Borough 2005). Crews can construct about 1 mile per day (BLM 2012).

Construction of ice roads for specific projects using traditional techniques may be limited by freshwater availability in the program area. Innovative techniques, including ice chipping, that minimize the use of freshwater or identify additional water sources could allow for additional construction of ice roads. Examples of alternative sources include naturally deep lakes melting lake ice, trapping and melting snow, extracting water from gravel mine sumps, and desalinating marine water obtained beyond the barrier islands. Additional NEPA analysis at the site-specific level would assess water needs and measures to address water supply issues.

Snow trails could be used for smaller equipment, such as seismic trucks, camps, and maintenance vehicles. Low-ground pressure vehicles are used to pre-pack snow and groom trails if needed. Snow trails due not use ice as a construction medium and are typically thinner than ice roads and are wide enough for one vehicle only. If snow trail maintenance is necessary, a tracked vehicle would be used to tow a snow groomer to smooth out the trail and disperse snow to areas of the trail that need it.

A typical ice pad for exploration drilling is 1 to 2 feet thick and can require up to 5,000,000 gallons of water, depending on thickness and ice chip use (BLM 2012).

Current drilling technology is self-contained; reserve pits are not used. During initial exploration, drill cuttings would be transported out of the Coastal Plain for disposal. Once production pads and facilities have been established within the Coastal Plain, cuttings and muds from exploration wells may be transported to the nearest approved disposal well. Drilling an exploration well may take weeks or months, depending on depth, data collection program, and borehole conditions. Once the well is completed, additional down-hole testing and characterization can take up to a month (DOI 2005).

Following a promising discovery in an exploration well, delineation wells would be drilled to further characterize the discovery. These wells require similar resource commitments and require about the same time for drilling as an initial exploration well. After drilling, logging, and other downhole evaluation activities are complete, exploration and delineation wells may either be completed and suspended for future use or plugged and abandoned according to regulatory requirements, with all wastes removed from the site (DOI 2005).

B.7.3 Development

For the purposes of this hypothetical scenario, the assumption is that economic conditions would remain favorable to produce oil from the program area. Another assumption is that economically feasible oil accumulations would be discovered in all potential areas and that multiple anchor fields (each containing at least 400 million barrels of producible reserves) would be discovered. Further, the assumption is that several different operators would independently explore and develop new fields in the Coastal Plain. See **Figure B-1**, Conceptual Layout of a Stand-Alone Oil Development Facility, for a conceptual rendering of a hypothetical anchor field and associated facilities.

In caribou areas, roads would be built on north-south and east-west orientations to the extent possible, in order to promote immediate crossing and limit interference with caribou migration. BLM biologists have determined that caribou are more likely to cross roads that are close to perpendicular to their direction of travel. **Figure B-2**, Conceptual Layout of a Caribou Area Stand-alone Oil Development Facility, shows how the hypothetical layout could be adjusted for caribou mitigation if deemed appropriate by permitting agencies.

In this hypothetical scenario, development would start following the discovery of an anchor field. The first anchor field discovered is expected be in the western half of the Coastal Plain, most likely in the Topset play. Development would likely begin with the construction of a gravel pad for wells, CPF, airstrip, storage tanks, communications center, waste treatment unit, and a camp for workers. Typically, these facilities occupy a total of approximately 50 acres (BLM 2012).

Large modular units and infrastructure too large for transport up the Dalton Highway and across existing North Slope routes to the Coastal Plain would be shipped by barge. Camden Bay has been identified as the most likely location for a barge landing (DOI 1987). If facilities were adequate and approval was given by the operator, Point Thomson is another option.. Barge trips are expected to begin in Dutch Harbor, Alaska. See **Map B-2**, Potential Marine Vessel Transportation Route. A barge landing and an associated staging pad, used to store equipment and modules until ice roads can be constructed, would disturb approximately 10 acres, including the landing area and a gravel staging pad. If dredging is required for a barge landing, it would be analyzed on a project level.

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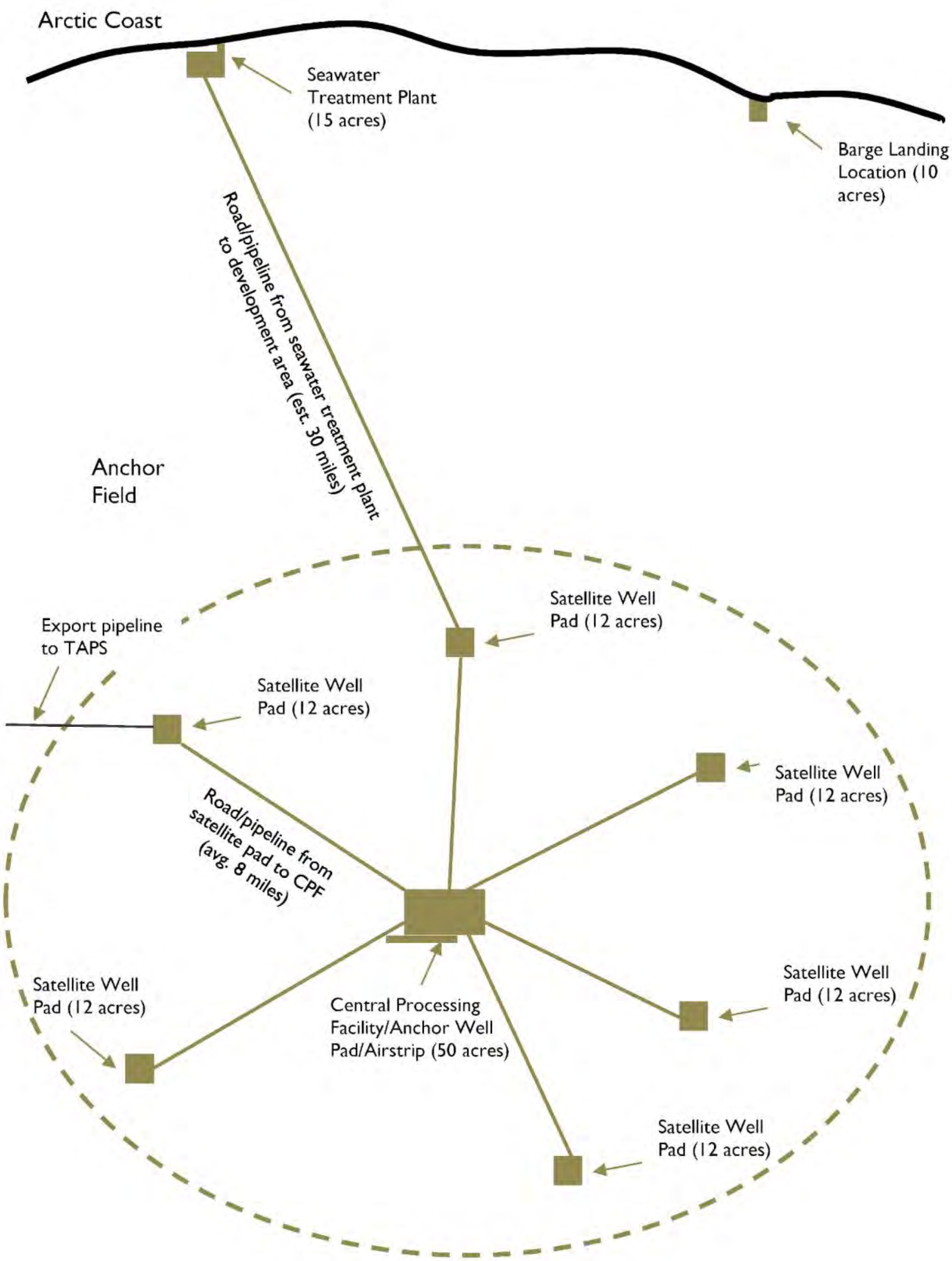
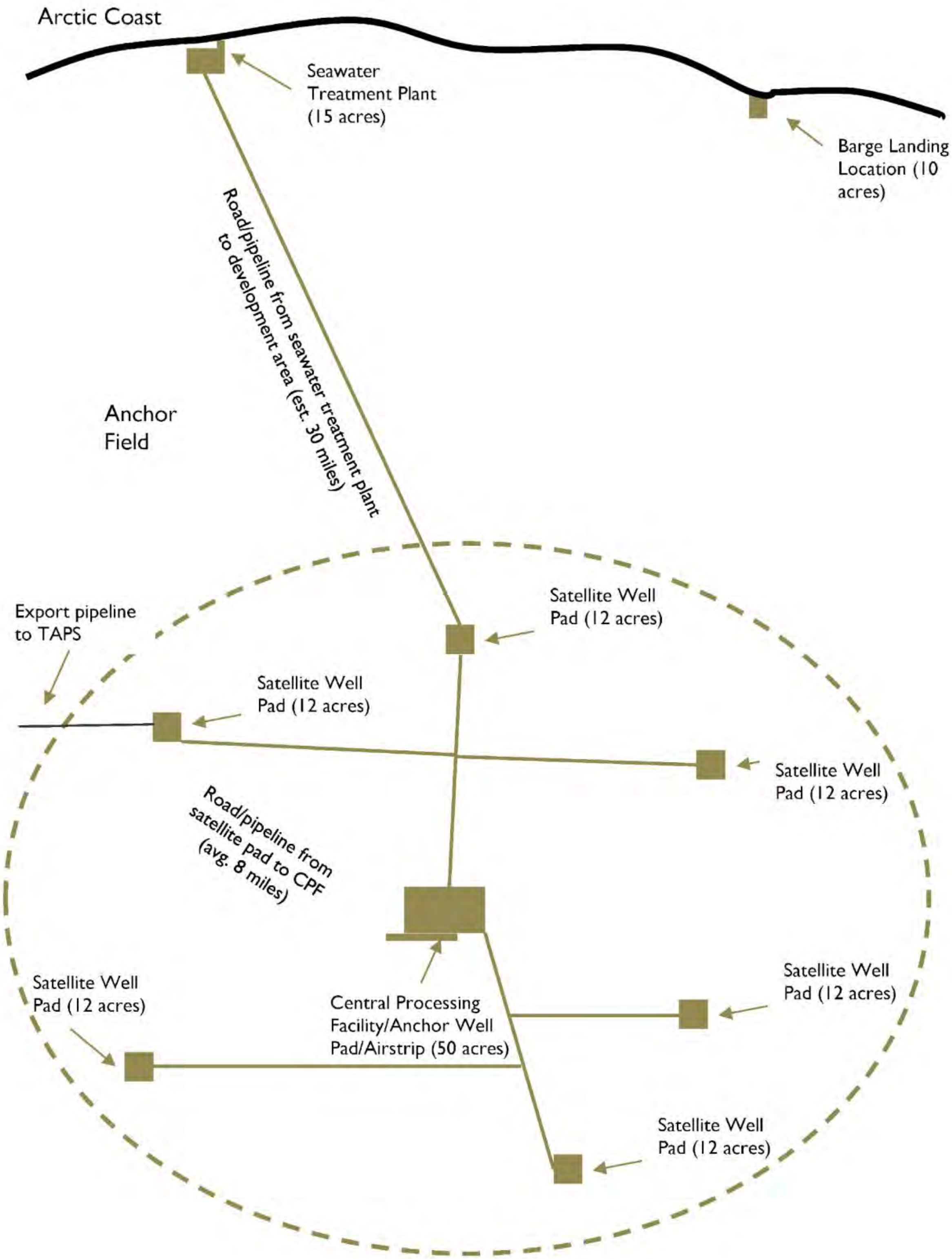
Figure B-1. Conceptual Layout of a Stand-Alone Oil Development Facility*

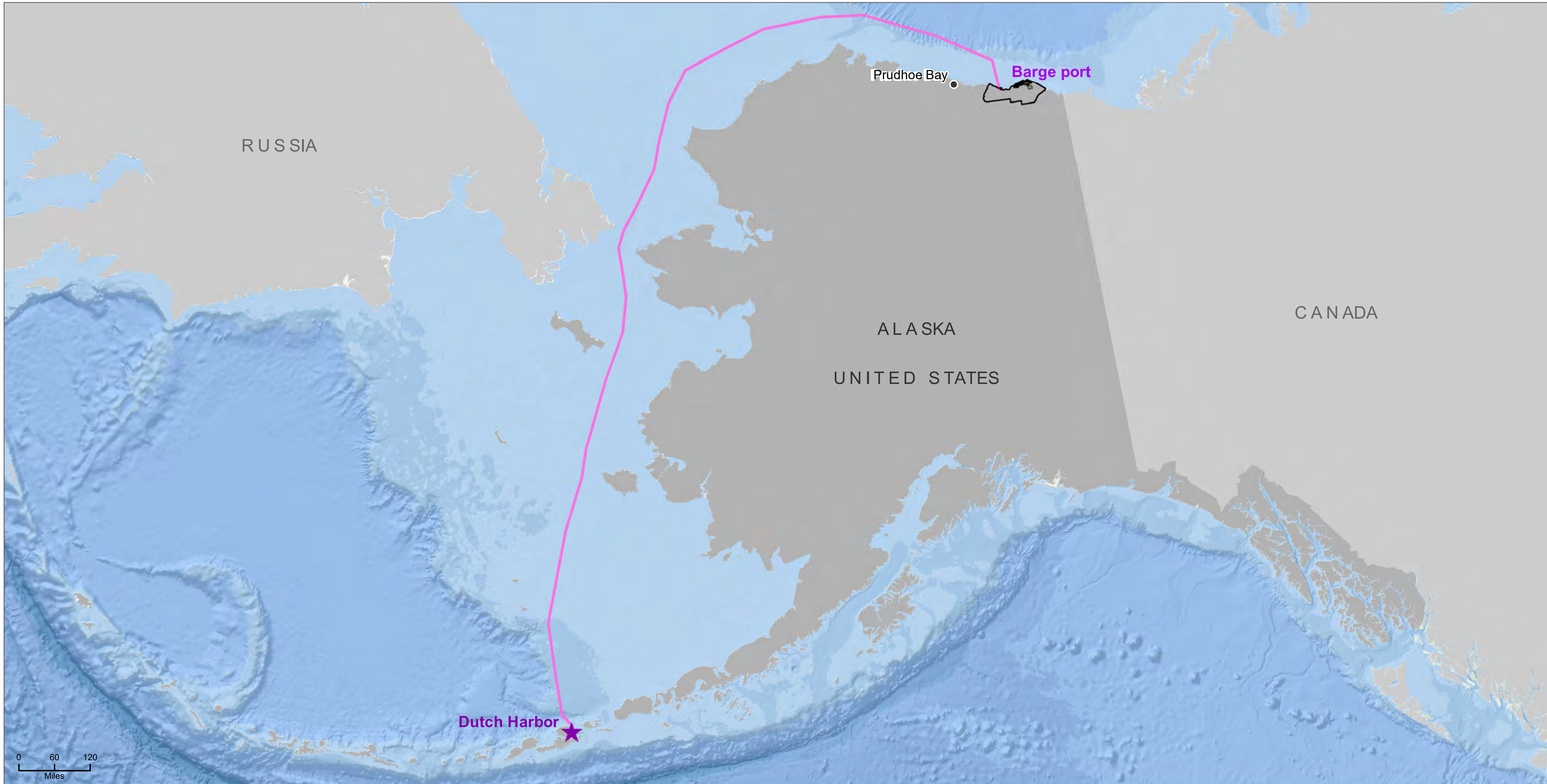


*Facility locations and sizes are conceptual and are not to scale

Figure B-2. Conceptual Layout of a Caribou Area Stand-alone Oil Development Facility*



*Facility locations and sizes are conceptual and are not to scale



Potential marine vessel transportation route

Public Law 115-97 Coastal Plain

Data Source: BLM GIS 2018
Print Date: 08/27/2019

Map B-2

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An average of two barge transports per year is anticipated; the number of transports would vary based on ice conditions and the large equipment needed for upcoming development phases. The barge landing would likely use a floating dock for support. The dock would likely consist of impermanent, industrial strength plastic, modular blocks that can be joined together.

A seawater treatment plant could also be constructed along the coast, if needed, to source saline water for waterflooding, reservoir pressure support, or other subsurface uses. Local lakes are typically the preferred water sources, due to the cost and maintenance requirements of a seawater desalination plant; however, with limited information about surface water resources in the Coastal Plain, those sources may not be sufficient to meet water needs. Thus, for the purpose of analysis, it is assumed that a seawater treatment plant would be required. Seawater treatment plants from other Arctic developments require approximately 15 acres of surface disturbance.[5] A road and seawater transport pipeline would be constructed from the seawater treatment plant to the CPF. Typical gravel roads in the Arctic require 7.5 acres of surface disturbance per mile (BLM 2012).

Following the construction of a gravel anchor pad for a CPF, airstrip, wells, and worker camp, facility construction and production drilling is expected to begin. A CPF is the long-term operational center for production activities in an anchor field. It generally contains equipment for processing oil, gas, and water, as follows:

- Separators for oil, gas, and water, with an output of sales-quality oil
- Filters for produced oil to extract solids
- Processors to remove water and natural gas liquids from associated gas, followed by gas compression and reinjection into the reservoir through gas injection wells
- Compressors for gas and pumps for water injection back into the reservoir

In addition to a CPF, it is expected that a generator, airstrip, storage tanks, a communications center, waste treatment units, and a maintenance shop would be constructed on the anchor pad. Living quarters and offices may or may not be constructed on an anchor pad with the rest of the facilities. All buildings would be supported aboveground on pilings to accommodate ground settling or frost heaving. Pile driving would be needed for the construction of these buildings.

Production wells would extend horizontally in the target formation and could take approximately 45 to 60 days to drill. Total horizontal distance could be up to 6 miles under favorable geologic conditions. This rate of drilling allows approximately eight wells to be drilled on the same pad per year. Depending on drill rig availability, drilling could take place on multiple well pads at the same time. Drilling and completing each well would require anywhere from 420,000 up to 8 million gallons of water[6] (BLM 2012).

Current drilling technology is self-contained; reserve pits are not used and drilling muds are not placed on the ground. Using grind and inject technology, cuttings are now crushed and mixed with seawater in a ball mill to form slurry. Then it is combined with the remaining drilling muds and reinjected into confining rock formation at an approved depth, typically greater than 3,000 feet below surface. An Alaska Department of Environmental Conservation (ADEC)-approved injection well is used (DOI 2005). This reduces the

[5]The seawater treatment plant and gravel support pad at Prudhoe Bay measure 15 acres.
[6]Robert Brumbaugh, BLM-Alaska Oil and Gas Section Chief, meeting with Francis Craig, EMPSi geologist, on May 30, 2019, regarding water use for recent wells.

environmental impacts of disposing of drill cuttings because it avoids the need to bury cuttings on-site or haul them to a landfill. Drilling muds and additives are reconditioned and recycled, to the extent possible.

The anchor pad or satellite pad may have a grind and inject, Class I or Class II disposal well, or both. These are used to dispose of industrial wastes and fluids associated with oil and gas production, respectively (EPA 2018). Disposal wells require approval by the EPA for Class I, or by the Alaska Oil and Gas Conservation Commission for Class II before use. Solid, unburnable waste would be disposed of in large trash receptacles or other approved containers and hauled to approved off-site landfills.

The anchor pad or satellite pad may have a grind and inject, Class I or Class II disposal well, or both. These are used to dispose of industrial wastes and fluids associated with oil and gas production, respectively (EPA 2018). Disposal wells would need to be approved by the ADEC before use. Solid, unburnable waste would be disposed of in large trash receptacles or other approved containers and hauled to approved off-site landfills.

Wells are expected to be hydraulically fractured for initial stimulation; however, this process requires less water than the multi-stage hydraulic fracturing used in unconventional reservoirs, such as shale. The amount of seawater necessary to stimulate conventional reservoir sandstone would vary, depending on the length of the fracture desired in the horizontal section of the wellbore and the specific formation properties. The amount of stimulation can be gauged by poundage of proppant used (typically sand). As pressurized water opens up spacing between the formation particles, the proppant lodges itself into the spacing, keeping it open for hydrocarbons to flow more freely. A smaller scale stimulation may use 50,000 pounds of proppant and require approximately 21,000 gallons of water. A larger stimulation could use 400,000 pounds of proppant and 180,000 gallons of water.

Water flooding using parallel injection wells would increase oil recovery by pushing oil toward producer wells and to maintain reservoir pressure. 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 barrels of oil per day would require approximately 2 million gallons of water per day.

A production pipeline would be constructed to connect a CPF to the TAPS. Vertical support members (VSMs) are counted as ground disturbance at a rate of approximately 0.04 acres per mile (USACE 2017). Pipelines would also connect each satellite pad to the CPF. It is assumed that pipelines for water, gas, and electric cables to supply satellite pads would also be run on the same VSMs. A pipeline to transport future petroleum production from Native lands could be constructed across the northern Coastal Plain to connect to TAPS or other export infrastructure. If there is already a pipeline from other development in the Coastal Plain and if the distance is shorter, then the pipeline from Native lands could tie into that pipeline.

Following the completion of an anchor pad, development would begin on satellite pads around the anchor field. Development of individual pools reachable from an individual satellite pad may be delayed until the project is economical or additional geological data are collected. Regardless of this, satellite pads would consist of wells and the minimum amount of required equipment. Production from these pads would be pumped via pipeline to the nearest CPF for processing.

Natural Gas Development

A gas line to Kaktovik is possible if gas is discovered nearby and it is considered economical to replace imported diesel or fuel oil as the primary source of power and heat to the village. In the longer term, gas could be exported to markets outside the North Slope; however, this is not likely to occur until other gas deposits closer to the infrastructure have been produced. Given the large gas reserves around Prudhoe Bay, it could take a considerable amount of time before gas would be exported from the Coastal Plain.

The State of Alaska is pursuing a plan to build a natural gas transport pipeline from the North Slope to markets in Asia. The Chinese oil industry has expressed interest in partial funding of the project in exchange for a share of gas from the pipeline. Additionally, memoranda of understanding to sell gas to companies in Japan, South Korea, and Vietnam have been secured. The pipeline is scheduled to come online in 2025 (Energywire 2018). Gas transported through the pipeline is expected to come from established fields with proven reserves initially. If economically viable gas resources are discovered in the Coastal Plain, they could be connected to the pipeline to maintain capacity as the primary fields are depleted. Estimated possible natural gas production from the Coastal Plain ranges from 0 to 7 TCF of gas produced (Attanasi 2005). These production estimates do not include gas that would be reinjected into the formation to maintain reservoir pressure as part of the EOR process.

If natural gas resources were to be developed, the addition of gas compression pumping equipment to existing CPF pads in oil fields would result in an approximately 13 additional acres of ground disturbance per CPF. Gas pipelines would be installed on the same VSMs as oil pipelines, so no additional acres would be disturbed for gas pipelines.

Unconventional Development

No unconventional hydrocarbon development is anticipated in the Coastal Plain for the period analyzed in this hypothetical development scenario. There is currently no unconventional oil and gas production on Alaska's North Slope; due to the high costs of and difficult operating conditions in the Arctic, the viability of hydraulic fracturing to produce from unconventional petroleum resources has not been proven from a technology or commercial viability standpoint (BLM 2012). Coal bed methane potential is low, and its production is unlikely, due to a lack of infrastructure to transport methane gas from northern Alaska to any significant market. Gas hydrates[7] (methane hydrates) are expected to exist in the Coastal Plain, but no definitive discoveries have been published at this time. Commercial scale gas hydrate development is currently an unproven technology and is not likely to occur in the program area in the foreseeable future.

B.7.4 Production

Production is anticipated to peak at an estimated 100,000 barrels per day[8] from each field (not necessarily concurrently) after 3 years from initial production, though for any particular development this number may be exceeded. From that point onward, production is estimated to decline at a rate of approximately 8 percent per year.[9] New production is expected to come online at various points during the decline but is not expected to bring production back to peak rates. Produced resources would be processed at a CPF to separate water and gas from salable oil and natural gas liquids. Water and gas would be reinjected into the formation to enhance oil recovery; oil and natural gas liquids would be shipped to market, likely via TAPS.

Field production can last from 10 to 50 years before abandonment (BLM 2012). In the Coastal Plain, assuming the 100,000 barrel-per-day peak production and the 8-percent decline per year, the assumption was made that it would take an estimated 35 years after reaching peak production to get to the point of abandoning a field. Reinjecting produced gas and water helps maintain oil reservoir energy and improve hydrocarbon recovery efficiency by pushing oil toward the production wells, increasing the ultimate oil recovery. Associated gas

[7]A crystalline compound in which water molecules are chemically bound to another compound or to an element.
[8]Estimate based on production projections for Willow and Pikka Nanushuk developments on the North Slope.
[9]Estimate based on standard decline estimates from the State of Alaska and the estimates used in NPR-A analyses.

and water injection wells are needed where no gas sales line exists and where water disposal is not allowed at the surface (BLM 2012).

Depending on market forces, the size and number of fields discovered, and the timing of development, the projected ultimate recovery in the Coastal Plain is estimated to be anywhere from 1.5 BBO to 10 BBO (Attanasi and Freedman 2009). This is based on the estimated daily production rate for the two to four main developments and estimates of available reserves.

Hypothetical production rates and estimated ultimate recovery are not expected to change significantly under any of the alternatives. This is because management under the alternatives is expected to change the configuration and locations of facilities and timing of development; however, it would not change the total amount of production over the lifetime of a Coastal Plain exploration and drilling program. Changes in the amount and time sequence of production cannot be predicted at this time, given the limited data on the formations, reservoirs, and resources in the Coastal Plain.

B.7.5 Abandonment and Reclamation

Abandonment and reclamation occur once a well pad or field is no longer producing enough oil to cover costs. Typically, abandonment and reclamation take from 2 to 5 years following the termination of production (BLM 2012). Wells are plugged with cement to prevent fluid migration between formations; they are plugged at the surface to satisfy federal requirements. After plugging, the well casing is cut below the surface and buried. On-site equipment, facilities, and solid wastes are removed from the site. Gravel from pads and roads would be removed and reused in other areas. Gravel pits would have side slopes constructed and reclaimed as ponds. Pipelines and VSMs would be removed and scrapped or reused in other developments.

Once all satellite pads feeding to a CPF are no longer producing, or when the flow of produced oil is reduced to the point that operation is no longer economically viable, the CPF would be decommissioned. Following reclamation, the acreage would be regained against the 2,000-acre surface development limit. This would allow for additional development of new fields as initial development is reclaimed.

B.8 Coastal Plain Oil and Gas Leasing Program EIS Alternatives Hypothetical Scenarios

B.8.1 Alternative A

Under Alternative A (the No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales following the ROD for the Leasing EIS. Alternative A would not include the direction under PL 115-97 to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain in the Arctic Refuge. Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015). Alternative A is being considered to provide a baseline for the comparison of impacts under the action alternatives.

Because no leasing, exploration, or development would occur under this alternative, no production would occur, and no surface would be disturbed.

B.8.2 Alternative B (Preferred Alternative)

Due to limited restrictions and stipulations under this alternative, hypothetical development would be expected to occur in approximately the same manner as the hypothetical unconstrained scenario. In the long term, four CPFs are projected to be built. Hypothetically, this could include two CPFs in the high potential area, one

CPF in the medium potential area south of Kaktovik, and one CPF in the low potential area. This hypothetical scenario includes the possibility that one or more CPFs could be located on state or native lands. Approximately 14 satellite pads are projected to be developed, in addition to the four anchor pads associated with the CPFs; an estimated 174 miles of gravel road would be needed to connect facilities.

It is projected that one seawater treatment plant and at least one barge landing and storage pad would be needed under this hypothetical scenario. It is possible that one or more of the CPF development clusters under the hypothetical scenario would be roadless. This would entail an expanded airstrip at the CPF with the capacity to handle the larger cargo planes and increased air traffic. In a hypothetical roadless development scenario, it is expected that service roads would still connect satellite pads to the central CPF, so no airstrips would be required at satellites.

An ice road would be constructed each winter under a roadless hypothetical scenario to connect to the CPF and to transport larger and heavier supply items required for the coming year. Any equipment or supplies not transported during the winter would be flown in. Additional flights would be needed, compared to a hypothetical roaded development. Roadless development would depend on sufficient water resources for the construction of ice roads each winter. Under the hypothetical development scenario for this alternative, it is expected that the 2,000-acre surface development limit would be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative.

B.8.3 Alternative C

Under this alternative, hypothetical development would be expected to occur in approximately the same manner as the hypothetical unconstrained scenario. In the long term, three CPFs are projected to be built under a hypothetical scenario. This could include two in the high potential area and one in the medium potential area south of Kaktovik. Approximately 15 satellite pads are projected to be developed under a hypothetical scenario, in addition to the three production pads associated with the CPFs. An estimated 180 miles of gravel road would be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be needed under a hypothetical scenario. Under the hypothetical development scenario for this alternative, it is expected that the 2,000-acre surface development limit would be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative.

B.8.4 Alternative D1

Due to additional restrictions and stipulations under this alternative, the potential locations for drill pads and CPFs under a hypothetical development scenario could be limited, and pad configurations and locations could change. In the long term, two CPFs are projected to be built under a hypothetical scenario. This could include one in the high potential area and one in the medium potential area south of Kaktovik. The assumption is that approximately 16 satellite pads would be developed under this hypothetical scenario, in addition to the two production pads associated with the CPFs. An estimated 185 miles of gravel road would be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be needed under a hypothetical scenario. Under the hypothetical development scenario for this alternative the 2,000-acre surface development limit is expected to be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative.

B.8.5 Alternative D2

Due to additional restrictions and stipulations under this alternative, limiting the leasable area to 800,000 acres, the potential locations for drill pads and CPFs under a hypothetical development scenario could be further limited as compared to Alternative D1, and pad configurations and locations could change. In the long term, two CPFs are expected to be built under a hypothetical scenario. This could include one in the high potential area, and one in the medium potential area south of Kaktovik. The assumption is that approximately 16 satellite pads would be developed under a hypothetical development scenario, in addition to the two production pads associated with the CPFs. An estimated 185 miles of gravel road would be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be needed under a hypothetical scenario.

Under the hypothetical development scenario for this alternative, the 2,000-acre surface development limit is expected to be reached. See *Surface Disturbance Due to Oil and Gas*, below, for more details on the surface disturbance projected to be created under the hypothetical development scenario for this alternative. Because a timing limitation stipulation would be applied to the entire Coastal Plain under this alternative, the time frames for reaching peak production could be extended, compared with the other action alternatives.

B.9 Surface Disturbance Due to Potential Future Oil Development

B.9.1 Production Facilities

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 50 acres (BLM 2012). Similar projects estimate gravel needs at 10,000 cubic yards per acre (BLM 2012), for a total of 500,000 cubic yards per 50-acre CPF.

A typical satellite well pad associated with potential future development in the Coastal Plain is projected to have approximately 30 wells and occupy approximately 12 acres. A well pad of this size would require approximately 120,000 cubic yards of gravel.[10] Pads would be constructed to a thickness sufficient to maintain a stable thermal regime. This hypothetical scenario assumes an approximately 5-foot thickness, based on data from Point Thomson (USACE 2012).

B.9.2 Support Facilities

A seawater treatment plant supplies 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 pad of this size would require approximately 150,000 cubic yards of gravel.

A barge landing area with a floating dock or a module transfer island would likely be constructed in order to transport in CPF modules. Comparable facilities at other North Slope developments occupy approximately 10 acres.

B.9.3 Roads and Pipelines

Roads from similar oil and gas developments create a ground disturbance of approximately 7.5 acres per mile (BLM 2012). Roads are projected to be the greatest source of disturbance associated with future petroleum development in the Coastal Plain. Depending on the hypothetical development scenario for each alternative, anywhere from an estimated 1,550 to 1,650 acres of road could be built. Road requirements are somewhat

[10]Based on gravel need estimates from NPR-A IAP/EIS (BLM 2012).

elastic in that operators could route roads through Native or State lands or even build some roadless developments, especially if there were a possibility of the 2,000-acre development limit being exceeded.

Pipelines are hung on VSMs and would be used to transport oil to the CPFs and eventually to TAPS. Other pipelines attached to the VSMs are for water, gas, and electricity. The seawater line would connect from the coast to the CPF and associated satellite pads. The gas line would connect in the field and also would likely connect to other CPFs to provide gas to other reservoirs for EOR. The electricity would be primarily used for the pumping and operations CPF and satellite pads.

Pipeline VSMs are counted toward the 2,000-acre development limit, but spans are not. VSMs in the Arctic create approximately 0.04 acres of surface disturbance per pipeline mile (BLM 2012). The estimate is that approximately 200 to 240 miles of pipeline would be constructed in the Coastal Plain under the hypothetical development scenarios for each alternative, depending on field design; this would disturb approximately 8 to 10 acres of ground.

B.9.4 Gravel Mines

Gravel pits would be constructed to supply gravel needs for pads and roads related to future development. Between an estimated 10 million and 12 million cubic yards of gravel would be required to construct the following under the hypothetical development scenarios for each alternative:

- Roads, airstrips, and pads for wells
- CPFs
- The seawater treatment plant
- The barge landing pads and storage

Gravel could be sourced from hard rock or unconsolidated sand and gravel deposits, depending on what sources are available in the area surrounding development. Blasting could be required to produce gravel from hard rock or to loosen rock for extraction. Due to the number of outcrops and surface deposits in the Coastal Plain, pits are expected to be constructed next to facilities or roads used for satellite access. Minimal additional road construction is expected to be needed to access gravel mines.

In estimating potential gravel mine ground disturbance, the hypothetical development scenario used information from the gravel mine at Point Thomson, the closest oil and gas development to the Coastal Plain. In that case a 60-acre pit and an additional 11-acre pad for storage and operational needs were constructed in order to provide approximately 2.65 million cubic yards of gravel for roads, pads, and an airstrip (Exxon Mobil Corporation 2009).

Gravel pits and associated storage pads are expected to be needed to supply oil exploration, development, and production in the Coastal Plain. This would encompass approximately 280 to 300 acres under all alternatives. The acreage required for gravel mining could increase or decrease, depending on local conditions. Gravel supply plans would be detailed in site-specific NEPA documentation for any future developments.

B.9.5 Surface Disturbance Estimates

Table B-4 and **Table B-5**, below, show surface disturbance estimates for the construction of oil and gas production facilities and infrastructure.

Table B-4
Estimated Surface Disturbance by Facility

Estimated Facility Sizes[11]	Acres of Estimated Surface Disturbance
CPF, airstrip, anchor well pad	50
Satellite pads	12
Gravel roads	7.5 per mile
VSMs	0.04 per mile
Seawater treatment plant	15
Barge landing and equipment storage	10

Sources: BLM 2004, 2012; USACE 2017

Table B-5
Hypothetical Projected Facilities and Estimated Surface Disturbance by Alternative[1]

Facility Type	Alternative B		Alternative C		Alternatives D1 and D2	
	Number of Potential Facilities	Estimated Acres of Disturbance	Number of Potential Facilities	Estimated Acres of Disturbance	Number of Potential Facilities	Estimated Acres of Disturbance
CPF, airstrip, anchor well pad	4	200	3	150	2	100
Satellite pads	14	168	15	180	16	192
Roads	174 miles	1,305	180 miles	1,350	185 miles	1,388
VSMs (pipeline miles)	212 miles	8	214 miles	9	217 miles	9
Seawater treatment plant	1	15	1	15	1	15
Barge landing and storage	1	10	1	10	1	10
Gravel pits and stockpiles[2]	—	296	—	292	—	288
Total (approximate)	—	**2,000**	—	**2,000**	—	**2,000**

[1]All potential facility numbers and surface disturbance acreages are general hypothetical estimates and are not based on specific project proposals. Acreages are approximate and rounded to the nearest acre.
[2]The number of gravel pits is dependent on the locations of gravel resources in relation to project components and thus is unknown at this time.
— = not applicable

B.10 ECONOMIC IMPACTS

Issuance of an oil and gas lease under the directives of Section 20001(c)(1) of PL 115-97 has no direct impacts on the environment; however, it is a commitment of oil and gas resources for potential future exploration and development, subject to environmental review and permits, that would result in future indirect impacts from exploration and development activities. Indirect impacts because of a lease sale include direct and indirect impacts from post-lease activities, including seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, an analysis is provided of the potential direct and indirect impacts that may follow a leasing decision along with the potential cumulative impacts throughout the entire program area.

[11]Estimated facility sizes were determined based on facility sizes from comparable North Slope projects, such as Alpine, and the professional expertise of the BLM and Alaska Department of Natural Resources staff.

Following issuance of an oil and gas lease, subsequent possible future development of oil and gas resources in the Coastal Plain would have direct and indirect economic impacts on the economy. **Table B-6**, below, estimates the number of direct and indirect jobs that would be created because of potential future exploration, development, and production in the Coastal Plain.

Direct and indirect income projected to be created by potential future Coastal Plain development is shown in **Table B-7**, below.

Government revenues projected to be created by leasing and potential future Coastal Plain development are shown in **Table B-8**, below. These revenues represent estimates of the taxes and royalties that would be collected from leasing, developing, producing, and transporting oil and gas resources from the Coastal Plain. These estimates are based on the hypothetical unconstrained scenario detailed in **Section B.5**. Additionally, local governments could experience increased economic activity and revenues from an increase in hotel/bed tax collections.

Table B-6
Projected Direct and Indirect Jobs: Potential Exploration, Development, and Production Phases

Effects	Jobs (average number of part-time and full-time jobs)	Annual Average	Peak
Direct	Exploration	250	650
	Development	470	680
	Production	730	1,150
Indirect	Exploration	190	560
	Development	3,130	4,570
	Production	3,160	4,970

Source: Northern Economics estimates, based on the following models and data sources: i) Alaska Department of Natural Resources Cash Flow model (modified for use in this analysis), ii) MAG-PLAN model (used to estimate some of the capital expenditures); iii) Spring 2018 Revenue Forecast published by the Alaska Department of Revenue (for data on transportation costs); iv) Annual Energy Outlook 2018 published by the Energy Information Administration (for data on oil price projections); v) IMPLAN model (used to estimate direct, indirect, induced effects); vi) Attanasi and Freeman 2009 (used to estimate some capital expenditures of petroleum development)

Table B-7
Projected Direct and Indirect Labor Income: Potential Exploration, Development, and Production Phases

Effects	Labor Income (in Millions of 2017 Dollars)	Annual Average	Peak
Direct	Exploration	$29	$77
	Development	$96	$140
	Production	$125	$197
Indirect	Exploration	$10	$30
	Development	$211	$307
	Production	$212	$307

Sources: Northern Economics estimates based on the following models and data sources: i) Alaska Department of Natural Resources Cash Flow model (modified for use in this analysis), ii) MAG-PLAN model (used to estimate some of the capital expenditures); iii) Spring 2018 Revenue Forecast published by the Alaska Department of Revenue (for data on transportation costs); iv) Annual Energy Outlook 2018 published by the Energy Information Administration (for data on oil price projections); v) IMPLAN model (used to estimate direct, indirect, induced effects); vi) Attanasi and Freeman 2009 (used to estimate some capital expenditures of petroleum development)

Table B-8
Projected North Slope Borough, State, and Federal Government Revenues

Government Revenues (in Millions of 2017 Dollars)	Annual Average	Total
North Slope Borough property taxes	$50	$1,139
State royalties	$936	$22,460
State taxes	$2,153	$49,519
Federal royalties	$936	$22,460
Federal taxes	$495	$11,883

Sources: Northern Economics estimates based on the following models and data sources: i) Alaska Department of Natural Resources Cash Flow model (modified for use in this analysis), ii) MAG-PLAN model (used to estimate some of the capital expenditures); iii) Spring 2018 Revenue Forecast published by the Alaska Department of Revenue (for data on transportation costs); iv) Annual Energy Outlook 2018 published by the Energy Information Administration (for data on oil price projections); v) Attanasi and Freeman 2009 (used to estimate some capital expenditures of petroleum development)

The stipulations applied under Alternatives B, C, D1, and D2 could result in unquantifiable diversions from the hypothetical unconstrained scenario presented above. The impacts associated with stipulations could result in additional consultations with stakeholders, studies for permitting, delays for timing limitations, and construction of additional facilities and infrastructure. Some of these actions could result in higher employment and income effects due to additional expenditures that would be necessary to comply with the required operating procedure, including additional spending on consultation and studies. Some of these actions could also delay exploration, development, and production and would therefore also delay potential employment and income effects and revenues that could accrue to the local, state, and federal governments.

B.11 References

Attanasi, E. D. 2005. Undiscovered Oil Resources in the Federal Portion of the 1002 Area of the Arctic National Wildlife Refuge: An Economic Update. USGS Open-File Report 2005-1217. Internet website: https://pubs.usgs.gov/of/2005/1217/pdf/2005-1217.pdf.

Attanasi, E. D., and P. A. Freeman. 2009. Economics of undiscovered oil and gas in the North Slope of Alaska: economic update and synthesis: U.S. Geological Survey Open-File Report 2009-1112. Internet website: https://pubs.usgs.gov/of/2009/1112/pdf/ofr2009-1112.pdf.

Bird, K. 1999. Geographic and Geologic Setting in the Oil and Gas Resource Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska, by Arctic National Wildlife Refuge Assessment Team, U. S. Geological Survey Open File Report 98-34. Internet website: https://pubs.usgs.gov/of/1998/ofr-98-0034/ANWR1002.pdf.

Bird, K., and L. Magoon. 1987. Petroleum Geology of The Northern Part of The Arctic National Wildlife Refuge, Northeastern Alaska. US Geological Survey Bulletin 1778. Internet website: http://dggs.alaska.gov/webpubs/usgs/b/text/b1778.pdf.

BLM (Bureau of Land Management). 2004. Alpine Satellite Development Plan Final Environmental Impact Statement. Internet website: https://www.blm.gov/eis/AK/alpine/dspfeisdoc.html.

_____. 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.

_____. 2018. SAExploration Inc. Seismic Application (in progress). Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/projectSummary.do?methodName=renderDefaultProjectSummary&projectId=111085.

DOE (Department of Energy). 2019. Gas Hydrates R&D Program. Internet website: https://www.energy.gov/fe/science-innovation/oil-gas-research/methane-hydrate.

DOI (Department of Interior). 1987. Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement. Washington, D.C., U.S. Fish and Wildlife Service, U.S. Geological Survey, and Bureau of Land Management. Internet website: https://pubs.usgs.gov/fedgov/70039559/report.pdf.

_____. 2005. Reasonably Foreseeable Development Scenario for Oil and Natural Gas Resources in the Kobuk-Seward Peninsula Planning Area, Alaska. October 2005. Internet website: https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=66967.

EIA (US Energy Information Administration). 2018. Annual Energy Outlook 2018: Table 12: Petroleum and Other Liquids Prices, Reference case. Internet website: https://www.eia.gov/outlooks/aeo/tables_ref.php.

_____. 2019. Oil and natural gas resource categories reflect varying degrees of certainty. Internet website: https://www.eia.gov/todayinenergy/detail.php?id=17151.

Energywire. 2018. China chases elusive North Slope gas bonanza. Margaret Kriz Hobson, E&E News reporter. Published: April 17, 2018. Internet website: https://www.eenews.net/stories/1060079247.

EPA (US Environmental Protection Agency). 2018. UIC Well Classes. Internet website: https://www.epa.gov/uic.

Exxon Mobile Corporation. 2009. Project Description Point Thomson Project, North Slope, Alaska. Internet website: http://dog.dnr.alaska.gov/Documents/SPCS/PointThomson/Application/AttachmentI-ProjectDescription.pdf.

North Slope Borough. 2005. North Slope Borough Comprehensive Transportation Plan. Prepared by ASCG Incorporated. August 2005. Internet website: http://www.north-slope.org/assets/images/uploads/TransportationPlan_Final.pdf.

SEC (U.S. Securities and Exchange Commission). 2010. Securities and Exchange Commission, 17 CFR Parts 210, 211, 229, and 249, Release Nos. 33-8995; 34-59192; FR-78; File No. S7-15-08, RIN 3235-AK00, Modernization of Oil and Gas Reporting. Internet Website: https://www.sec.gov/rules/final/2008/33-8995.pdf.

USACE (US Army Corps of Engineers). 2012. Point Thomson Project EIS. Internet website: http://www.arlis.org/docs/vol1/AlaskaGas/Report3/Report_PtThom_FEIS/index.html.

_____. 2017. Nanushuk Project EIS/DEIS. Internet website: http://www.nanushukeis.com/documents.html.

USFWS (US Fish and Wildlife Service). 2015. Arctic National Wildlife Refuge Comprehensive Conservation Plan. Internet website: https://www.fws.gov/home/arctic-ccp/.

USGS (US Geological Survey). 1998. Arctic National Wildlife Refuge, 1002 Area, Petroleum Assessment. Fact Sheet 0028–01.

_____. 2002. Petroleum Resource Assessment of the National Petroleum Reserve in Alaska (NPRA) Play Maps and Technically Recoverable Resource Estimates. Open File Report 02-207.

_____. 2008. Assessment of Gas Hydrate Resources on the North Slope, Alaska, 2008. Fact Sheet 2008-3073.

_____. 2010. Updated USGS Assessment of Undiscovered Oil and Gas Resources of the National Petroleum Reserve in Alaska (NPRA). Fact Sheet 2010-3102.

_____. 2017. Assessment of Undiscovered Oil and Gas Resources in the Cretaceous Nanushak and Torok Formations, Alaska North Slope, and Summary of Resource Potential of the National Petroleum Reserve in Alaska, 2017. Fact Sheet 2017-3088.

Van Wagner, D. 2018. Analysis of Projected Crude Oil Production in the Arctic National Wildlife Refuge. United States Energy Information Administration. Internet website: https://www.eia.gov/outlooks/aeo/anwr.php.

Ycharts.com. 2018. Alaska North Slope Crude Oil First Purchase Price. Internet website: https://ycharts.com/indicators/alaska_north_slope_crude_oil_first_purchase_price.

Appendix C
Collaboration, Coordination, and Traditional Knowledge

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Appendix C. Collaboration, Coordination, and Traditional Knowledge

C.1 Introduction

This appendix summarizes the public and agency outreach that the BLM has engaged in as it developed the Coastal Plain Oil and Gas Leasing Program EIS, as required under NEPA. This outreach included keeping the public and agencies informed of the process and offered several opportunities for the public and agencies to express their concerns, share their knowledge, and suggest how the BLM should proceed. This section also identifies the individuals who prepared the EIS.

C.2 Scoping

Formal scoping began on April 20, 2018, with the publication in the *Federal Register* of a Notice of Intent (NOI) to prepare the EIS for the Coastal Plain oil and gas leasing program. The NOI notified the public of the beginning of the scoping process, which included a description of the 60-day public scoping period to solicit public comment and to identify issues (https://goo.gl/HVo5Mj). The scoping comment period ended on June 19, 2018. In addition, the NOI described the NEPA process, identified preliminary issues for analysis in the EIS, and provided information on means to submit scoping comments.

The BLM used several additional methods of outreach to notify the public of the Leasing EIS and the scheduled public meetings. It placed advertisements in the *Anchorage Daily News*, the *Fairbanks Daily News Miner*, and the *Arctic Sounder*. The BLM also distributed public notices via press releases, emails, public service announcements, and flyers. Nongovernmental organizations were also active in notifying constituents of the Leasing EIS process and meetings. Additionally, the BLM maintains a project website with information related to the development of the Leasing EIS: https://goo.gl/HVo5Mj. The website includes background documents, maps, information on public meetings, and contact information.

The BLM received 4,226 unique written submissions during the public scoping period; the number of substantive comments extracted from these submissions varied between all letters. Overall, more than 4,000 substantive scoping comments were identified using the comment analysis response application, an ePlanning software of the BLM. The final scoping report is available on the project website (https://goo.gl/HVo5Mj).

C.3 Public Review and Comment on the Draft EIS

The Notice of Availability (NOA) of the Draft EIS and the public meeting schedule were published in the Federal Register on December 28, 2018. The BLM issued a press release on December 20, 2018 notifying the public that the Draft EIS was available for public review. The public comment period was scheduled for 45-days, which was initiated on December 28, 2018, with the publication of the NOA and, and was later extended for an additional 30 days, until March 13, 2019. Public meetings were held from February 4, 2019 to February 13, 2019. Public notices announcing the comment period were placed in newspapers with circulations in or near locations where the public meetings were held. These newspapers included Anchorage Daily News, the Fairbanks Daily News Miner, and the Arctic Sounder. The BLM also distributed public notices via press releases, emails, public service announcements, and flyers. Information was also posted on the project website, where the public was also able to download a copy of the Draft EIS and provide their comments on the Draft EIS.

The BLM received written comments by mail, fax, email, online comment form via ePlanning, and handwritten and verbal testimony at public meetings. Comments received covered a wide spectrum of thoughts, opinions, ideas, and concerns. A total of 1,066,803 comment letter submissions were received; 3,709 of these were considered unique submissions and 1,063,094 were part of form letter campaigns.

C.4 TRIBAL CONSULTATION

To initiate the government-to-government consultation process as required by Presidential Executive Memorandum dated April 29, 1994, the BLM initiated the government-to-government tribal consultation process with letters sent on March 2, 2018, to the following five tribal governments whose members could be affected by oil and gas leasing actions on the Coastal Plain:

Tribal Governments Contacted for Government-to-Government Consultation
Arctic Village Council
Iñupiat Community of the Arctic Slope
Native Village of Kaktovik
Native Village of Venetie (Venetie Village Council)
Native Village of Venetie Tribal Government

A second invitation letter to participate in government-to-government consultation was sent out by the BLM on April 23, 2018, to the following eight tribal governments:

Tribal Entities Contacted for Government-to-Government Consultation
Beaver Village Council
Birch Creek Tribal Council
Chalkyitski Village Council
Gwitchyaa Zhee Gwich'in Tribal Government (Fort Yukon)
Naqsragmiut Tribal Council (Anaktuvuk Pass)
Native Village of Barrow Iñupiat Traditional Government
Native Village of Nuiqsut
Native Village of Stevens

Two tribes requested government-to-government consultation that were not included in the initial communications from the BLM and BLM has agreed to consult with, as follows:

- Circle Village Council
- Native Village of Eagle

To date, the BLM has held government-to-government consultation meetings with the following tribal governments:

Date	Location	Tribal Government
May 23, 2018	Arctic Village	Arctic Village Council, Native Village of Venetie (Venetie Village Council), and Native Village of Venetie Tribal Government
June 11, 2018	Venetie	Arctic Village Council, Native Village of Venetie (Venetie Village Council), and Native Village of Venetie Tribal Government
June 13, 2018	Kaktovik	Native Village of Kaktovik

Date	Location	Tribal Government
August 30, 2018	Fort Yukon	Beaver Village Council, Chalkyitsik Village Council
October 2, 2018	Arctic Village	Arctic Village Council, Native Village of Venetie (Venetie Village Council), Native Village of Venetie Tribal Government
October 9, 2018	Kaktovik	Native Village of Kaktovik
October 17, 2018	Anchorage	Beaver Village Council
March 1, 2019	Utqiaġvik	Iñupiat Community of the Arctic
March 5, 2019	Kaktovik	Native Village of Kaktovik
March 12, 2019	Utqiaġvik	Native Village of Barrow Iñupiat Traditional Government
March 27, 2019	Kaktovik	Native Village of Kaktovik
May 15, 2019	Kaktovik	Native Village of Kaktovik
June 1, 2019	Arctic Village	Arctic Village Council
August 7, 2019	Arctic Village	Arctic Village Council, Native Village of Venetie (Venetie Village Council), Native Village of Venetie Tribal Government,
August 9, 2019	Kaktovik	Native Village of Kaktovik

Tribal consultation continued through the development of the Final EIS.

C.5 ANCSA Corporation Consultation

The BLM also sent a letter of notification and inquiry on March 2, 2018 to Arctic Slope Regional Corporation and Kaktovik Iñupiat Corporation, offering the opportunity to participate in Alaska Native Claims Settlement Act (ANCSA) corporation consultation. To date, the BLM has held consultation meetings with both of these ANCSA corporations, as well as Doyon, Limited, to discuss the EIS process. Meeting dates and locations are listed below:

Date	Location	Corporation
April 25, 2018	Anchorage	Arctic Slope Regional Corporation
May 18, 2018	Anchorage	Arctic Slope Regional Corporation
June 13, 2018	Kaktovik	Kaktovik Iñupiat Corporation
June 19, 2018	Anchorage	Arctic Slope Regional Corporation
July 6, 2018	Anchorage	Doyon Limited
July 27, 2018	Anchorage	Arctic Slope Regional Corporation
October 9, 2018	Kaktovik	Kaktovik Iñupiat Corporation
October 19, 2018	Anchorage	Arctic Slope Regional Corporation
March 5, 2019	Kaktovik	Kaktovik Iñupiat Corporation
April 8, 2019	Anchorage	Arctic Slope Regional Corporation
July 11, 2019	Anchorage	Arctic Slope Regional Corporation
August 9, 2019	Kaktovik	Kaktovik Iñupiat Corporation
August 12, 2019	Anchorage	Arctic Slope Regional Corporation

ANCSA consultation continued through the development of the Final EIS.

C.6 Coordination and Consultation with Local, State, and Federal Agencies

The BLM has reached out to governmental agencies in a number of ways, most notably through inviting or accepting requests for such agencies to participate as cooperating agencies as defined in 43 Code of Federal Regulations (CFR) 1508.5. Agencies who are participating as a cooperating agency include:

Participating Cooperating Agencies
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
State of Alaska
North Slope Borough
Native Village of Kaktovik
Native Village of Venetie Tribal Government
Venetie Village Council
Arctic Village Council

The BLM is consulting with the Alaska State Historic Preservation Office as part of Section 106 consultation under the National Historic Preservation Act to determine how activities resulting from the Coastal Plain oil and gas leasing program could impact cultural resources listed on or eligible for inclusion in the National Register of Historic Places. The BLM initiated consultation with the State Historic Preservation Office on June 29, 2018. Formal consultations with the State Historic Preservation Office may also be required during implementation of individual projects. Consultation is ongoing and completion of the development of a Programmatic Agreement for Section 106 compliance will be completed prior to signing of the Record of Decision for this EIS.

To comply with Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), the BLM began consulting with the USFWS and National Marine Fisheries Service (NMFS) early in the EIS process. Both provided input on issues, data collection and review, and alternatives development. The BLM is consulting with the USFWS and NMFS to identify ESA issues and support development of their Biological Opinions.

Section 810 of Alaska National Interest Lands Conservation Act (ANILCA) focuses on issues related to the effects of proposed activities on subsistence use. An ANILCA Section 810 notice and public hearing is required if a proposed action may significantly restrict subsistence uses and needs. An evaluation and finding of effects on subsistence uses and needs from actions that could be undertaken under the four alternatives considered in this EIS is provided in **Appendix E**. The preliminary evaluation found that the cumulative case presented in the EIS met the “may significantly restrict” threshold for the community of Kaktovik; therefore, it made a positive finding pursuant to ANILCA Section 810. As a result, a public hearing was held in the potentially affected community of Kaktovik on February 5, 2019 in conjunction with the Draft EIS public meeting. The final evaluation also finds that the cumulative case may significantly restrict subsistence uses for Kaktovik.

C.7 Coordination with Canadian Government and International Porcupine Caribou Board

The Department of the Interior (DOI) has been consulting and exchanging information with the Canadian government throughout development of the EIS. In May of 2019, in Ottawa, DOI Assistant Secretary for Land and Minerals Management Joseph Balash and Department of State Senior Advisor Jon Harrison consulted with Canadian counterparts on the effects of sales of oil and gas leases in the Coastal Plain of the Arctic National Wildlife Refuge. At this meeting, the two sides agreed to exchange further views on the role of the International Porcupine Caribou Board (IPCB).

The DOI has had ongoing coordination and consultation with the IPCB. The DOI attended the Board’s annual meeting in Fairbanks in September 2018. The DOI confirmed the US’s commitment at this meeting to working with Canadian, First Nation, and First Alaskan partners to ensure the long-term sustainability of the herd.

C.8 INCLUSION OF TRADITIONAL KNOWLEDGE

Traditional knowledge is critical in the assessment of impacts in rural communities, particularly with regard to their subsistence practices and cultural concerns. Throughout the NEPA process, testimony was provided and traditional knowledge was shared in a variety of forums to include public meetings, and government-to-government and ANCSA corporation consultations. This information was utilized during the development of action alternatives, and also to inform changes made in the Final EIS. The following representative comments identify specific areas or issues where commenters and stakeholders emphasized the importance of traditional knowledge. Excerpts from public comment meetings, consultation meetings, and public comment submissions containing traditional knowledge relevant to these topic areas have been organized under these topic areas. Each excerpt has its origin identified as well.

C.8.1 Cultural Resources

Iizhik Gwats'an Gwandaii Goodlit, "The Sacred Place Where Life Begins"

- Commenters requested the inclusion of traditional knowledge to address potential impacts on the Gwich'in people from industrial activities in "The Sacred Place Where Life Begins," which is considered a significant ethnographic cultural resource. "The Gwich'in people have relied upon the caribou for centuries, countless generations. They hold the coastal plain as a sacred place. Our subsistence way of life will be significantly impacted and restricted if the Porcupine Caribou herd and the migratory waterfowl migration habitat, food and water resources and/or birthing grounds are impacted. All of the tribes rely upon migratory waterfowl as a critical resource in the spring." –Ben Stevens, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska
- "The Gwich'in Nation, along with the majority of Alaskans and Americans have always opposed any development in Izhik Gwatsan Goodai Goolit, the sacred place where life begins, due to the highly negative impact it would have on the Gwich'in as people, their culture and traditions, the language and overall health of their communities that lie on the migration route of the Porcupine herd. The Porcupine caribou rely on the coastal plain for their birthing grounds, to protect their young from the mosquitoes and other predators that otherwise would kill their newborns. But we must also keep in mind that the rich ecosystem houses more than just the 40,000 caribou calves born each spring. There are birds that migrate from all 50 states and six continents. The walrus, whales, seals and many other marine mammals and sea life make their way to the coastline to also nest and give birth." –Adrienne Blatchford, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska
- "And there is more about our culture. And yesterday I was talking about what we are really talking about is it's like the (Speaking in Alaskan Native language). Iizhik Gwats'an Gwandaii Goodlit. Norma Kassi from Old Crow gave it the name, Iizhik Gwats'an Gwandaii Goodlit, Sacred Place Where the Life Begin. That means a birthplace. Like me, a woman, when I had -- when I was going to have my baby, I prepare to have my baby for nine months and then to deliver, and then nursing and then training. We did -- all the mother do that. All life do that Caribou do that. And that's the place they want to do gas and oil development. (Speaking in Alaskan Native language.) It's a good place, a safe place, a healthy place to have caribou cow to have the calf. And they have done that for thousands of years. Each and every one of those caribou -- right now I think there is 250,000 Porcupine caribou herd, and each one born right there. It's been like that for thousands of years. Even when bow and arrow day, our people went through a lot of starvation before. It's not like -- they don't even bother with calving ground then. They let that thing process so they can live. And that's where they want to do gas and oil development." –Sarah James, Public Scoping Meeting, June 12, 2018, Venetie, AK

- “The closest thing that we have on this planet to the Garden of Eden is ANWR. And that's how we believe. I believe personally that it's -- it's -- you don't know what you are doing. You don't realize the implications of how devastating it's going to be to go up in that land and disturb that area. I mean, I'm telling you, I'm not joking.” –Paul Shewfelt, DEIS Public Meeting, February 7, 2019, Fort Yukon, Alaska
- “But I'll tell you something: One time I went up to Arctic Village and I went to -- I stayed up there the summertime, and then I went to this family, and they said, let's go up to Daa'chunla'. Oh, okay. Let's go. So we went up there. And my grandma, she said, do you know where you are going? I said no. I don't know where I'm going. You are going where no man ever made footprint. There is not a footprint up there that belongs to anybody.” –Belva Ansaknok, DEIS Public Meeting, February 7, 2019, Fort Yukon, Alaska

Broader Cultural Ties to the Coastal Plain

- Commenters requested that the BLM document the broader cultural ties to the Program Area for the Iñupiat and Gwich'in people. Ethnographic resources also require protections, including ethnographic landscapes, traditional cultural properties, Native American sacred sites, and intangible cultural resources (e.g., oral traditions, indigenous knowledge, and traditional skills). “We have a creation story. In our creation story it's said that there was once a time when there were just animals. And in our story, the animals had human characteristics. They were like human beings. And then there was a split between the animal nation and us where we—where human beings were created. In our story it's said that we came from the caribou. Gwich'in came from the caribou. And at that time when that split happened, the caribou and the Gwich'in made an agreement that from that time on, the caribou would always retain a part of the Gwich'in heart, and the Gwich'in would always retain a part of the caribou heart. So, we are one and the same in a spiritual way with the caribou. …. We have a reciprocal relationship with the land since forever. The Creator gave us this place and this herd, which is why we're here today speaking to you. We follow Creator's laws. It's in our blood, natural law. The western value and system, the values and system of the western ways have forgotten the original laws of Creator. And now we see the threats to humankind itself.” –Faith Gemmill-Fredson, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- “You know, we have been -- from archeology findings, from 26,000 years that we have been finding in the headwaters on Canadian side, Old Crow River. Before it was hard to get information like that.” –Edward Sam, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- “If you want proof to know how long we have been here and to know how long we have lived off the caribou, there are caribou fences surrounding our villages and throughout our Gwich'in Nation. In Old Crow, Yukon, Canada researchers found arrowheads and caribou bone tools made by our people over 25,000 years ago. That's our proof that we lived on the caribou for thousands of years.” –Jewels Gilbert, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- “That’s our feeding ground. That's our garden out here. … we have been environmentalists for 10,000 years. And look at it. We try to keep our land clean the way it is for a thousand years. We don't try to destroy it because we know it help us. In return, we take care of the land. In return, it takes care of us. That's the way we believe. …But when I was upriver and all that camping and getting harvest, spring -- like right now it's -- our young men is going out and getting those wonderful waterfowls. They are on their way to the calving grounds, calving grounds of the Porcupine caribou herd. And they are going to see some stuff they are never going to see. And it will change.” –Louie John, Public Scoping Meeting, May 24, 2018, Arctic Village, AK

- "Over 75 historical sites that were once used for subsistence usage areas are now restricted to access from my people who once hunted there. And that -- and to hear you can't hunt, that (Alaska indigenous word), you can't hunt at (Alaska indigenous word), that hurts me because my son won't ever, ever get the chance to ever hunt where my grandparents hunted, where I learned to hunt, also." –Raymond Edward Igalook, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska
- "When the elders first got together, the main thing we were worried about was when the freshwater touches the saltwater, this is where the food chain in the Arctic begins. You cannot destroy that because if you do, you have broken the food chain of the Arctic Ocean. And when you look at from Point Barrow going out 200 miles to 168 miles west of Wrangell Island going out 200 miles, this turned out to be the last third of the world's … fish nursery. That's got to be protected. Remember when the Yukon River had no fish that one year? That occurred because the seismic was being done off of work—off of Wainwright all across. The fish that used to go down to the rivers in the southern part of Alaska, eastern part of Asia and northern part of Japan, those fish were chased into the Arctic Ocean." –George Edwardson, DEIS Public Meeting, February 6, 2019, Utqiagvik, Alaska
- "The land is all we have left to survive. And believe it or not, we still use the land like always. We go on the land seasonal. Also, if we have to go any time and pretty much anywhere, we do it to hunt, trap and haul wood, just to pretty much go wherever we want. …. The caribou is like the land, our ancestors, our rich past and, most of all, the reason we all are here today right now. Put all these categories into one, and you have the Porcupine caribou herd. The caribou is our past, our history, our future." –Chief Galen Gilbert, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska
- "And he told me that you get these little tundra tussocks, you put on the post. And from here to probably longer this whole airport, way out there, way out there, it goes a long way to the -- and I told him, how come we are doing this? He say caribou, they will see it and they will keep their distance from it, and they will just keep going right to where we are living in the tent. And that caribou, the bull caribou, we call them hasaii. This is pretty small. When I grew up, these are small. And my grandfather said, caribou will start coming in. And the caribou are right here from the corner of the house, right there, coming in, because the caribou, they see that long string of posts with the tundra tussock on there, and they keep their distance. And they keep their distance right to the tent. That's when my grandfather got 30, 40. Shoot the caribou right there at the mouth of the tent. We don't have to pack. Right there we just butcher it up. And that's the way I grew up. ... Nowadays our way of life is changing lots, but we still—I go 30 miles, 40 miles just to harvest caribou now, at Bob Lake, halfway to Arctic." –Macarthur Tritt, DEIS Public Meeting, February 9, 2019, Venetie, Alaska

C.8.2 Subsistence Use and Resources

General Traditional Knowledge on Subsistence Use

Some commenters provided general discussions on subsistence use, as seen below:

- "You know, that connection that we have for the land like that has gone to where we have got, like, moose and fish and things like that, but these people's strong connection to that food [Caribou] is very sacred. And when we think of sacred, to me growing up … living in a fish camp, fish, hunting, things like that, is when we prepare the meat to get all that blood all over your hands and on your body, you know, it's very sacred to us. It's a ceremonial thing. I know for a fact after when I'd be sleeping at night, I'd have strange dreams sometimes. It was just like I could feel that animal inside me. And when we ate, I'd be very strong, very healthy. And as you said, you know, this food is very sacred to us. ….You know, the way we -- we treat our land, it treats us. If we don't treat it right, it's not going to happen, you know." –Travis Cole, DEIS Public Meeting, February 4, 2019, Fairbanks, AK

Reliance on the Porcupine Caribou Herd and the Lack of Practical Alternatives

A number of commenters requested that the EIS in its analysis acknowledge that the Gwich'in people traditionally depend on caribou and that in some cases no other practical alternative to replace food supplies are available; in addition, there was a request to acknowledge that Old Crow has a unique dependence on PCH, in addition to use of the herd by Kaktovik and Alaska.

- "And as you see, my people here, my family, they are all my brothers and sisters. We all came from the same generation. And we all live on caribou. We live on whitefish. We live on trouts. We live off our land. We don't go to the store. You buy steak, that's 15 bucks. One time a hunter came up to me and he said, I don't want to buy $15 steak. I want to buy $30 gun shells. I'll get more caribou with that." –Debbie Tritt-Kennedy, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "The prices of food there are extremely high. It's $20 for a can of coffee, $40 for a steak. Three bananas are $12. We take care of ourself, and that's what our food security does for us. What will your message be to my people when we no longer hunt for our food security? When an oil spill happens -- and mark my words it will -- the price of that is going to be more than we can endure. Our animals will be poisoned, our land contaminated." –Bernadette Dementieff, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska
- "The people living there, we are subsistence people. We hunt. We eat caribou, the birds, the way we eat off the ocean, and we have to make sure we protect our ability to feed ourselves. When you look at that 1002 area, it slopes into the ocean. You have got to keep that in mind. …over 60, 70 percent of us are subsistence hunters, and once you stop the migration routes, where are we going to eat? We were promised one time 12 pounds of beef if they had an accident, and that never came through. So what are you going to do for us if we can't feed ourselves? There is three communities that depend on that Porcupine herd." –George Edwardson, Public Scoping Meeting, May 31, 2018, Utqiagvik, AK
- "What will happen if we don't have any caribou? My kids and my people will be in danger. The high cost of food in our local stores are already high to get for our residents. The airfare and the freight also are high. This is my third scoping meeting I have attended, and it's not easy listening to all these comments and concerns. And I hope you take this into consideration and think how important this issue is to us. Our livelihood is at stake." Tiffany Yaltin, Public Scoping Meeting, June 12, 2018, Venetie, AK
- "… you go to the store here and buy a gallon of milk for, like, $20 and, you know, like if you are down there Anchorage, you buy a gallon of milk for, like, $5. Try buy a loaf of bread for $5 where you buy them for, like, a quarter, 75 cents to a dollar, but it's pretty spendy because the high price of Raven, it really takes a toll on our village because, you know, they are the only airlines that come into our village." –Glen Solomon, Public Scoping Meeting, June 12, 2018, Kaktovik, AK
- "… we were very fortunate because if you go to the store, the little piece of meat costs $27.90. Times that by ten for 31 days, $270 times 31. I cannot afford this dinner alone. That does not include breakfast and lunch for my family, plus we have to pay for our own propane, which is $300 of propane, which lasts 42 days… 95 percent of our groceries comes from this land. ... Five percent of our groceries comes from Fairbanks. But if you include freight -- so if you are paying for a piece of meat or a box of meat, you are paying for groceries for $70 in Fairbanks, plus you still have to pay for it to get it here to Venetie, which the freight costs -- with the freight prices rising, it's very outrageous. So basically that box of meat could feed my family for maybe a week and a half, but we are paying almost $270. Right now yesterday we paid $350 for two boxes of meat, a thing of tissue,

and pull-ups and diapers. That does not include the freight coming from Fairbanks." –Crystal Sisto Druck, Public Scoping Meeting, June 12, 2018, Venetie, AK

- "And our traditional food back home, it's the same source of meat… the caribou. It's a main food source. Because if you buy a little chunk like this (indicating) almost as big as your hand, a chunk of meat in the village, it would probably be like about $50, almost. Why would you spend so much that money? It's survival, too, because you can't -- you can't survive on that little chunk of meat in the store. You rather get caribou, bring it home, butcher it, bless it. Part of our big thing is our religion. It's part of our religion because when the weather gets real cold, you know, the way the caribou acts, we even know how the weather is going to be, like if it's going to be cold or if it's going to be warm weather. … And all the beliefs come with that caribou. And the bones is our tools, you know. We use our regalia. Back in the day, we used it for knife. … caribou is very, very important to us. The trails are there for thousands of years, and they are still there. And you know, it's old ecosystem, like the geese, waterfowl, they all breed there, too. And those little, tiny shore birds, we call it dill. It's like dill pickle. They are -- dill are little shorebirds. And those are -- those used to be a lot, you know, around, but even that, this little bit cut back, we don't see it that much. But those are really born in the Arctic Refuge, too, because the water, waterfowl, geese and those are important, too. Important, also." –Kenneth Frank, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "As we all know, we depend on the Porcupine [sic] that goes up there and calve in the spring, which is right around the corner. That's our food security. We depend on this animal for our food, our basic needs. We also make clothing out of it. We use their bones to make tools and such things like that, that we are teaching our kids to do that because I believe in the future that we won't be able to go down to the store and buy food. We won't be able to go to the gas station." –Mary Beth Solomon, DEIS Public Meeting, February 7, 2019, Fort Yukon, Alaska
- "It's caribou leg and boots. We use every part of the caribou. These boots is the warmest you can wear if you have caribou hair insole in it. 60-below you can survive with that. … Caribou is our dance. We do caribou dance. We do caribou skin hunt dance. We tell stories from way back. That's our history. What happened last week, men went out and got meat. Men came here and helped cut meat. … it's medicine for us. … We use caribou every day… we do need that medicine. And we do live with it every day because our ancestor lived with it. And unborn going to live with it. Ancestor that's not here today with us live with it. … So it's still our shelter. That haven't gone away yet. It was our caribou skin hut. We dance caribou skin hut. So we haven't gone away from any one of these. And then it's our tool, just like what I said. It's 30,000 years. And clothing. We got boots we use every day and mitts -- and this one right here. And same goes when you're out camping. …. Caribou meat, it keep forever. It don't go stale. And this is caribou inside the stomach lining. And ch'ehtsihguu we call it. That means wrap around the stomach, the whole stomach. So this is our food and who we are." –Sarah James, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska
- "We are able to take that fall time caribou skin and make a sleeping mat, far better than what you can find at some outfitter store because it's warm. It's hollow hair. Or we can sew it and caribou leg skin boots. There's so much to a caribou that it's just awesome. But why take a chance of ruining that? Why? How can you say you have got these protocols that can work? Drilling machines and the contractors are going to do everything that's set in stone. You will have road construction crews. You will have flare tips burning off gases." –Macarthur Tritt, DEIS Public Meeting, February 9, 2019, Venetie, Alaska
- "Everything in the clothing we got off this caribou. We got boots. We got gloves. We got hats. Everything, drum, tools, from the horn to the toes. All those bones you see is from the caribou. There

is our tools. That's how they lived a long time ago by using those caribou bones. That's how they got the tools. They make a sewing needle. They got skin on their backstrap for thread. Even from their leg you could make grease out of something, the marrow. That's your fat to cook your meat. That's how they provide us. That's how our animals provides us everything that we need. And we will fight for them. They come back and be nice to us and give us our food. But I'm just speaking up for these young kids to make it good for them, to make sure they got their -- like we have. And as our parents said, fight for our rights. And that's what I'm doing right now for our human beings' food, our resource. That's the main food that we have. And nobody can take it away." –Marie John Willoya, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska

- "I'm here to do a hearing and talk about the caribou that I got. And just this past week I have been down back and forth going down about 30 miles down, shooting, shooting, hunting caribou and bringing it back. And we bring it all here into the community hall, and they cut it all up and they distribute it to the community. And it's just something that we all do to live off the caribou, you know. And I love doing it. I love providing for my family, the community and other communities. And a lot of people, they -- they want caribou meat, you know. They -- it's their Native food. People living in Fairbanks are buying store-bought food. …There is going to be a big change if they disturb that area up there. …. we are already seeing animals that had contaminated meat, and we don't know where that came from." –James Martin, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska

Reliance on Migratory Birds, Fish, and other Marine Mammals, including Polar Bears

The following section compiles accounts of reliance on subsistence resources other than caribou that the tribes rely on within the Program Area.

- "And that's how healthy our people were. Everything was healthy. They couldn't even -- here right now springtime, sun is coming back up. In those days, they said it's so noisy that people have to yell at each other. It's so noisy that state bird, what you call it, ptarmigan, Alaska state ptarmigan was the most annoying one. …. And many, many birds come there. Many, many—150 different species of bird. I'm worried about that one little bird that lives there all year-round up there. There is a hot spring up there, and that bird lives in that hot spring. And once that oil get into that tundra, it will seep into the tundra. It will get to that little bird. So I'm worried about that. There is one from North Pole—I mean, South Pole. They fly from South Pole, Arctic tern. And that's pretty far. So we worry about all those things, and we got story on them just like we had—I'm just saying the raven story." –Sarah James, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "You have heard a few people talk about the polar bears that are being threatened now. One of the only strongholds that they have has been Kaktovik because they have got the whaling -- the remains from their whaling and what they call the bone pile up there. And it's been reported that the polar bears are now cross breeding back to the grizzlies. They are saying that they originally evolved from grizzlies, and now they are devolving back into grizzlies. They have seen polar bears up here on the mountains following caribou. They have seen polar bears in Fort Yukon 150 miles south of here. And that's 500 miles from any coast. There has been other mammals. They are hunting other mammals out there, not just the caribous. You know, there's all kinds of ground squirrels and moose and things like that up there, too." –Lance Whitwell, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "Many of our people still depend heavily on the Chinook salmon, and we trade heavily with Arctic Village relatives. So the development in the coastal plain will affect all of our people. We fully believe that that development cannot be done in the -- I heard it like ten times today -- responsible manner.

I'd like to see that. That would be nice." –Rhonda Pitka, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska

- "We not only use the ocean for the animals, like hunting them, but also we used it to make salt. On the west end of the island -- that would be towards Barrow -- we fished with nets, as well, both for the trout and (Inupiaq word), the whitefish. I'm not sure -- I forget what the -- what you would call it. It's a different kind of fish. Good fish. The island is also a nesting area for all the species of birds which we also gathered for food. A aahaliq -- 1 always forget the English name for aahaliq. It's a black and white bird which we call in Inupiaq aahaliq. ….We also have other species of edible fowl: geese, swans and many kinds of birds. Some we cannot hunt as children. You see, we also killed the small brown birds for our elders since the smaller birds have softer meat. We used to have more elders living in our land in our village, but nowadays most of our elders no longer live long or live in the villages. We still take care of our elders, but they are -- there are facilities for them to live in and be cared for as a group. But if they still have family, they are cared for by them. We as a village also living by the Brooks Range to the south, we also have access to the Dall sheep, which is a delicacy for Christmas and Thanksgiving feasts we have as a village. Thanksgiving, Christmas, 4th of July and whaling season events." –Maryann Iqilan Nasoaluk Nageak Rexford, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska
- "I come from an island that was once populated up to an estimate of over 10,000 people. Upon the depletion of the whale population, 99 percent of our population was eradicated, over 9,000 human beings on one island killed for economic gain." –Panganga Pungowiyi, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska
- "My concern -- I also have many concerns, as others had mentioned, the whales and animals going by. Camden Bay is the gathering waters and extremely important area for bowhead whales. All the drainage from anything of that area is going to flow into there. …. a huge concern of mine is before we allow access to industry, we should allow access to our hunters from Nuiqsut and Kaktovik to utilize ANWR as they should. They have restricted access. They are not allowed to use four-wheelers at certain times. They can only go in certain areas. They can't even get to somebody's camp that these folks talk about. And yet we want to go and drill and we don't allow access for our hunters. So I hope that's looked into." —Qaiyaan Harcharek, Public Scoping Meeting, May 31, 2018, Utqiagvik, AK
- "[W]haling is hunting to provide our family for nutritional and dietary needs. So in the same way that caribou is a supplement to our diet, so funds have to be put aside for care…so that research impacts on wildlife can be already funded. …. the people have to be involved, just like the whaling captains are involved in the CAA, conflict avoidance agreement, for bowhead whaling so that each village have created a whaling subsistence zone in Kaktovik, Cross Island and now Barrow so that there is a cooperative arrangement with vessel traffic controls so that people have -- villages that have quota, they are provided quota." —Arnold Brower, Jr., Public Scoping Meeting, May 31, 2018, Utqiagvik, AK
- "Some of the ducks we never see them no more. Birds are same thing. That worries me. And we don't -- we don't say nothing, then we going to have more problems than 30 years ago." –Trimble Gilbert, Public Scoping Meeting, June 12, 2018, Venetie, AK
- "And I was talking to one of my friends last night, [indiscernible] and Jerry that testified earlier. I asked them, I said, how long does it -- when they come through, the ducks come through, how long does it last? He said sometimes it lasts a whole week. Lasts a whole week. Several thousand a day. And you can imagine how many -- how many ducks in this little area down there, but cover the whole Yukon River. It's really massive, geese that go to the north. And fish do the same thing. And fish,

they come up the river. They come up the river from where the mouth of the Yukon is. And they spawn in the clean water, clean water they spawn. And they do that year after year. They do that year after year. We all know that. The people that lives on the Yukon, they share fish. They share fish that comes up to the clean water to spawn. So like when spawning happens this year, it will come back in four to five years from now. And I was talking about the fish. Not only king salmon or chum salmon does that. Whitefish does that, too. They winter in the lakes and then they come out in the springtime and then they spawn. They spawn. They spawn during the summer. And then in July the little fish like this come up the creek, bunch of them. And we all know there is millions of creeks in Alaska. It happens the same way. So I'm talking about our way of life. It's really a way of life. We are guarding the fish, the animals that use the area up there." –Gideon James, Public Scoping Meeting, June 12, 2018, Venetie, AK

- "In addition to caribou, fish and waterfowl are important to the subsistence harvest of Gwich'in people, and impacts to these resources must be carefully evaluated. … In Arctic Village, for example, residents vary their activities between fishing, berry-picking, and harvesting waterfowl throughout the summer, to hunting migrating caribou in the fall into the winter, to ice fishing and fur trapping throughout the winter until spring. BLM must consider potential impacts to these subsistence resources themselves, as well as impacts to subsistence hunters, such as reduced access and availability, and impacts from the disturbance of traditional subsistence use areas. Oil and gas activities will negatively impact the many species of birds which use the Coastal Plain. …[I]n 2000, residents of Fort Yukon reported harvesting 3,615 birds. Collisions with infrastructure, spills of oil and other chemicals, noise from operations, and loss of habitat will lead to displacement, potential disruption in migration, and possible direct mortality of birds. BLM must clearly articulate how these important fish and bird populations will be monitored to detect short- and long-term negative impacts to our subsistence resources." –Bernadette Demientieff, Gwich'in Steering Committee, Scoping Letter, June 19, 2018
- "Animals come and go during the winter and summer. The migratory birds come and go. Those have been our bread and butter for centuries, past centuries, past centuries. Now some of the major nesting ground areas are disrupted and destroyed or even practically reduced to a certain size. According to the way we live, we are harvesting people. We can smoke, sun dry and prepare food and store them for the winter use. But our capacities in terms of the kind of climate changes we are facing from the '50s and '60s to today are drastically changing quite a bit." –Johnnie Brower, DEIS Public Meeting, February 6, 2019, Utqiagvik, Alaska
- "[P]eople say not only the caribou will be impacted; the birds. This is one of the biggest places where the birds, the ducks come. And it's really big here in Venetie. People come here to hunt ducks. So that's going to be impacted, as well. So that's just as important." –Tonya Garnett, DEIS Public Meeting, February 9, 2019, Venetie, Alaska

C.8.3 Traditional Knowledge of the Caribou

Tribal Management of the Herd and Tribal Understanding of the Historic Migration Path

It was requested that the BLM discuss the role of the Gwich'in in the active management of the herd, in either a traditional or a contemporary, co-management context. Excerpts collected on this topic also seemed to reference traditional knowledge of the historical migration path of the PCH, as well as any changes to the migration path.

- "We have been managing the moose in this area. We have been managing the fish, the wildlife, the waterfowl for as long as we have been here. Whenever our hunters decide to harvest, they are practicing active management. When they decide not to shoot the first leaders that come through, they are practicing active management. When they decide to take a bull and not a cow, they are practicing active management. And so I want to make that record clear because I think sometimes there is this notion that our management is not enough, that we are not qualified as biologists, that we always need these experts from western institutions to affirm our knowledge that we know based on many, many generations." –Charlene Stern, Public Scoping Meeting, May 24, 2018, Arctic Village, AK

- "When I was growing up in this community, even from the time we were very young, every fall the caribou migrates back here to this mountain over here called Dachanlee. And we wait for them to come back from the calving grounds. Our people are waiting and watching. Over there we can watch and see when they start coming. And when they come, we have protocol, cultural protocol. The leaders have to come and pass. Once they pass, then it's our time to go up to the mountain. We all go up to the mountain, and there are campsites all over that mountain that are set up. And families are on the mountain and ready to start hunting caribou to support ourselves for the winter. It's a very sacred time, and it's a very important time for our people. It's one of the most important times of our community." –Faith Gemmill-Fredson, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "I hunt for caribou in Venetie all my life. We depend on caribou in Venetie, and please don't disturb the calving grounds in ANWR. Every year female caribou get pregnant, and thousands of thousands of females lay their beautiful babies, wet the caribou babies. They lay down and their mom lick it, the baby. After they have baby, they move forward again, baby caribou run with their mom, thousands and thousands and thousands. And baby caribou are strong enough to stay with their mother. And they go across rivers, streams and plain country until caribou grow bigger and stronger. And they travel down to Arctic Village and Venetie, and another herd travels to Old Crow flats and another herd travels to Fort McPherson and another herd travels to Alkavik in Canada. Caribou, they stay whole winter long. And when spring comes, females get pregnant again, and caribou do that for thousands of years for generations and generations. please don't disturb the calving grounds. And don't bother the calving grounds. And this caribou I'm talking about is -- we Gwich'in people are really strong. And I'm going to say in my language, Gwich'in. (Speaking in Gwich'in)." –Jeffrey John, Public Scoping Meeting, May 29, 2018, Fairbanks, AK
- "….So that subsistence hunting, we know right now today it's not feasible to go get caribou because they are fawning. They are calving. This is an area that we don't have to go to look for caribou in this season. But those are the adherences that need to be done, however schedule that they can be done. So those require for collaborative effort to have funding already. …. The caribou, as we know, eats lichen. And lichen takes quite a while for it to reproduce. So that space is -- large space is needed for caribou to have adequate nutritional needs met, too. For those reasons I speak that there should be -- there must be funding allocated, set aside for wildlife research, wildlife monitoring and collaboratively co-managing perhaps these kinds of renewable resources." —Arnold Brower, Jr., Public Scoping Meeting, May 31, 2018, Utqiagvik, AK
- "Okay. Well, so start off with, that's the path, the migratory path of the Porcupine herd, the caribou herd, and it's a very narrow route they have on the ocean side. And the slope of the land is if anything happens on land, it will be in the ocean. And what kind of protection do you have for the ocean? And also that's the migratory path of the birds, the ducks, the geese. When they migrate, that is their route, too. The snow geese used to be in the barrier islands around Prudhoe Bay area, but when the industry got out to the barrier islands, they chased them out of the islands and the snow geese went over into Canada. I was over there around 2000, and their Fish & Game was saying the snow geese had overpopulated and had destroyed their nesting areas. Now the snow geese are wandering around

looking for a place to nest now. And just because the barrier islands were touched." –George Edwardson, Public Scoping Meeting, May 31, 2018, Utqiagvik, AK

- "And lately we have been having concerns because of -- for various reasons -- I don't know all of the reasons -- the area biologists and stuff -- the fluctuation and major decline in caribou herds, the Western Arctic herd, Teshekpuk heard, Central herd. The only one that has maintained or is actively growing is the Porcupine herd that is in ANWR periodically. The point being, you know, that 10, 15 years ago at 490,000 animals in the Western Arctic herd and today at 220,000, that's maybe half the size of that herd, and 38 communities that that herd is feeding. And it graces 38 communities in its migratory path." –Gordon Brower, Public Scoping Meeting, May 31, 2018, Utqiagvik, AK
- "Every part of the animal we get, we got a name for it. Yeah. Every little part we got, we eat them, down to the hooves. Yeah, we boil the hooves. We eat it. Every part, eyeball and all. Yeah. The caribou they go up many miles. They go down to Beaver Mountain. They travel. They come home and go home to have their calves. That's many miles, rugged area. And when they make it, they make sure they have their calf very good and they come home and they come back to our village where we can be, you know, happy people. And these caribou, they are having a hard time right now with the mosquitoes and all that bother them. It's hard for them to keep up. And they can't speak. The caribou don't speak. So we got to fight for them." –James John, Public Scoping Meeting, June 12, 2018, Venetie, AK
- "This herd used to go by Anaktuvuk Pass migration route, and they haven't seen them for six years now because they've been over here. ... This herd migrates more further than any other caribou herd in the world. They estimate maybe 2,900 miles a year that this herd, Porcupine herd, migrate. That's a long way. Part of their migration route is always going through here or going up to the calving grounds or from the calving grounds coming back through here. It's always been like that. Nowadays with climate change now that their routes have changed and all that, but it seems like they always come back to this place here." –Carlie Swaney, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska

Tribal Understanding of Caribou Biology, Phenology, and Social Interactions

Commenters requested that any scientific study of the caribou needs to incorporate indigenous knowledge in order to consider the full range of areas and habitats that are vital to caribou throughout the year.

- "And then we -- where we are talking about is windy and breezy all the time. That's where that vegetation come out. And that's the only safe place and healthy place and quiet place to have their calf. And that's why they go up there. And if we do gas and oil development, that's going to be gone. All the predators up there in the foothills raising their young. And caribou are on the coastal plain and I think -- they can't go up in the foothills. It's too cold and there are predators up there. And if they do go up high, it's too cold and there's no food." –Sarah James, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "So what I want to say is that when these people speak for the animals, it is very -- these are very intelligent animal. They travel thousands, thousands, thousands of miles to the feeding ground, into the calving ground. And when they travel, they got their own leaders. Any caribou don't lead, but they got special group within their herd that leads. I know that because I used to run them down with snowshoe, and I -- it's a hard time. It's hard to run it down with the group of leaders like that. And you can tell by the calluses in front of their legs. There is calluses right there. And the reason I bring this up because we are here to protect migrating animals and species. … There is new life that begins up

there so everybody will stay healthy as in Gwich'in country." –Gideon James, Public Scoping Meeting, May 24, 2018, Arctic Village, AK

- "There is a difference in vegetation between the uplands, the foothills on the other side of the Brooks Range here and the coastal plain. The coastal plain is rich in minerals, salts because of the salt air, and it's so windy that bushes and shrubs and trees and stuff can't grow. So there is a specialized ecosystem that grows specific types of vegetation that the caribou mothers need to eat after they give birth. It's high nutrition. It's the highest nutrition area that they can find, and that is one of the reasons why they give birth there. And you can't find those in any other areas. If you look at the map, if you look at the elevations on the map, the coastal plain is a low-lying area. If you get off of that plain, you go back into the foothills again, and it's a totally different kind of vegetation…..One of the elders was telling me one time that caribou have a scent gland in their foot, and as long as they are going good, they are putting off a scent that says it's fine, this is the trail, follow me. But if they get spooked or if they get startled or something like1 that, then it goes to an adrenaline type of a deal and they put off a different smell and the rest of the herd will not follow them. It doesn't take much to change the migration of the caribou herd. It doesn't take very much at all….These river valleys right here that cut through the mountains, the caribou come through here because they are heavy. They are heavy with calves. They are pregnant. A caribou calf is 40, 50 pounds. And that mother caribou is maybe 150 pounds. Can you imagine that, trying to walk through three feet of snow over the mountains? But these river valleys, they go all the way through to the other side. That's why they come here. That's the easiest route for them to go over to the Arctic refuge and the coastal plain. There is no other way. The only other way is for them to go 200 miles east and cut up right through all the flats, the Porcupine River flats. And I think the people here have shown you quite a bit that it's a lot more than just subsistence food that would be affected here. It's cultural, socioeconomics. And the hard part is that just nobody knows what they will do." –Lance Whitwell, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "…caribou [have] to be free to move to the coast during insect relief periods. It's pretty obvious. So, I think like the worst thing you can probably do to caribou is restrict movement. If they move freely, they seem to do reasonably well, but they have to get to areas that -- you know, the important areas in different parts of their life history." –Craig George, Public Scoping Meeting, May 31, 2018, Utqiagvik, AK
- "We use every part of the caribou, even to the hooves, to the marrow, to the ligament." –Sarah James, Public Scoping Meeting, June 12, 2018, Venetie, AK
- "Same thing happens with the caribou when they – when they travel, they use only one route. And any caribou don't lead. There is a leader in that herd. There is a leader in the herd that does it. They call that the (Alaskan Native word.) That means leader. They lead the herd. And you can tell by the calluses on their arm right here. Yeah, thick calluses. Those are the leader." – Gideon James, Public Scoping Meeting, June 12, 2018, Venetie, AK
- [Re: the calving ground] "Those caribou chose that place for a reason, and they are smart. They know what works to protect their young. They know they need the wind that's there. They need that wide open plain so they can see predators. They need the wind to blow away the mosquitoes because mosquitoes will exsanguinate calves to death. They know why they calve there. To the east is mountains. You go over more mountains, and finally you come to a coastal plain on the Canada side that's similar, and sometimes they calve there. My fear is that they will go east because they will come back down the mountain, they will see out there, oh, there is roads, there is pumps, there is people, it stinks here, and they won't calve there. They will keep going. And the only way they can go is east.

And what will that do to the path that they take when they pass by your villages here? What will it do when their migratory routes possibly shift to the east?"–Will Mayo, Public Scoping Meeting, June 12, 2018, Venetie, AK

- "But I go hunt up there in the Arctic Village for this rich caribou because each caribou, wherever it's from, it tastes different... It eats that lichens off the mountain. A lot of that plant grow up there. It eats that, and that's why it tastes real good…Like Arctic Wildlife Refuge is full of the caribou, their food. Also the reason they are surviving all these years, thousands of years, is because the caribou, it—when it calves there, the babies will survive. Or otherwise the mosquitoes will kill the babies. So as that's the only place it's been surviving for thousands of years." –Pete Peter, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "…when we go out and we hunt caribou, we see the first bunch. They tell us not to bother it because those are the leaders. We let them go by and we wait for the ones behind, and we shoot those ones because we want those leaders to know that trail. And the ones that are following them are learning that trail. And if they—if they do anything to disturb that area out there and the leaders see that, they are not going to go back there. The leaders, they are just going to turn away. They try to avoid that stuff as much as they can, you know." –James Martin, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska
- "The calving ground is the only place where those young ones survive. They've got this little plant growing up there. For about two weeks they eat on that plant to keep up with their mom. The mom is always on survival. Wolf is chasing it. Bears are chasing it. And we come along and we grab our share, you know. And it's really important that they don't drill up there. … it's the only place where those plants grow and they eat that for two weeks to keep up with their mom. And if they don't, they fall to wolves, bears." –Bobby Tritt, DEIS Public Meeting, February 9, 2019, Venetie, Alaska
- "Recently, we have noticed that the herd is around our village for a very short time or sometimes not at all. They rarely venture on to the privately held lands around the village that we are able to access and we notice that they mostly stay in the foothills of the Brooks Range. We have relied much more heavily on the Central Arctic herd in recent years.…. We have shared that we have difficulty hunting caribou in and around Kaktovik as we do not have access into the refuge in the summertime with motorized vehicles and because the caribou rarely, if ever, migrate to our village. We are only able to harvest caribou by traveling up the river corridors by boat. Mostly, caribou, even after calving, remain in the foothills of the Brooks Range and do not venture to the coast. We are concerned with the apparent absence of Traditional Knowledge in the DEIS.'" – M. Rexford, Native Village of Kaktovik, DEIS Letter, March 13, 2019

C.8.4 Sociocultural Resources

The Ethnographic Importance of the Porcupine Caribou Herd

Tribal members and commenters also requested that the BLM include in their analysis a discussion of the ethnographic cultural resources of the Indigenous PCH subsistence users in the Northwest Territories and the potential impacts (direct, indirect, as well as cumulative) that the project may have on these ethnographic cultural resources, including the traditional use of the PCH; the relation of the health and harvesting of the PCH to spirituality and cosmology; and the importance of harvesting caribou to the identity, traditional skills, Indigenous knowledge, and way of life of the Indigenous peoples of the Northwest Territories.

- The Porcupine caribou herd is vital to our cultural way of life. We use every part of the animal to meet our needs. In the past, even our homes were made from caribou hides. But now we still use bones to make cultural tools, and we still use the hides for many articles of clothing, cultural clothing.

Hunting in itself is a cultural practice. At the time when the herd is in our territory, we practice many of our own spiritual beliefs that have been taught to us and handed down generation to generation from our ancestors; thereby, we are spiritually bound to the caribou, too. The herd also represents an important facet of the social fabric of our community…. Men, they are the providers of the community. They are our hunters. And some of them are taught from the time they are just small. They can't even hold a gun yet, but they are taught. They are taught how to respectfully take the animal, how to give proper respect for what they take, to only take what we need to feed our communities and to do it in a way that's respectful to the land and giving proper thanks. And we have all other -- many other teachings, but that's part of it. For the women, we take care of our homes, our families. We are the backbone of our families, the women. … There are some parts that young women are not supposed to eat. We teach our young women that. And once we put aside those parts, there is meat that's sent down to the community for families that need it. And then whatever is left in the camp, we cut it and we have drying racks and we dry and smoke our meat. And that's going to feed our family all winter. And at that time, a lot of teachings are being taught from the mothers and the grandmothers to the young women. So the caribou is not just our food. It's not just our culture. It's a part -- it's a vital component of the social fabric of our community. All these teachings are taught when we are out on the land. And then one of our young men spoke yesterday talking about how we can't afford to live without the caribou. You go to our store, look at the prices. You can't feed your family on that all year, unless you are a millionaire. And I don't see no millionaires in here. The caribou is essential to the economic well-being of our people. We have to have the caribou as our subsistence to feed our families because we can't afford what's sent up here from outside. We won't survive without it. …. We have to live our subsistence way of life to survive here. The prices that are added on just because of the cost of freight is too high for us to depend on anything else. So a critical part of our food security is at threat. How are you guys going to replace that? You can't replace that." –Faith Gemmill-Fredson, Public Scoping Meeting, May 24, 2018, Arctic Village, AK

- "But you know, we are all healthy, really healthy. We are not sick. We are all healthy because we eat caribou. And I don't see anybody that's sick, seriously, all these years that I work as a health aide because our iron is high, protein is high and everything…. I don't want to buy caribou on the farm. No way. I'd rather hunt for it. I'd rather teach my kids. I'd rather teach my grandchildren. I sew. I sew caribou skin. I make a lot of stuff with it. I make living with it. I put food on the table. That's what we do, all of us. And why are they disturbing our caribou? That's our life. I grew up with it. They grew up with it. That's all we know. We learn. We go out in the world. I came back to it. Some of us went out in the world, and they came back. They'd rather stay here. And one of you should try it. Try stay here one year with us and maybe you will change your mind." –Bertha Ross, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "We are not separate. We are together. What happens to them happens to us. It happens to you. It happens to all of us. If they lose their food source, we will lose our food source, too. … It's a cycle. And we give ourselves to the land, and the land gives itself back to the caribou. You cannot break that cycle. You break that cycle, you will break our way of life, all of us. If it happens to us, it will happen to you." –Diloola Erickson, Public Scoping Meeting, May 29, 2018, Fairbanks, AK
- "For all the trauma, through everything that my people have been through, we have had something to gather and celebrate, and that is our traditional food. As a young woman, I have seen what has happened to my people. I have seen spiritual, mental and physical sickness ravish. My mother took me out of the village very young. She wanted to give me what she thought would be a better life. But being forced to move from my village, I lost my language, I lost my culture, and I lost my identity.

For many years growing up, I filled those voids with unhealthy things. I have been through so much in my journey to speak my language, which I still struggle with. I see that we have gone from 98 percent speaking to 11 percent. This is what happens when you take away our food security, when you take away our health. This is not just something that we eat. It is for our spiritual and our mental and our physical well-being." –Sikanik Maupin, Public Scoping Meeting, May 29, 2018, Fairbanks, AK

- "My sister is a community health aide in the rural villages, and she was a health aide in Arctic Village for many years. One year a few years back, the caribou didn't come through Arctic Village. … What we saw medically was very alarming to us. Our elders had no food, no traditional food, so they had to rely on hot dogs, Spam, macaroni and cheese, expensive food that is completely useless to us. And that winter my sister had to treat the majority of those elders for many gestational [sic] issues. They were vomiting. They had the runs because they didn't have their traditional food. They were sick. And that's what we are -- we will be facing in Arctic Village, in Venetie, and in Fort Yukon and Birch Creek. This is very real." –Kathy Tritt, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "And every part of the caribou is like a medicine to us. It works like a medicine. It's our medicine. We can't live without all that." –Sarah James, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "And some of the best time for us as Gwich'in people is when we bring home -- the food home to our family, but especially our elders. And I'll never forget my son carrying the caribou head -- because don't waste anything. He carried the caribou head to one of our elders, grandma to my kids, and brought that to her. And she opened the door, and there is my little boy, 12-year-old boy, standing there with this caribou head for her. And she cried and just kissed on my son. And that's a part of his healing. That's a part of him becoming a man and learning how to respect in both ways and having that relationship that Shawna was talking about. And also that relationship with our elders and importance that has been passed down for millennia to take care of each other, but especially our elders." –Jody Potts, DEIS Public Meeting, February 4, 2019, Fairbanks, AK

The Ability to Pass on Traditional Knowledge to Descendant Communities

Tribal members and commenters noted that the initial reduction of traditional use areas will limit the ability to pass on traditional knowledge to younger generations and traditional use and knowledge of the use areas will be lost; accordingly, they suggested that the EIS measure this impact as long-term or permanent and consider the loss of knowledge as a significant subsistence impact. The following excerpts also discuss this topic.

- "In my current research, I co-conduct numerous research projects on what brings wellness for Alaska Native communities, and again it's been shown it's tribal governance, as well as the land, animals, but most of all the culture, the culture built on this timeless relationship with the land and the animals. Culture that is passed down from father to son, from mother to daughter, from auntie to niece, uncle to nephew, year after year, decades after decades, centuries after centuries. This culture is also rooted in important values, such as sharing, caring for elders, language and, again, respect. This sharing respectful culture extends to people we meet, people like you. When you visit our communities, we open our homes, we feed you, and we treat you with respect despite any differences that lie between us. As I know, many of you were treated like family by the Gwich'in during your recent trip to Arctic Village." –Jessica Black, Public Scoping Meeting, May 29, 2018, Fairbanks, AK
- "We have ancestral knowledge that has taught us how important it is to defend our sacred land, animals and waters, and we have done that. The land, the animals, the water are part of an intricate

beautiful culture, the Gwich'in culture, a culture that ensures the land, animal and water relatives are taken care of, too, a balance, a relationship that is built on respect. …. it's been shown that it's tribal governance, as well as the land, animals, but most of all the culture, the culture built on this timeless relationship with the land and the animals. Culture that is passed down from father to son, from mother to daughter, from auntie to niece, uncle to nephew, year after year, decades after decades, centuries after centuries. This culture is also rooted in important values, such as sharing, caring for elders, language and, again, respect. This sharing respectful culture extends to people we meet, people like you. When you visit our communities, we open our homes, we feed you, and we treat you with respect despite any differences that lie between us. As I know, many of you were treated like family by the Gwich'in during your recent trip to Arctic Village." –Jessica Black, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska

- "I just have a strong feeling that it [the project] would destroy our culture because it's already on the base of being lost because our language is used only by people that are in their late 40s now on up. And the kids, they don't—they don't use Gwich'in anymore. They are speaking English, which is not—which is not very appropriate for them to speak English because it's not their language and it's not—it's not what they understand. And I think if they interfere with the caribou, that will destroy their language, their way of talking because everything that they use on caribou is used in Gwich'in. And so every single piece of the caribou has a Gwich'in name. …. So caribou has a lot of meaning in Gwich'in, in the language because they tell you where they live or they tell you where to go. They tell you all this stuff about caribou, which the Gwich'in people can talk about in their language. So I think the language is a major concern for me and the caribou that the elders live on. We hardly got any elders, but there is still elders up there that really live on caribou, and they don't really care about store meat." –Caroline Tritt-Frank, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "I just want to say a little comment I learned from my grandfather. Our ancestors said that -- they told us this word about (speaking in Gwich'in). It means not to get away from their guideline of survival. They said don't forget their name, don't forget their way. And it's a good message for us and not to forget them. And in the past…the way they learn about caribou was one of them, was one of the guidelines. They learned the way of the caribou. The caribou is the one that taught them how to survive. And the caribou taught them how to use whatever is on those caribou. And they gave us all the stories and the knowledge and everything to the people. … And from that they learned a lot from the caribou how to—you know, how to use whatever is being used on the caribou, like the skin, the meat and the intestine… And then they taught us to—how to take care of them. They taught us how to—not to disrespect the caribou. They taught us not to neglect the caribou or, you know, to do wrong to them. It's a good message that our people had. So with that, you know, we use every part of the caribou for survival. And so that's how we survive from way back. So I think it's a good message. And some of our people, you know, we still hang onto these stories so we can bring that to our generation for our people, for our kids to depend on the caribou." –Kenneth Frank, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "He said our ancestor, and they said that let's not stray away from their guideline, their survival and their life. And they were with the caribou, and the caribou taught them how to survive in early days. And then one of the men, he became a caribou and the caribou taught them everything about what you use on the caribou and how to survive. In return, the caribou told the human to defend him into the future for our generation, our grandchildren, and all that. So that's what that message is all about. And you know, this is a caribou message that I'm giving you. You know, it's kind of a long story with

our spirituality, but I think I'm going to end it here because it's -- with that (speaking in Gwich'in.)" – Kenneth Frank, DEIS Public Meeting, February 4, 2019, Fairbanks, AK

- "And in an educational system, the caribou is mostly used a lot with language. And the western education is interfering with our cultural values, and it's destroying the way that our young people stays on the language." –Caroline Tritt-Frank, DEIS Public Meeting, February 4, 2019, Fairbanks, AK

C.8.5 Climate Change

Commenters requested that the EIS include traditional knowledge on past and present climate change, effects on the Porcupine Caribou Herd (PCH) as well as their habitats and migration behavior. The BLM received information on many topics that informed the development of the EIS. Examples of issues that were identified through public testimony and included in the EIS for further analysis are described below:

- "This is the bow and arrow day location for Gwich'in people where the caribou travel, and that's where all the village was colonized into village because our parents got forced to build a village and put it where we can survive. Arctic Village was one place that they put Arctic Village here because the treeline was here [indicating]. And now the treeline is all the way to Brooks Range. And that's due to more climate change, which is caused by fossil fuel burning." –Sarah James, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "The taiga, this kind of forest that you see right here is called the taiga. And it's like the farthest north timber, the farthest north trees. But that's not being the case anymore. There has been more and more spruce trees, willows, shrubs all moving north. They're migrating north as the climate changes. And you know, caribou eat lichen. Here we call it caribou moss. It's lichen, and it grows about one inch every hundred years. And when you have shrubs and other kinds of trees that start growing, it shades out that moss, and that moss cannot grow. It will not regrow once the caribou have eaten it. The sea level rising we heard some people mention. It's not only the erosion problem that it's causing along the coast. The flooding that's been occurring on the coastal plains on the low-lying areas, I believe this is the third year in a row that Deadhorse has been flooding. The pipeline haul road has been shut down three times because the last three years it's been flooded out. That's climate changing. We have been seeing a lot of strange insects, new insects that we have never seen before. Especially when the caribou go more southerly, there have been incidences of ticks, big, huge ticks that get infested on them, and they can actually suck a caribou's blood until they are dead. They suck all the blood out of them." –Lance Whitwell, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "Things that are changing with the climate, of course, we have mentioned the weather getting warmer. It rains in the winter. When it rains in the winter, it forms a hard crust on the top of the snow. And as Gideon was saying, you could see -- if you are following the trails you will see the scarring on the caribous' legs because they have to push through that hard crust of ice that's on top of the snow. And as the water, the rainwater goes down into the snow to the ground layer and then refreezes as ice, the caribou can't dig through the ice to get to their food. And many of them starve. There has been many natural occurrences to where almost half of the caribou herd has died in one year, in one event. And it is still happening." –Lance Whitwell, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "The bears are coming ashore because of climate change. It's not the problems that they are getting used to us being around them. It's they don't have a habitat. They are coming ashore, and that's directly related to the oil situation. The fact that we have climate change, the oil is open -- the ocean is open, and the bears have to come to shore. So you know -- and some of it could be mitigated by the whaling captains. They took a lot of the blubber this year and threw in the ocean. That could have been food

for the bears. They could have been eating on it rather than come to town." –Robert Thompson, DEIS Public Meeting, February 5, 2019, Kaktovik, AK

- "So the impact of the plants by the global warming… we have less snow covering on the tundra, but how much impact has that occurred? … So each season we have less snow than last year, but this year we have hardly any snow. ... it impacts the food source of the animals, the caribou, all the way to the lemming. So that will impact tremendously. And those type of studies are not occurring." –Robert Suvlu, DEIS Public Meeting, February 6, 2019, Utqiagvik, Alaska
- "Polar bear has been a problem. One went as far as Fort Yukon before, and then just recently here. That's not normal. Wolf was a problem two days ago, a day ago, hearing a lot of desperate cry. They are hungry. Snow is too deep. They can't get food. They have to team up in order to get food. So that's a threat to us, to our kids that go to school, walk to school." –Sarah James, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska
- "Back when I was about five, six, seven years old, you can even hear people talking, so much noise with geese there. Now I go there, I got tears in my eyes. Barely see geese. We are losing. We are losing ducks, caribou, and less and less. Moose is getting less. Fish is pretty scary." –Macarthur Tritt, DEIS Public Meeting, February 9, 2019, Venetie, Alaska
- "As someone else had said previously, we can see the changes that are happening with our own eyes. It is more dangerous today to hunt for our traditional food than it has ever been. Our old ice has melted. When we pull a whale up after hunting, it is cracking the ice and people are falling in and dying. Our way of life I'm seeing before my eyes is changing, and I truly don't know if my children when they grow up are going to enjoy the same foods as I did growing up. I don't even know if they're going to be able to go back to Utqiagvik because it's falling into the water." –Siginiq Maupin, DEIS Public Meeting, February 11, 2019, Anchorage, AK
- "… you can see with your own eyes that the climate is changing around us. And you can see with your own eyes that we have to do something to protect access to lands, to protect the air that we breathe, to protect the salmon runs. My family has gone to the Copper River near the Canadian border every year of my life to get our salmon limit, and we weren't able to go this year because the entire salmon system was shut down. Because of the warming oceans, because of inaction on behalf of us as a society, as well as on our government to deal with this crisis that we are living in. There were not enough salmon to let people go and get the food that they -- that sustains us throughout the year." –Laura Herman, DEIS Public Meeting, February 11, 2019, Anchorage, AK

C.8.6 Cumulative Effects

A number of commenters and tribal members stated that the Draft EIS failed to address cumulative effects of climate change and oil and gas on cultural resources, including on unknown traditional land use sites/archeological sites in the Coastal Plain and the broader region of cultural landscapes significant to the Vuntut Gwich'in relationship with the PCH. The following excerpts echo this and provide specific examples of such effects.

- "Historical trauma to our people has been alluded to time and time again as systemic issues; yet the judicial system is occupied with disproportionate numbers of Alaska Natives. Missing and murdered indigenous women are at the highest where development occurs, with no database and continued disregard to their cases. And the majority of offenders are nontribal members. Alcohol and drug abuse plague our small communities. Our children fill the systems, from private and State facilities to foster care. This is the war we already face from being forced to settle time and time again for the government deals which only benefit the one percent. That's what brings me here today to talk about the attack on the Arctic coastal plain, better known as area 1002 in the Arctic National Wildlife Refuge. …. Yet there are shareholders that have already seen what they have given up for compensation checks and a promise of good health and wealth. The land that's been developed in the NPR-A will never go back to its original state. The industrial footprint left behind and the health issues that the indigenous people are left with, no money can fix." –Adrienne Blatchford, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska

- "There is harmony. We could all be in harmony, all four directions coming together to stand for water, stand for life and for that food out there that grows the land and goes through the waters that sustain our lives. They are being killed due to the oil, the gas, the coal. And we are not even able to have a good diet because we are being so driven out by your way. You bring your food to us, and that is what we have to eat. You bring us your clothing. There is no room for our traditional ways when it comes to your governments and your corporations. And I get the feeling -- you know, I wouldn't doubt there is a lot of these people getting paid for your vote. I wouldn't doubt it was one of you." –George Pletnikoff, Public Scoping Meeting, May 30, 2018, Anchorage, Alaska

C.8.7 Public Health and Safety

Finally, a number of written and oral comments expressed concerns that the Draft EIS failed to adequately consider impacts of the program on public health and safety and provided accounts of such impacts within the tribes.

- "The other thing I want to talk about is the community and public health. I used to work up north for, like, four years working in the clinic. As itinerary travel from village to village, I see a lot of health issues, the health issues that we don't even have in our community. I see patients with respiration problem. I see people with mental health problem that we don't have. I asked that question to one of the elders up there. She said before the oil company came, we had a healthy life, but now look around. As far as you could see, it's just all you could see is oil rigs everywhere. And she said, this is what happened. My husband died of cancer. And my kids, my grandkids have mental health problems. And she said, all these are created when the oil company came. " –Myra Thumma, Public Scoping Meeting, May 24, 2018, Arctic Village, AK
- "Like many others, I have experienced severe health issues without the access to regular balanced traditional diet. Science again proves that our DNA demands high protein and high-fat foods to sustain our bodies that keep us in these harsh conditions. For the Gwich'in, 60 percent of their diet is the caribou. Development in this coastal plain would not only cause cultural genocide, but also elimination of food security." –Ben Stevens, Public Scoping Meeting, May 29, 2018, Fairbanks, AK
- "You know, since the Air Force has been here, I mean, for the last, what, 70 years or so, I mean, we have seen an uprise in cancer. And you know, I mean, they dumped drums and stuff. We have no idea what they are. And on our beaches, on our shores, they displaced our village numerous times, no apologies, no, you know, I'm sorry, no reparations. But we live with that. We have thrived through that." –Charles Lampe, Public Scoping Meeting, June 12, 2018, Kaktovik, AK
- "…. I thought we going to have better life, but in the last 30 years, you should see the graveyard in every community. It's bigger and bigger because of the alcohol, drugs and alcohol, something that's not good for the Athabascan people, not only here, but all over Alaska, Native people, more crimes and all that. A lot of them been lost with alcohol. Some of the village we losing that populations near the pipeline, like down Stevens Village and all that. I hope they come home someday to have a good life." –Trimble Gilbert, Public Scoping Meeting, June 12, 2018, Venetie, AK

- "And during my period of 58 years living in Alaska, during my younger years, I barely seen any sickness. But from the start -- from beginning of the pipeline, more sickness came into our community. And it's unstoppable because everything came to our village that's made out of oil. Also the animal. I see animal that are -- they are not healthy anymore. And the animal numbers are going down. And continually I'm stuck in the middle of everything, in between both cultures. And with the oil—with the big oil company, all the disease came with it. Like alcohol, drugs. All those -- of that came from Lower 48 when the oil companies started the big oil boom back in the '70s. In the '70s, everything came with it." –Ricky Frank, DEIS Public Meeting, February 4, 2019, Fairbanks, AK
- "I don't know if you gentlemen are aware that we now have the highest rates of suicide, highest ever. I know a 14-year-old boy that just committed suicide in St. Michaels. To me it's -- we are going down the wrong path. …we have been marked needing immediate relocation. The Army Corps of Engineers have -- we are highly vulnerable now more than ever because our -- one more storm like we had in 1964, and the water -- our drinking water will be contaminated." –Sara Thomas, DEIS Public Meeting, February 6, 2019, Utqiagvik, Alaska
- "Ever since 1977, July of 1977 when the first oil flow, they were pumping 2.5 million gallons or barrels a day for 30 years. And it's been 32 years since we have our gathering to oppose oil development. And I still stand by our tribe member and our tribe member in Canada. They oppose oil development. The elders that have been deceased, that's why I come standing here. I still support my leaders in the past. They oppose oil development, and I still do. The main vegetation in the winter is the lichen. The main vegetation that the caribou eat during the wintertime, the lichen, is the one that the nuclear particles -- radioisotope, they call it, it detects -- the lichen detect the radioactive material, and it goes down the food chain. I hate to tell my people that, but it's very, very, very dangerous. Just like a half life of 28 years on plutonium 360. Strontium 90, they give you half life of 28 years. Our people in the past from Old Crow, our next community down, I see people die from it. But I'm just one person. I'm trying to understand what's going on. And it really don't look good." –Edward Sam, DEIS Public Meeting, February 9, 2019, Arctic Village, Alaska
- In my village, we are surrounded and engulfed by methane flaring, something that is heavily restricted in the Lower 48, but not as restricted here. We have had a 50 percent and higher amount of respiratory illnesses grow in Nuiqsut since the oil fields have been built. The air is so dirty there that people are forced to move out and move to Anchorage and Fairbanks because they literally can't breathe. We have children with asthma. We have had two children in a 500-population town diagnosed with leukemia. We have cancer clusters growing everywhere." –Siginiq Maupin, DEIS Public Meeting, February 11, 2019, Anchorage, AK
- "I stand here today in honor of those missing and murdered indigenous women whose lives were cut short because of all of this that has come into our land. I stand here today to all of the -- to honor all of the people that have died of cancer and autoimmune diseases inflicted upon them because of this desecration of our land." –Adrienne Aakaluk Titus, DEIS Public Meeting, February 11, 2019, Anchorage, AK
- "All right. What I'm trying to tell you is that suicide rate has a lot to do with confidence. And in order for you guys to help us build confidence, take a step back and let some Natives get in these positions that you are sitting in. I promise you that. One thing -- yeah, Anchorage -- there is one thing that is very highlighted about Anchorage. It's diverse. We are always, yeah Anchorage is so diverse. It's not in the political realm. It's not diverse where people are making decisions. You see that?... So I'm just letting you know what you are doing here today does perpetuate suicide. It does. You are sitting in here making decisions for us. You see that? Making decisions for indigenous people. I'm not -- I'm

not okay with that. I'm glad my daughters aren't here today. I'm glad they are not in this building right now because I wouldn't want them to see this. I want them to have some confidence in themself. I want them to see some Alaska Natives up there on the stage with you guys, but it's not. Everybody see that? There are no Alaska Natives on the stage right now talking about indigenous land." –Samuel H. Johns, DEIS Public Meeting, February 11, 2019, Anchorage, AK

C.9 LIST OF PREPARERS

The following individuals participated in preparing this EIS. The list includes each individual's agency and role in the EIS.

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Appendix D
Laws and Regulations

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ACRONYMS AND ABBREVIATIONS

Acronym	Full Phrase
AAS	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ANILCA	Alaska National Interest Lands Conservation Act of 1980
ANS	aquatic nuisance species
APDES	Alaska Pollutant Discharge Elimination System
Arctic Refuge	Arctic National Wildlife Refuge
AS	Alaska Statute
BLM	Bureau of Land Management
CAA	Clean Air Act
CFR	Code of Federal Regulations
Coastal Plain	Public Law 115-97 Coastal Plain
CWA	Clean Water Act
EIA	Energy Information Administration
EIS	environmental impact statement
EO	Executive Order
EOR	enhanced oil recovery
EPA	Environmental Protection Agency
ESA	Endangered Species Act
I-I Agreement	Inuvialuit-Iñupiat Polar Bear Management Agreement
Leasing EIS	Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NISA	National Invasive Species Act
NMFS	National Marine Fisheries Service
NSB	North Slope Borough
PCH	Porcupine Caribou Herd
PL	Public Law
SHPO	State Historic Preservation Officer
US	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	United States Fish and Wildlife Service

Appendix D. Laws and Regulations

Requirements of international agreements, federal, state, and local laws and regulations, and executive orders associated with future development in the Coastal Plain are provided below.

D.1 International Agreements

D.1.1 International Porcupine Caribou Herd Agreement

In 1987, the United States (US) and Canadian governments signed the Agreement between the Government of the United States of America and the Government of Canada on the Conservation of the Porcupine Caribou Herd. This bilateral agreement recognizes that the Porcupine caribou herd (PCH) regularly migrates across the international boundary between Canada and the United States. It further recognizes that the herd should be conserved according to ecological principles that emphasize the importance of conserving habitat, including calving, post-calving, migrating, wintering, and seeking insect relief habitat.

The main objectives of the agreement are to conserve the PCH and its habitat through international cooperation and coordination so that the risk of irreversible damage or long-term adverse effects, including cumulative effects, as a result of use of caribou or their habitat is minimized. It also ensures opportunities for customary and traditional uses of the PCH. The agreement set up the International Porcupine Caribou Board, composed of representatives from both countries, who give advice and recommendations to the countries on the conservation and management of the herd. The International Porcupine Caribou Board, in turn, set up the Porcupine Caribou Technical Committee, composed of biologists from each country, to advise them in their recommendations. This agreement was signed by the US on July 17, 1987, in Ottawa, Canada, and entered into force in this country at that time.

D.1.2 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 US. It recognizes the responsibilities of circumpolar countries for coordinating actions to protect polar bears. The agreement prohibits hunting, killing, and capturing polar bears, except for bona fide scientific and conservation purposes, preventing serious disturbance to the management of other living resources, and by local people under traditional rights. 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 US on November 15, 1973, in Oslo, Norway; it was ratified on September 30, 1976, and went into force in this country on November 1, 1976.

D.1.3 Inuvialuit-Iñupiat Polar Bear Management Agreement (I–I 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 I–I Agreement is a voluntary user-to-user agreement between Inuvialuit (in Canada) and Iñupiat (in Alaska) hunters. It provides for annual quotas, hunting seasons, protection of polar bears in or during construction of dens, females accompanied by cubs-of-the-year and yearlings, collection of information and specimens to monitor harvest composition, and annual meetings to exchange information on the harvest, research, and management. The I-I also establishes a joint commission to implement the I-I Agreement, and a technical advisory committee, consisting of biologists from agencies in the US and Canada involved in research and management. Their function is to collect and evaluate scientific data and make recommendations to the joint commission.

D.1.4 Memorandum of Understanding for the Conservation and Management of Shared Polar Bear Populations

In 2008, the US and Canada signed a Memorandum of Understanding (MOU) to facilitate and enhance coordination, cooperation and development of partnerships around the conservation and management of polar bears. The two countries share management responsibilities for the Southern Beaufort Sea polar bear population, and indigenous peoples from both countries have harvesting rights. The agreement provides a framework for the development and implementation of mutually agreeable immediate, intermediate and long-term actions that focus on specific components of polar bear conservation. The MOU established a Bilateral Oversight Group whose function is to achieve enhanced, collaborative action on polar bear management and conservation.

D.2 FEDERAL LAWS AND REGULATIONS

The following summarizes federal laws and regulations relevant to the oil and gas leasing program in the Coastal Plain. Some obligations would be placed directly on the applicant. Others would be required of federal agencies before they would grant authorizations to oil and gas companies.

D.2.1 Bureau of Land Management (BLM)

- The National Environmental Policy Act of 1969 (NEPA) sets out policy and provides the means by which the federal government, including the 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 (EIS) (42 United States Code [USC] 4321 et seq.).
- Section 28 of the Mineral Leasing Act of 1920 (30 USC 185; 43 Code of Federal Regulations [CFR] 2880), provides the BLM with the authority to issue right-of-way grants for oil and natural gas pipelines and related facilities (not authorized by appropriate leases).
- Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) 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 USC 3120).
- The Tax Cuts and Jobs Act of 2017 (Section 20001(c)(1) of Public Law [PL] 115-97, December 22, 2017) directs the Secretary of the Interior, acting through the BLM, to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain in the Arctic National Wildlife Refuge (Arctic Refuge). PL 115-97 amends ANILCA Section 1003 to authorize oil and gas leasing in the Coastal Plain and authorizes the BLM to issue rights-of-way or easements across the Coastal Plain for the exploration, development, production, or transportation necessary to carry out the oil and gas leasing program.
- The BLM issues geophysical permits to conduct seismic activities, as described in 43 CFR 3150.
- Applications for transportation and utility systems in conservation system units are processed under ANILCA Title XI.
- The BLM reviews and approves applications for permit to drill (including drilling plans and surface-use plans of operations) and subsequent well operations, as prescribed in 43 CFR 3160, for development and production on federal leases.

- As described in 43 CFR 3130 and 3180, 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.
- Section 106 of the National Historic Preservation Act (54 USC 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 include the Antiquities Act of 1906 (54 USC 320301 et seq.), the American Indian Religious Freedom Act (42 USC 1996), the Archaeological Resources Protection Act (ARPA) (16 USC 470aa et seq.), the Abandoned Shipwreck Act of 1987 (43 USC 2101 et seq.), and Executive Order 13007 (Indian Sacred Sites).
- Under the Endangered Species Act the BLM consults with the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) regarding the effects of its actions on threatened and endangered species and designated critical habitat, and conferences on species proposed for listing.
- Under the Magnuson-Stevens Fishery Conservation and Management Act, the BLM conducts an essential fish habitat consultation with NMFS regarding authorized, funded, or undertaken actions that may adversely affect essential fish habitat.
- The BLM would ensure that all identified archaeological resources are protected, consistent with the ARPA to ensure there is no "[u]nauthorized excavation, removal, damage, alteration, or defacement of archaeological resources."
- The BLM disposes of mineral materials pursuant to the Materials Act of 1947 and 43 CFR 3600.

D.2.2 US Fish and Wildlife Service

- The USFWS manages the Arctic Refuge, as defined under Section 303(2) of ANILCA, which establishes the Arctic Refuge and additions as part of the National Wildlife Refuge System. The purposes for which the Arctic Refuge is established and is managed are as follows: (i) to conserve fish and wildlife populations and habitats; (ii) to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats; (iii) to provide, in a manner consistent with the purposes set forth above in (i) and (ii), the opportunity for continued subsistence uses by local residents; and (iv) to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in (i), water quality and necessary water quantity win the refuge. PL 115-97 amended Section 303(2)(B) of ANILCA to add as a purpose of the Arctic Refuge "to provide for an oil and gas program on the Coastal Plain."
- The mission of the National Wildlife Refuge System Administration Act, as amended through the National Wildlife Refuge Improvement Act, is "to administer a network of lands and waters for the conservation, management and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." Under the National Wildlife Refuge System Administration Act, each refuge shall adhere to the mission of the National Wildlife Refuge System. The USFWS is required to monitor the status and trends of fish, wildlife, and plants in each refuge.
- The Endangered Species Act (ESA); (Section 7(a)(I)) "requires federal agencies, in consultation with and with the assistance of the Secretary, to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species." All federal agencies shall, in consultation with and with the assistance of the Secretary of the Interior or Commerce (Secretary), ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species 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 USC 1538) of the ESA identifies prohibited acts related to endangered species and prohibits all persons, including all federal, state, and local government employees, from taking listed species of fish and wildlife, except as specified under provisions for exemption (16 USC 1535(g)(2) and 1539). Generally, the USFWS manages land and freshwater species, while NMFS manages marine species, including anadromous salmon; however, the USFWS is responsible for some marine animals, such as nesting sea turtles, walrus, polar bears, sea otters, and manatees.

- The National Invasive Species Act (Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (as amended through the National Invasive Species Act [NISA])—The NISA mandates the USFWS to lead national efforts to prevent the spread of aquatic invasive species. The NISA furthered aquatic nuisance species (ANS) activities by calling for ballast water regulations, the development of state management plans and regional panels to combat the spread of ANS, and additional ANS outreach and research. Section 1204 of the NISA authorizes the ANS Task Force to provide funding to states that have an ANS management plan. It established the ANS Task Force to coordinate nationwide ANS activities.
- All marine mammals are protected under the Marine Mammal Protection Act of 1972 (MMPA) (16 USC 1361 et seq.). Jurisdiction of the MMPA is shared by NMFS and the USFWS, depending on the species being considered. Under the MMPA, the taking of marine mammals without a permit or exception is prohibited. "Take" under the MMPA, 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]." The USFWS may authorize the incidental take of small numbers of marine mammals of a species or stock only if such take would have a negligible impact on a species or stock and would not have an unmitigable adverse impact on the availability of such species or stock for subsistence purposes.
- The Migratory Bird Treaty Act (16 USC 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 prohibits taking eagles, including their parts, nests, or eggs. The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." "Disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, I) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. If a project may result in take, and after avoidance and minimization measures are established, the USFWS may issue an eagle take permit.
- The Fish and Wildlife Coordination Act provides one of the basic legal authorities for assessing the impacts on fish and wildlife resources at water resource development projects. Under the act, any public or private agency under federal permit or license to modify or control for any purpose any stream or other water body is required to consult with the USFWS to conserve wildlife resources by preventing loss of and damage to such resources. Wildlife resources is explicitly defined to include

birds, fishes, mammals, and all other classes of wild animals and types of aquatic and land vegetation that wildlife depend on. Further, the act states that reports that determine the possible damage to wildlife resources and estimates wildlife loss "shall be made an integral part of any report prepared or submitted by any agency with the authority to authorize" water projects (16 USC 662 (b),(0)).

- Native American Graves Protection and Repatriation Act (25 USC 3001-3013) requires the USFWS to plan for and facilitate the return of human remains, funerary objects, sacred objects, and objects of cultural patrimony to lineal descendants and culturally affiliated Alaska Native tribes.

D.2.3 Environmental Protection Agency (EPA)

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

- Under Section 402 of the CWA (33 USC 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 US for facilities, including oil and gas, operating within state jurisdiction. Point-source discharges that require an Alaska Pollutant Discharge Elimination System (APDES) 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 US 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 (42 USC 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 cover injection of nonhazardous and hazardous waste through a permitting process for fluids that are recovered from down hole. Also covered are municipal waste, stormwater, and other fluids that did 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, which 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).

- Under Section 311 of the CWA, as amended (33 USC 1321, 40 CFR 112), the EPA requires a "spill prevention containment and countermeasure plan" for storage of 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 USC 40; FRP Rule; 40 CFR 112, Subpart D, Sections 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 USC 7475) and 502 of the CAA (42 USC 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 maintains oversight authority of the State's program.
- Under Section 309 of the CAA (42 USC 7609), the EPA requires a review and evaluation of the draft and final EIS for compliance with Council on Environmental Quality guidelines.
- The EPA retains oversight authority over the APDES program.

D.2.4 National Marine Fisheries Service

NMFS is responsible for the stewardship of national marine resources. The agency conserves and manages fisheries to promote sustainability and prevent lost economic potential associated with overfishing, declining species, and degraded habitats.

- Provides consultation under the ESA, Section 7(a)(2) on the effects on threatened or endangered species.
- Provides consultation under the Fish and Wildlife Coordination Act on the effects on fish and wildlife resources.
- Provides consultation under the MMPA on the effects on marine mammals; issues Incidental Harassment Authorization under the MMPA for incidental takes of protected marine mammals (bowhead whales and ringed seals).
- Provides consultation under the Magnuson-Stevens Fishery Conservation and Management Act 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 US 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 US, including wetlands, and for work or structures in, on, over, or under navigable waters of the US. These USACE authorities are set forth as follows.

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

D.2.6 Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management provided subject matter expertise in the drafting and review of this NEPA document 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 (EO) 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 EOs may apply, as follows: EOs 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), 13112 (invasive species control), and 13751 (safeguarding against invasive species).

D.4 STATE OF ALASKA

The State issues several permits associated with oil and gas activities. The Alaska Department of Natural Resources issues temporary water use and water rights permits, permits for cultural resource surveys, cultural resource concurrences, 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 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 plan for exploration and development. Additional State authorities are presented below.

D.4.1 Alaska Department of Natural Resources

- Issues rights-of-way and land use permits for use of State land, ice road construction on State land, and State freshwater bodies under Alaska Statute (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 Alaska cultural resource permits for surveys under the Alaska Historic Preservation Act (AS 41.35.080).
- Issues cultural resources concurrences for development on State land (but not on federally managed land) that may affect historic or archaeological sites under the National Historic Preservation Act of 1966 (54 USC 300301 et seq.), and the Alaska Historic Preservation Act (AS 41.35.010 through .240).
- Adjudicates instream flow reservations and other applications for reserved water rights under AS 46.15.145, Reservation of Water; permissible in-stream uses are 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 State Historic Preservation Officer (SHPO). Section 106 of the National Historic Preservation Act requires federal agencies to avoid or minimize impacts on properties listed on or eligible for listing on the National Historic Preservation Act by requiring federal agencies to identify sites that may be affected and determine their eligibility to be listed. This consultation is done through the SHPO.

D.4.2 Alaska Department of Environmental Conservation

- Issues an APDES “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 USC 1342); AS 46.03.020, .100, .110, .120, and .710; 18 Alaska Administrative Code (AAC) Chapters 15 and 70, and Section 72.500; these permits may include a mixing zone approval where appropriate; in addition to developing, issuing, modifying, and renewing permits, the APDES program includes the Storm Water Program, Compliance and Enforcement, Federal Facilities, and the Pretreatment Program.

- Issues a certificate of reasonable assurance for permits issues by the USACE under Section 404 of the CWA; these permits may include discharge of dredge and fill material into Waters of the US.
- Issues a Class I well wastewater disposal permit for underground injection of non-domestic wastewater under AS 46.03.020, .050, and .100.
- Reviews and approves all public water systems, including plans, monitoring programs, and operator certifications under AS 46.03.020, .050, .070, and .720, 18 AAC, Section 80.005.
- Approves domestic wastewater collection, treatment, and disposal plans for domestic wastewaters (18 AAC, Chapter 72).
- Approves financial responsibility for cleanup of oil spills (18 AAC, Chapter 75).
- Reviews and approves the "oil discharge prevention and contingency plan" 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, Chapter 75; The State review applies to oil exploration and production facilities, crude oil pipelines, oil terminals, tank vessels and barges, and certain non-tank vessels.
- Issues 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 Chapter 50).
- Issues solid waste disposal permits for State lands under AS 46.03.010, 020, 100, and 110; AS 46.06.080; 18 AAC Section 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, 010, and 020 and 18 AAC, Section 60.430.
- Approves the siting of hazardous waste management facilities.

D.4.3 Alaska Department of Fish and Game

- AS 16.05.841—The Fishway Act, deals exclusively with fish passage; applies to streams with documented resident fish use and without documented use by anadromous fish.
- AS 16.05.871—The Anadromous Fish Act, 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.
- AS 16.05.841 and AS 16.05.871—Issues "fish habitat permits" for activities in streams used by fish that the agency determines could represent impediments to fish passage or for travel in, excavation of, or culverting of anadromous fish streams.
- Issues public safety permit 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 Resource or, via the Fish and Wildlife Coordination Act, to federal permitting agencies.

D.4.4 Alaska Oil and Gas Conservation Commission

- Issues permits to drill under 20 AAC Section 25.05.

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

D.4.5 Alaska Department of Public Safety

- Fire marshal approval.

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

ANILCA Section 810 Final Evaluation

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Appendix E. ANILCA Section 810 Final Evaluation

E.1 Subsistence Evaluation Factors

Section 810(a) of the Alaska National Interest Lands Conservation Act (ANILCA), 16 United States Code (USC) 3120(a), requires that an evaluation of subsistence uses and needs be completed for any federal determination to "withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands." As such, an evaluation of potential impacts on subsistence under ANILCA Section 810(a) must be completed for the Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS or EIS). ANILCA requires that this evaluation include findings on three specific issues, as follows:

- The effect of use, occupancy, or disposition of public lands on subsistence uses and needs
- The availability of other lands for the purposes sought to be achieved
- Other alternatives that would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes

Per Bureau of Land Management (BLM) Instruction Memorandum No. AK-2011-008 (BLM 2011), three factors are considered when determining if a significant restriction of subsistence uses and needs may result from the proposed action, alternatives, or in the cumulative case, as follows:

- Reduction in the *abundance* of harvestable resources used for subsistence purposes
- Reduction in the *availability* of resources used for subsistence caused by alteration of their distribution, migration patterns, or location
- Legal or physical limitations on *access* of subsistence users to harvestable resources

Each alternative must be analyzed according to these criteria. ANILCA Section 810 also requires that cumulative impacts be analyzed. This approach helps the reader separate subsistence restrictions that could be caused by activities proposed under the five alternatives from those that could be caused by past, present, or future activities that have occurred or could occur in the surrounding area.

An alternative would be considered to significantly restrict subsistence uses if, after consideration of protection measures, such as lease stipulations or required operating procedures, it can be expected to substantially reduce the opportunity to use subsistence resources (BLM 2011). Substantial reductions are generally 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.

If the analysis determines that the proposed action, alternatives, or the cumulative case may significantly restrict subsistence uses, the BLM is required to notify the State of Alaska and appropriate regional and local subsistence committees. It also must conduct ANILCA Section 810 hearings in potentially affected communities.

It is possible that the finding may be revised to "will not significantly restrict subsistence uses" based on changes to alternatives, new information, or new mitigation measures resulting from the hearings. If the significant restriction remains, the BLM may prohibit the action or finalize the evaluation by making the following determinations:

- A significant restriction of subsistence uses would be necessary, consistent with sound management principles for the use of public lands
- The proposed activity would involve the minimal amount of public land necessary to accomplish the purpose of the use, occupancy, or other disposition
- Reasonable steps would be taken to minimize adverse effects on subsistence uses and resources resulting from such actions (Section 810(a)(3))

The BLM can then authorize use of the public lands.

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

This ANILCA Section 810 evaluation relies primarily on the information contained in the Leasing EIS. **Chapter 3** describes areas and resources important for subsistence, and specific communities' degree of dependence on various fish and wildlife resources. It also describes the environmental consequences anticipated under each alternative, which the BLM uses to determine whether each alternative and the cumulative case would cause a significant restriction to subsistence uses. Consistent with NEPA and Council on Environmental Quality (CEQ) guidance, this evaluation does not analyze or present impacts under a worst-case scenario. Rather, it discusses impacts under each alternative based on the assumptions and discussion in the hypothetical development scenario (**Appendix B**).

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of Public Law (PL) 115-97 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, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases 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 Coastal Plain. Therefore, the analysis in Chapter 3 is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.

The Leasing EIS uses a hypothetical development scenario (see **Appendix B**) to inform the impact analysis for each alternative; however, additional National Environmental Policy Act (NEPA) and ANILCA Section 810 analyses would occur with future project-specific proposals. The regulations governing leasing and development provide for multiple decision stages prior to any ground-disturbing activities being authorized and require further compliance with applicable laws, including NEPA, during post-leasing decision stages. Until the BLM receives and evaluates an application for an exploration permit, permit to drill, or other authorization that includes site-specific information about a particular project, impacts of actual exploration and development that might follow lease issuance are speculative, as so much is unknown as to location, scope, scale, and timing of that exploration and development. At each decision stage, the BLM retains the authority to approve, deny, or reasonably condition any proposed on the ground-disturbing activity based on compliance with applicable laws and policies. Therefore, the analysis of effects of exploration and development in the Leasing EIS, including this ANILCA 810 evaluation, necessarily reflects a more general, programmatic approach than could occur at the post-lease project-specific stage.

The EIS summarizes the relevant subsistence activities of communities that use the program area or the resources that migrate through the program area and are harvested elsewhere. Consistent with the EIS, this evaluation focuses on subsistence impacts to four communities: Kaktovik, Nuiqsut, Arctic Village, and

Venetie. They are the closest to the program area and have subsistence uses in or near the program area or rely heavily on resources that use the program area.

In addition, because of the importance of the program area to caribou-particularly the PCH and CAH – relevant data on subsistence uses of caribou by 22 Alaskan communities, including the four subsistence study communities listed above is also included in the EIS.

The EIS recognizes that the Gwich'in people, Inuvialuit, and other user groups in Canada have cultural, historical, and subsistence ties to the Arctic Refuge or the PCH or both; however, Section 810 of ANILCA only applies to subsistence uses by rural Alaska residents, per the definition of "subsistence uses" in Section 803 of ANILCA. More information regarding subsistence impacts affecting Canadian communities and user groups can be found in **Section 3.4.3**, Subsistence Uses and Resources.

Kaktovik and Nuiqsut engage in subsistence activities in and around the program area. Kaktovik uses the program area to procure most of the resources they harvest (**Map 3-28** through **Map 3-39** in **Appendix A**). Nuiqsut's marine mammal and furbearer use areas overlap the program area (**Map 3-40** through **Map 3-43** in **Appendix A**). Arctic Village and Venetie subsistence use areas do not overlap the program area, but these communities rely heavily on resources that use the program area, specifically caribou from the Porcupine Caribou Herd (PCH) (**Map 3-44** in **Appendix A**).

While the EIS describes potential impacts to subsistence use of all resources, this evaluation focuses on impacts to subsistence use of fish, marine mammals (bowhead and beluga whales, bearded seals), and caribou. Other resources such as waterfowl, polar bears, and furbearers may be culturally important to residents of these communities, but they do not comprise the majority of the wild foods consumed by residents of Kaktovik, Nuiqsut, Arctic Village, or Venetie (**Section 3.4.3**, Subsistence Uses and Resources). Residents of Kaktovik and Nuiqsut rely most heavily on fish, marine mammals, and caribou. Combined, these resources make up 98 percent of the harvest for Kaktovik and 97 percent of the harvest for Nuiqsut (**Tables 3-32** and **3-33** in **Chapter 3**). Fish and large mammals (caribou and moose) make up 86 percent of the harvest for Venetie (**Table 3-35** in **Chapter 3**). Nineteen percent of Venetie's annual harvest is caribou, although they receive appreciably more through sharing with other communities (Van Lanen et al. 2012; Kofinas et al. 2016). Detailed harvest data for Arctic Village is not available but it is likely similar to the harvest documented for Venetie.

In addition to Kaktovik, Nuiqsut, Arctic Village, and Venetie, 18 communities have positive customary and traditional use determinations for the PCH and/or the Central Arctic Herd (CAH) (**Map 3-27**, Subsistence Study Communities, in **Appendix A**). These 22 communities, referred to in the EIS as the caribou study communities, could be affected by impacts on caribou abundance and availability, and were therefore included in **Chapter 3**. Those communities with the greatest reliance (where caribou accounts for greater than 10 percent of the annual subsistence harvest, and on average over 50 percent of households use caribou) include Alatna, Anaktuvuk Pass, Bettles, Coldfoot, Eagle, Kaktovik, Nuiqsut, Point Lay, Utqiagvik, Venetie, Wainwright, Wiseman, and likely Arctic Village (although detailed harvest data is not available for this community). Alatna, Bettles, Point Lay, Utqiagvik and Wainwright harvest caribou primarily from the Western Arctic Herd, and Eagle harvests caribou primarily from the Fortymile Herd. These herds would not be impacted by development in the program area. Coldfoot, and Wiseman harvest primarily CAH caribou. The majority of Nuiqsut's harvest consists of Teshekpuk Lake Caribou Herd animals, although Nuiqsut also harvests caribou from the CAH. Anaktuvuk Pass harvests a combination of Western Arctic, Teshekpuk Lake, and CAH caribou. Teshekpuk Lake caribou would not be impacted by future oil and gas exploration, development, and production activities in the program area, and potential impacts on CAH caribou are expected to be low for Alternatives B, C, D1, and D2. Kaktovik, Arctic Village and Venetie rely heavily on PCH caribou. Therefore, Kaktovik, Arctic Village, and Venetie are the only communities that may be appreciably affected by changes in the abundance or availability of PCH caribou. For these reasons, caribou-related discussion in this evaluation focuses exclusively on impacts on the PCH caribou from future on-the-ground activities and consequent impacts on subsistence use of them by these three communities.

E.2.1 Evaluation and Finding for Alternative A: No Action

Alternative A would not comply with the directive in Section 20001 of PL 115-97 to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Arctic Refuge Coastal Plain. There would be no oil and gas lease sales in the program area. Current management actions and resource trends would continue in the program area, as described in the Arctic Refuge Revised Comprehensive Conservation Plan (CCP) (USFWS 2015). Existing impacts on subsistence uses and resources, described in **Section 3.4.3**, Subsistence Uses and Resources, would continue along current trends.

E.2.1.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

The United States (US) Fish and Wildlife Service (USFWS) determined that the preferred alternative selected in the Record of Decision (ROD) for the Arctic Refuge Revised CCP (USFWS 2015) and subsequent cumulative effects would not significantly restrict subsistence use of resources in the program area.

E.2.1.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Alternative A does not propose the disposition or use of public lands with regard to the proposed action; therefore, evaluating the availability of other lands is not applicable.

E.2.1.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Alternative A would eliminate the use of public lands needed for subsistence purposes, but it does not meet the purpose of the proposed action, nor does it comply with PL 115-97.

E.2.1.4 Findings

Alternative A will not result in a significant restriction in subsistence uses. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.2 Evaluation and Finding for Alternative B

Section B.8.2, Alternative B in **Appendix B**, speculates up to four central processing facilities (CPFs) would be built under Alternative B: two CPFs would be built in the high potential area, one CPF would be built in the medium potential area on State or native lands, or just south of Kaktovik, and one CPF would be built in the low potential area. Under this scenario, four CPFs and associated airstrips, 14 satellite pads, 174 miles of road, a seawater treatment plant, and at least one barge landing and storage pad would be built. The 2,000-acre surface disturbance limit would be reached under Alternative B.

The hypothetical development scenario anticipates that future development would occur in the same manner as the baseline scenario described in **Appendix B** under Alternative B. The entire Coastal Plain would be offered for lease sale. Compared to the other action alternatives, this alternative has the largest amount of acres where only Required Operating Procedures (ROPs) would apply (**Table 2-1** in **Chapter 2**). Approximately 359,400 acres would be subject to a no surface occupancy (NSO) stipulation to protect caribou calving habitat, fish and hydrologic resources, and subsistence activities adjacent to major rivers. There would be zero acres subject to controlled surface use (CSU), and 585,400 acres would be subject to timing limitations (TLs). While the 46 ROPs apply to the entire program area, approximately 618,700 acres would be subject to ROPs only. **Map 2-1**, Alternative B and **Map 2-2**, Alternative B, Lease Stipulations (**Appendix A**) illustrate where NSO and TLs would be adopted.

E.2.2.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

This evaluation summarizes potential impacts on major subsistence resources (fish, marine mammals, and caribou) for residents of Kaktovik, Nuiqsut, Arctic Village, and Venetie before a discussion of other issues, such as impacts on resource access anticipated under Alternative B. **Table E-2** classifies each impact as minor, moderate, or major, based on the discussion in the EIS and BLM policy guidance (BLM 2011). **Table E-3** summarizes the extent to which impacts on access would affect subsistence users.

Fish

Section 3.3.2, Fish and Aquatic Species, describes potential impacts on non-salmon fish (primarily Dolly Varden and Bering cisco), which are important subsistence resources for residents of Kaktovik (**Table 3-32**). Impacts from future oil and gas exploration, development, and production that may affect subsistence harvest of non-salmon fish are as follows:

- Habitat loss or alteration
- Disturbance or displacement
- Injury or mortality due to noise, entrainment, or contaminants

Select streams listed in **Chapter 2** would have 0.5- to 1-mile setbacks for surface development under Alternative B; all other fish-bearing streams would have a 500-foot setback, and all of the nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea (within the boundary of the Arctic Refuge) would be subject to NSO. In addition, an impact and conflict avoidance and monitoring plan to assess, minimize and mitigate the effects of infrastructure on coastal habitats would be required. Numerous mitigation measures would be implemented to address impacts on fish and fish habitat, namely Lease Stipulations 1, 3, 4, and 9, and ROPs 3, 8, 9, 12, 13, 14, 15, 16, 18, 19, 20, 22, 24, 40, and 41. While potential impacts on fish would be most pronounced under this alternative, it is likely that the proposed mitigation measures would effectively reduce impacts on fish that are important to residents of Kaktovik. Dolly Varden or Bering cisco abundance or availability would not likely be affected to the extent that subsistence use of these fish would be significantly impaired.

Marine Mammals

Section 3.3.5, Marine Mammals, describes potential impacts on bowhead whales and ringed/bearded seals, which are important subsistence resources for residents of Kaktovik and Nuiqsut (**Tables 3-32** and **3-33**). Impacts from future oil and gas exploration, development, and production that may affect subsistence harvest of marine mammals are mortality or injury due to vessel strikes and disturbance or displacement due to vessel traffic or noise and activity associated with onshore infrastructure.

Whales and seals could be injured or killed by vessel strikes, although such events would be highly unlikely. Collisions with whales are rare for slow-moving vessels such as barges, and ringed/bearded seals are able to avoid oncoming vessels (George et al. 1994; Laist et al. 2001). There is no indication that vessel strikes would be a major source of mortality for whales or bearded/ringed seals during marine transport associated with future on-the-ground activities in the program area.

Large vessel traffic in the vicinity of Kaktovik could temporarily disturb or displace whales or bearded/ringed seals. These animals demonstrate habituation to noise and activity associated with vessel traffic and onshore infrastructure when disturbance does not result in physical injury, discomfort, or social stress (NRC 2003). This impact would not have population-level effects, and ROP 46 is designed to minimize impacts on marine mammals from vessel traffic.

Potential impacts on marine mammals important for subsistence would be minor or effectively mitigated under Alternative B. Specifically, Lease Stipulation 4 would require NSO in nearshore marine, lagoon and barrier island habitats, Lease Stipulation 9 would require that lessees implement a conflict avoidance and monitoring plan for coastal areas. In addition, ROPs that would apply under Alternative B would sufficiently mitigate residual impacts to subsistence use of bowhead whales and seals by residents of Kaktovik and Nuiqsut.

Caribou

Table 3-19 lists potential impacts on terrestrial mammals, including caribou. Impacts from future oil and gas exploration, development, and production that may affect subsistence use of caribou are as follows:

- Displacement of maternal caribou during calving
- Habitat loss or alteration
- Mortality or injury due to vehicle collisions
- Altered movement patterns due to linear infrastructure
- Altered caribou behavior due to aircraft traffic and development activities

Displacement of maternal caribou during calving was one of the primary issues raised during scoping and in comments on the Draft EIS. Oil and gas development on the Coastal Plain of the Arctic Refuge and its potential impact on the PCH calving grounds has been the subject of much discussion for decades. As a result, PCH habitat, movement, and population dynamics have been well studied. Studies on the CAH and others have shown that maternal caribou with young calves would avoid infrastructure by about 2.49 miles (Dau and Cameron 1986; Cameron et al. 1992; Lawhead et al. 2004). The literature generally suggests that calving would most likely shift to the east or southeast if displacement of maternal caribou occurs during the calving season (Griffith et al. 2002). This could result in reduced calf survival, as areas east of the program area are characterized by suboptimal forage and, as a result, higher calf mortality and lower pregnancy rates (Russell et al. 1996). These areas also have higher predation rates, which contributes to higher calf mortality (Young et al. 2002).

The likelihood or extent to which impacts to PCH caribou abundance could occur depends largely on the extent of surface development associated with future on-the-ground activities happening within important calving grounds. Although calving can occur throughout the program area, the EIS defines the most important calving grounds as the high-use PCH calving area (area used in greater than 40 percent of years). This area spans 2,745,109 acres across northeastern Alaska and Canada (Yukon Environmental GIS 2018, Map C-1). More surface development within this area could result in greater displacement of maternal caribou during calving, and thus could contribute to lower pregnancy rates and lower calf survival rates (Griffith et al. 2002; Russell and Gunn 2019). Alternatively, less or no surface development in this area, and the calving grounds in general, would result in less, negligible, or no displacement.

Direct habitat loss associated with future on-the-ground activities could occur on 2,000 acres in the program area. Additional habitat in the vicinity of infrastructure would be affected by dust deposition, gravel spray, thermokarst, flow alteration, and impoundments. Direct habitat loss would reduce forage availability for caribou. Aside from concentrations of the high-quality tussock tundra and moist sedge-willow tundra vegetation types, which are a critical feature of the PCH primary calving grounds, foraging habitat is abundant across the program area.

Development in the PCH calving grounds may have behavioral effects on maternal caribou which could affect population size (described below); nevertheless, it is not likely that development on 2,000 acres in the calving grounds, insect relief habitat, or general summer habitat would reduce forage enough through direct habitat loss to affect caribou health or body fat reserves on a large scale. Caribou would be displaced from areas that no longer have suitable forage, but displacement due to direct habitat loss is not expected to be widespread (Truett and Johnson 2000). Caribou abundance or availability and the subsistence use thereof would not likely be affected as a result of direct habitat loss.

Small numbers of PCH caribou could be killed or injured due to vehicle collisions associated with future oil and gas exploration, development, and production in the program area during construction, drilling, and operations. Collision risk would be highest during periods of oestrid fly harassment, when caribou move erratically and often seek relief on gravel pads, roads, and airstrips. Alternative B proposes a number of mitigation measures to reduce vehicle collisions with caribou. ROP 23 would require that lessees design and implement a traffic management and vehicle use plan, and ROP 42 would prohibit chasing wildlife (specifically caribou) with vehicles. These measures would minimize vehicle-related mortality risk to caribou on the North Slope (Truett and Johnson 2000). Residual mortality would likely be very low and would not significantly affect the abundance of caribou for subsistence use.

Movement patterns could be altered due to future linear infrastructure under Alternative B. Caribou movements can be delayed or deflected by roads or pipelines. Traffic volumes greater than 15 vehicles per hour have been shown to increase the probability of delays or deflections during road crossings (Curatolo and Murphy 1986; Cronin et al. 1994). Caribou crossing success would vary by season, behavioral motivation, level of habituation, and activity levels. Movements in response to insect harassment between late June and mid-August would be most likely to be affected.

Caribou are highly motivated to seek relief in coastal areas during insect harassment (Cronin et al. 1994; Murphy and Lawhead 2000). Thus, they are less likely to be affected by roads and vehicle traffic from mid- to late summer if appropriate mitigation measures, such as vehicle management plans, elevated pipelines and road-pipeline separations are used. Some deflection or movement delays may occur but is not expected to be of extended duration. The mitigation measures proposed under Alternative B (Lease Stipulations 3, 4, 7 and 9, and ROPs 23 and 42) should be adequate to maintain caribou passage to coastal areas. These stipulations would affect both PCH and CAH caribou during midsummer.

PCH caribou would likely still be available to subsistence hunters along the coast during traditional timeframes, but some uncertainty exists due to three factors that differ from the experience with the Central Arctic Herd: 1) PCH postcalving aggregations can be greater than 100,0000 animals (Russell and Gunn 2019), the CAH does not provide any data on how well groups of this size navigate oilfields; 2) hunting along roads in the program area could increase the probability of delays or deflections; and 3) the PCH uses both coastal areas and inland ridges for mosquito-relief habitat (Walsh et al. 1992) thus caribou could use inland areas more frequently in response to coastal development.

A CPF or one or more satellite pads could be located south of Kaktovik in the area bounded by the Hulahula and Jago Rivers. This is an important subsistence use area for residents of Kaktovik (**Map 3-28**, Kaktovik Subsistence Use Areas in **Appendix A**). The majority of Kaktovik's subsistence use area that is bounded by the Hulahula and Jago Rivers would be subject to NSOs or TLs. Development would not significantly affect the availability of caribou for subsistence use.

Caribou behavior could be altered by future oil and gas exploration, development, and production, specifically from aircraft traffic (see **Section 3.3.4**, Terrestrial Mammals). Responses vary depending on the season, degree of habituation, aircraft type, altitude, flight patterns, weather conditions, frequency of overflights, and the sex and age composition of caribou groups. Low-level flights or maneuvering in the presence of unhabituated caribou can elicit increased speed and abrupt direction change. Alternatively, caribou can become habituated to aircraft, particularly when aircraft pilots maintain altitudes greater than 500 feet above ground level and do not haze or harass the caribou (Valkenburg and Davis 1985). The EIS describes potential impacts of aircraft associated with future on-the-ground activities on caribou and caribou behavior in detail.

Although short-lived, caribou responses to aircraft can affect subsistence hunters. Residents of Nuiqsut consistently highlight aircraft disturbance of caribou as a concern and state that aircraft activity makes animals more wary and harvest more difficult (Stinchcomb 2017). The extent of this potential impact is highly contingent on the location of frequently used flight paths, which would depend on the locations of airstrips, CPFs, and other major facilities. Air traffic in the vicinity of Kaktovik associated with future oil and gas activities would increase under Alternative B, and could increase further if one or more CPF development clusters were roadless, as is described in **Appendix B**. If a CPF development cluster is either along the coast or in the area bounded by the Hulahula and Jago Rivers (**Map 3-29**, Kaktovik Caribou Subsistence Use Areas, in **Appendix A**), which would be permissible under Alternative B, caribou could be more difficult to harvest. Arctic Village and Venetie would not be affected by this short-term impact; however, this could affect the availability of caribou for residents of Kaktovik.

ROPs 34, 36 and 40 would require lessees to follow numerous mitigation measures to ensure that the effects of aircraft on caribou and caribou hunting would be minimized. These strict operating procedures are used on BLM-administered lands in the National Petroleum Reserve-Alaska (NPR-A) and are generally successful in reducing impacts. ROP 36 would require that lessees, operators, and contractors work closely with residents of Kaktovik during all phases of project application, design, and implementation. If done effectively, this consultation would assist permittees in the design and orientation of facilities, including airstrips, such that frequent, low-level traffic in caribou subsistence use areas would be nonexistent or considered minor to moderate (**Table E-2**). It is likely that residual impacts associated with future on-the-ground activities would not significantly affect caribou availability for residents of Kaktovik, if these requirements are followed closely.

A total of 22 percent of the high-use calving area (592,800 of the 2,745,109 acres) could be leased and subject to surface occupancy under Alternative B (**Table J-12** in **Appendix J**; **Table E-1**). Development on all of the acres subject to surface occupancy within the high-use calving area is not possible given the 2,000-acre surface disturbance limit mandated by PL 115-97. Using a 2,000 acre maximum footprint, the total potential disturbance and displacement is 633,000 acres; however, this number would vary with different road and pad scenarios, and some portion of this area could be overlapping the buffer from other development, outside of the program area, or in the ocean. All of the areas available for lease within the high-use calving area would be subject to TLs. Lower activity levels resulting from TLs result in lower levels of disturbance to caribou, but they do not effectively mitigate the displacement of maternal caribou during calving. Thus, maternal caribou could still be displaced within areas subject to TLs.

Under Alternative B, two CPFs and associated well pads and roads could potentially be located within the medium and low hydrocarbon potential areas, with one CPF potentially sited on private lands and one within or partially within the high-use PCH calving area. Surface disturbance associated with one CPF in the high use PCH calving area could total up to 488 acres based on Figures B1 and B2 in **Appendix B**. These facilities do not include coastal facilities and access roads to coastal facilities that would be located outside of the high-use PCH calving area. Depending on the configuration of the oil field, displacement of maternal caribou around 488 acres of surface disturbance could total up to 118,500 acres (4 percent) of the high use calving area based on 2.49 miles of observed displacement around infrastructure on the North Slope during calving. However, the precise location of infrastructure, and thus the extent of overlap between surface disturbance and the high-use PCH calving area, is unknown. It is possible there would be very little surface disturbance within the high-use PCH calving area, given that the hypothetical development scenario suggests that future development would move from west to east, would be concentrated along the coast, and that lessees would attempt to minimize lengthy travel from coastal and existing infrastructure, and between CPFs. Some additional displacement would occur for individual caribou calving west of the high-use PCH calving area and in some years when high density calving occurs in areas to the west that have been used less than 40 percent of years. The calving distribution may move farther west in years with warmer springs as discussed in **Section 3.3.4**, Terrestrial Mammals.

Griffith et al. (2002) modeled changes in calf survival under development scenarios outlined by Tussing and Haley (1999). Similarly, Russell and Gunn (2019) estimated calf survival between calving areas within and outside the program area. The 2,000-acre surface disturbance limit was not used in these models. Griffith et al. (2002) predicted an 8.2 percent decline in annual calf survival if the full development scenario described by Tussing and Haley (1999) occurred. Griffith updated the 2002 analysis in 2018, and recalculated an average 6.2 percent decline in calf survival under the full development scenario described by Tussing and Haley (1999) using data from 1985-2017, but Russell and Gunn (2019) used different methods and estimated a 10 percent decline in calf survival if calving is displaced from the program area. The full development described by Tussing and Haley (1999) and used in Griffith et al. (2002) and the development scenario described by Russell and Gunn (2019), would not occur under Alternative B.

Russell and Gunn (2019) used models of caribou movement, energy and protein intake, and demography to model the impact of potential development on population size based on changes in caribou activity budgets in the project area. The models predicted population change under each alternative for two starting populations (218,000 and 100,000 caribou), and under three climate conditions (“poor,” “average,” and “good”). As summarized in **Section 3.3.4**, Terrestrial Mammals, these models assumed that changes in behavior (e.g. time spent foraging; time spent moving) as a result of disturbance would result in changes in body condition and consequently, would affect calf survival and cows’ probability of pregnancy. Russell and Gunn (2019) modelled the worst-case scenario with respect to 1002 development, making the assumption that any area within the program area could be developed. Further, in this worst-case scenario they did not account for mitigation measures (e.g., lease stipulations and required operating procedures), that could limit development under the action alternatives, including Alternative B (see Russell and Gunn 2019, page 52). See **Section 3.3.4**, Terrestrial Mammals, for further discussion.

While these modelling results suggest that PCH population size will be impacted under multiple population and climate scenarios to the extent that subsistence hunting will be impacted, the lack of support for specific model assumptions in the literature limit the utility of these models when determining whether impacts to subsistence will be significant. As described in **Section 3.3.4**, Terrestrial Mammals, some of the assumptions used in these models are not well supported in the literature, nor do the models accurately integrate the 2,000 acres development limit and predicted development under Alternative B. Specific changes in feeding behavior and duration assumed for areas under NSO, CSU, and TLs are not supported by the literature. As a result, anticipated changes to body condition and consequent cow pregnancy rates and calf survival are difficult to compare among alternatives. They did not specify a zone of influence for these impacts, stating that they, “modeled the worst-case scenario with respect to [program area] development, making the assumption that any area in the [program area] would be potentially developed in the future.” They add that, “any day a caribou spends in [the program area] would potentially cause it to be disturbed.” Given the 2,000 acre limit on development,, approximately 57 percent of the total project area could be more than 2.49 miles from roads, pads, or gravel mines, and based on the hypothetical development scenario, much of the development would be outside of the high-use PCH calving area; thus, the model assumes changes to caribou behavior extend beyond 2.49 miles from infrastructure, the distance of reported displacement around infrastructure on the North Slope during calving (Dau and Cameron 1986; Cameron et al. 1992; Lawheadet al. 2004) and much of the program area would be outside of the 1.9 mile distance reported for changes in time spent feeding and resting near a large open pit mine (BHP 2004; Golder 2011). In addition, maternal caribou may respond to infrastructure by moving away as described above, rather than changing their activity budget.

While the PCH caribou population size would continue to fluctuate, but based on the hypothetical development scenario, potential impacts to herd size as a result of displacement of maternal caribou are still anticipated to be negligible. Potential impacts to herd size as a result of behavior, feeding, and body condition changes are not anticipated to impact population size. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Kaktovik and Nuiqsut are the only communities whose subsistence use areas overlap the program area. Thus, they are the only communities that could be legally or physically prohibited from accessing these areas. Potential impacts on subsistence access from future oil and gas exploration, development, and production are as follows:

- Loss of subsistence use areas due to direct overlap with infrastructure
- Physical obstruction of subsistence users or activities by infrastructure
- Legal or regulatory barriers

Under Alternative B, numerous lease stipulations and ROPs would ensure that Kaktovik and Nuiqsut residents’ ability to access resources is maintained. These include Lease Stipulations 1, 3, 4, 7, 9 and ROPs 23, 34, 36, 37, 39, 40, 41, and 42. Legal and physical access to subsistence resources may be altered, depending on the locations of CPFs and industry-established safety areas; however, it is likely that large-scale access to subsistence resources would be maintained.

E.2.2.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Section 1003 of ANILCA, 16 USC 3143, deferred the decision to conduct leasing in the program area until authorized by Congress. PL 115-97 provides that decision, and requires the Secretary of the Interior, acting through the BLM, to conduct leasing in the program area. The purpose of the EIS is to inform the BLM’s implementation of PL 115-97; Alternative B would fulfill this purpose. Lands outside the program area are not subject to PL 115-97 and would therefore not fulfill this purpose.

E.2.2.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Alternatives that would reduce or eliminate the use of public lands needed for subsistence are those that make more land in the program area unavailable for oil and gas leasing or those that would not allow oil and gas activity. Alternatives D1 and D2 would make more land in the program area unavailable for oil and gas leasing. Alternative A would not allow oil and gas leasing to occur.

E.2.2.4 Findings

Alternative B will not result in a significant restriction to subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal or would be adequately mitigated by stipulations or ROPs under which lessees must operate. PCH caribou abundance may be affected due to minor displacement of maternal caribou, but large-scale displacement and consequent large decreases in the abundance of PCH caribou available for subsistence use is unlikely. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.3 Evaluation and Finding for Alternative C

Section B.8.3, Alternative C in **Appendix B** anticipates that three CPFs would be built under Alternative C: 2 CPFs would be built in the high potential area and one CPF would be built in the medium potential area sound of Kaktovik. Under this hypothetical scenario, three CPFs and associated airstrips, 15 satellite pads, and 180 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. The 2,000-acre surface disturbance cap would be reached within the high and medium potential areas.

Under Alternative C, approximately 932,500 acres would be subject to NSO which would protect caribou calving habitat, in addition to other resources and uses (**Table 2-1** in **Chapter 2**). 317,100 acres would be subject to TLs, and 313,900 would be subject only to the ROPs. **Map 2-3**, Alternative C and **Map 2-4**, Alternative C, Lease Stipulations, in **Appendix A** illustrate where NSOs, TLs, and areas subject only to ROPs would be adopted.

E.2.3.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Fish

Potential impacts on subsistence fish species from future oil and gas exploration, development, and production under Alternative C would be similar to that described under Alternative B, although facility locations may differ due to the lands available for surface occupancy. Similar mitigation measures would be used, although lands along the coast would be designated as NSO (Lease Stipulations 1, 4 and 9). Minor impacts on fish are not anticipated to affect fish availability or abundance for residents of Kaktovik.

Marine Mammals

The potential impacts of disturbing and displacing bowhead whales and ringed seals from future oil and gas activities under Alternative C would be similar to that described under Alternative B; however, facility locations may differ, due to the lands available for surface occupancy. These minor impacts are not anticipated to affect bowhead whale or ringed seal availability or abundance.

Caribou

Direct habitat loss or alteration from future oil and gas activities would be similar to that described under Alternative B, because development of 2,000 acres in the program area would not vary by alternative. Direct habitat loss or alteration would not appreciably affect the availability or abundance of caribou for subsistence use.

Mortality or injuries from vehicle collisions would be similar to that described under Alternative B. ROP 23 would apply under Alternative C and would sufficiently address collision risk. Low-incidence mortality would not significantly affect the abundance of caribou for subsistence use.

Altered movement patterns due to linear infrastructure associated with future on-the-ground activities would be minor under Alternative C. The mitigation measures proposed under Alternative C would reduce impacts on caribou movement. The majority of Kaktovik’s subsistence use area that is bounded by the Hulahula and Jago Rivers would be subject to NSOs or TLs. Altered movement patterns would not significantly affect the availability of caribou for subsistence use by Kaktovik. Altered PCH caribou movement patterns during spring and summer would be unlikely to affect residents of Arctic Village or Venetie.

Altered caribou behavior due to aircraft traffic associated with future on-the-ground activities would be the same as that described under Alternative B. Aircraft traffic associated with Kaktovik would be the same as that described under Alternative B and would likely cause some caribou disturbance in the vicinity of Kaktovik; however, additional CPFs, airstrips, and heavily used flight paths would also be located outside Kaktovik’s primary subsistence use areas. Additionally, ROPs 34, 36, and 40 would also apply under Alternative C, further reducing adverse impacts on hunters. Minor impacts of aircraft on caribou behavior would not significantly affect caribou availability for residents of Kaktovik.

Under Alternative C, the majority of the high-use calving area within the program area could be leased but would be subject to NSO (**Table J-12** in **Appendix J**; **Table E-1**). Eighty-three thousand four hundred acres of the overall high-use calving area (3 percent) would be subject to TLs and 13,700 acres (0.5 percent) would be subject to ROPs only. As discussed under Alternative B, caribou could still be displaced within areas subject to TLs.

Under Alternative C, one CPF and associated well pads and roads could potentially be located within the medium hydrocarbon potential area. This CPF could be sited on private lands. If so, the CPF would be located north of the high-use calving area. Some maternal caribou could be displaced as a result of the CPF, but displacement would not be widespread. If a CPF were sited on private lands, one to two well pads could be located within the high-use calving area. Displacement of maternal caribou around two well pads could total up to 26,648 acres (less than 1 percent) of the high-use calving area based on 2.49 miles of observed displacement around infrastructure during calving.

As discussed under Alternative B, the precise location of future oil and gas-related infrastructure, and thus the extent of overlap between surface disturbance and the high-use calving area, is unknown. The majority of the high-use calving area would be NSO under Alternative C. In addition, it is likely that there would be no or very little surface disturbance within the high-use calving area, given that the hypothetical development scenario suggests that future development would move from west to east, would be concentrated along the coast, and that a CPF in the medium potential hydrocarbon area would likely be sited on private lands. Based on these assumptions, potential impacts to herd size as a result of displacement of maternal caribou would be negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Access to subsistence resources would be similar to Alternative B, and, in general, this access would be maintained.

E.2.3.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands is identical to that described under Alternative B (see **Section E.2.2.2**, above).

E.2.3.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Evaluation of other alternatives is identical to that described under Alternative B (see **Section E.2.2.3**, above).

E.2.3.4 Findings

Alternative C will not result in a significant restriction to subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal or would be adequately mitigated by stipulations or ROPs under which lessees must operate. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.4 Evaluation and Finding for Alternative D1

Section B.8.4, Alternative D1 in **Appendix B** anticipates that two CPFs would be built: one CPF would be built in the high potential area and one in the medium potential area south of Kaktovik. Under this scenario, two CPFs and associated airstrips, 16 satellite pads, and 185 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. The 2,000-acre surface disturbance cap would be reached in the high and medium potential areas.

Approximately 526,300 acres would be closed to leasing to protect caribou calving habitat under Alternative D1 (**Table 2-1** in **Chapter 2**). Of the remaining 1,037,200 acres available for leasing, 708,600 would be subject to NSO, 123,900 would be subject to CSU, 0 would be subject to TLs, and 204,700 would be subject to ROPs only. **Map 2-5**, Alternative D1 and **Map 2-6**, Alternative D1, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, ROPs would be adopted.

E.2.4.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Fish

Potential impacts on subsistence fish species would be similar to those described under Alternatives B and C, although future facility locations may differ due to the lands available for lease and surface occupancy. More extensive mitigation measures would be used, a 0.5- to 4-mile setback for surface development would apply on all streams and waterbodies, and NSO would apply along the coast. While minor impacts on fish could still occur from future oil and gas exploration, development, and production, they are not anticipated to affect fish availability or abundance for residents of Kaktovik.

Marine Mammals

Disturbance and displacement of bowhead whales and ringed seals associated with future on-the-ground activities would be similar to that described under Alternatives B and C, although future facility locations may differ due to the lands available for lease and surface occupancy. These potential minor impacts are not anticipated to affect bowhead whale or ringed seal availability or abundance.

Caribou

Direct habitat loss or alteration from future oil and gas exploration, development, and production would be similar to that described under Alternatives B and C, as development of 2,000 acres in the program area would not vary by alternative. Direct habitat loss or alteration from future on-the-ground activities would not affect the availability or abundance of caribou for subsistence use.

Mortality or injuries due to vehicle strikes associated with future oil and gas development in the Coastal Plain would be similar to that described under Alternatives B and C. ROP 23 would apply under Alternative D1 as well and would sufficiently address collision risk. Low-incidence mortality would not significantly affect the abundance of caribou for subsistence use.

Altered movement patterns due to roads and pipelines associated with future oil and gas development in the Coastal Plain would be similar to what is expected to occur under Alternative C, but the extent of this impact would be lessened. This is because the areas important for caribou movement would be largely subject to NSO, TLs, or would not be offered for lease sale. This would apply to spring migration and movements to and from the coast in response to insect harassment, and potentially to fall migration. Although some delays and deflections while crossing roads and pipelines are expected, PCH and CAH caribou movements would be relatively undisturbed and would not significantly affect the availability of caribou for subsistence use by residents of Kaktovik.

A total of 14,300 acres (0.5 percent) of the high-use calving area could be leased and subject to surface occupancy under Alternative D1 (**Table J-12** in **Appendix J**; **Table E-1**). 5,400 acres (0.2 percent) would be subject to CSU and 8,900 acres (0.3 percent) would be subject to standard lease terms and conditions only. Caribou could be displaced within these areas.

Similar to Alternative C, one CPF and associated well pads and roads could potentially be located within the medium hydrocarbon potential area under Alternative D1. This CPF would likely be sited on private lands. Since these assumptions are identical to Alternative C, impacts to maternal caribou would likewise be the same. Displacement would not be widespread and could occur on up to 26,648 acres (less than 1 percent) of the high-use calving area if one to two well pads were constructed in this area. Based on these assumptions, potential impacts to herd size as a result of displacement of maternal caribou from future on-the-ground activities would be small or negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Access to subsistence resources would be similar to Alternative B. In general, access to subsistence resources would be maintained.

E.2.4.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands would be similar to Alternative B (see **Section E.2.2.2,** above).

E.2.4.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Alternative D2 would make more land in the program area unavailable for oil and gas leasing. Alternative A would not allow oil and gas leasing to occur.

E.2.4.4 Findings

Alternative D1 will not result in a significant restriction in subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal or would be adequately mitigated by stipulations or ROPs under which lessees must operate. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.5 Evaluation and Finding for Alternative D2

Section B.8.5, Alternative D2 in **Appendix B** anticipates that two CPFs would be built under Alternative D2: one CPF would be built in the high-potential area and one in the medium-potential area sound of Kaktovik. Under this scenario, two CPFs and associated airstrips, 16 satellite pads, and 185 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. The 2,000-acre surface disturbance cap would be reached in the high- and medium- potential areas.

Approximately 763,500 acres would be closed to leasing to protect caribou calving habitat under Alternative D2 (**Table 2-1** in **Chapter 2**). Of the remaining 800,000 acres available for leasing, 505,800 would be subject to NSO, 105,200 would be subject to CSU, 189,000 would be subject to TLs, and 0 would be subject to ROPs only. **Map 2-7**, Alternative D2, and **Map 2-8**, Alternative D2, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, TLs, and areas subject to ROPs only would be adopted.

E.2.5.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Fish

Potential impacts on fish would be similar to those described under Alternative D1, although future facility locations may differ due to the lands available for lease and surface occupancy. While minor impacts on fish could still occur from future oil and gas exploration, development, and production, they are not anticipated to affect fish availability or abundance for residents of Kaktovik.

Marine Mammals

Potential impacts on marine mammals would be similar to those described under Alternative D1, although future facility locations may differ due to the lands available for lease and surface occupancy. While minor impacts on marine mammals could still occur from future oil and gas exploration, development, and production, they are not anticipated to affect marine mammal availability or abundance.

Caribou

Direct habitat loss or alteration from future oil and gas exploration, development, and production would be similar to that described under Alternatives B, C, and D1, as development of 2,000 acres in the program area would not vary by alternative. Direct habitat loss or alteration from future activities in the Coastal Plain would not affect the availability or abundance of caribou for subsistence use.

Mortality or injuries due to vehicle strikes associated with future oil and gas development in the Coastal Plain would be similar to those described under Alternatives B, C, and D1. ROP 23 would apply under Alternative D2, and Lease Stipulation 6 would be adopted as part of a suite of mitigation measures. These measures would sufficiently address collision risk. Low-incidence mortality from future activities would not significantly affect the abundance of caribou for subsistence use.

Alteration of movement patterns associated with future oil and gas development in the Coastal Plain would be similar to that expected under Alternative D1. Caribou movement would be relatively undisturbed and would not significantly affect the availability of caribou for subsistence use by Kaktovik residents.

Displacement of maternal caribou associated with future oil and gas development in the Coastal Plain would be similar to that expected under Alternative D1, although the extent of potential displacement would be less given that less area would be offered for lease sale. Potential impacts to caribou abundance as a result of maternal caribou displacement would be small or negligible. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Subsistence Access

Access to subsistence resources would be similar to Alternative B, and this access would be maintained.

E.2.5.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands would be similar to that described under Alternative B (see **Section E.2.2.2**, above).

E.2.5.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Of the action alternatives analyzed in the EIS, Alternative D2 offers the fewest amount of public lands for leasing, representing the minimum leasing acreage allowable under PL 115-97. Alternative A, the No Action Alternative, would not allow oil and gas leasing to occur.

E.2.5.4 Findings

Alternative D2 will not result in a significant restriction in subsistence uses. Potential impacts on subsistence resources and access from future oil and gas exploration, development, and production would be minimal, or they would be adequately mitigated by stipulations or ROPs under which lessees must operate. A positive determination pursuant to ANILCA Section 810 is not required.

E.2.6 Evaluation and Finding for the Cumulative Case

The goal of the cumulative case analysis presented in **Chapter 3** is to evaluate the incremental impact of the actions considered in the EIS, in conjunction with all past, present, and reasonably foreseeable future activities in or near the Coastal Plain, specifically, in the Kaktovik, Nuiqsut, Arctic Village, and Venetie subsistence use areas.

Actions included in the cumulative case analysis are listed in **Section F.3.2** in **Appendix F**. Past and present actions that have affected subsistence uses and resources are as follows:

- Oil and gas exploration, development, and production on the North Slope
- Transportation
- Subsistence activities
- Recreation and tourism
- Scientific research
- Community development
- Climate change

Reasonably foreseeable future actions include the following:

- Infrastructure projects developed through the Arctic Strategic Transportation and Resources (ASTAR) program

- Oil and gas development in the Colville-Canning Area
- Oil and gas activity in the vicinity of Alpine

E.2.6.1 Evaluation of the Effect of Use, Occupancy, or Disposition on Subsistence Uses and Needs

Actions included in the cumulative case analysis are listed in **Section F.2.2** in **Appendix F**. These actions fall in to six broad categories: oil and gas exploration and development, transportation, subsistence activities, recreation and tourism, scientific research, and community development. Additionally, climate change is considered a variable that could contribute to potential cumulative effects of the proposed alternatives and reasonably foreseeable future actions. This section describes the potential impacts each of these categories could have to Kaktovik, Nuiqsut, Arctic Village, and Venetie subsistence uses.

Oil and Gas Exploration, Development, and Production

Oil and gas exploration, development, and production is ongoing and planned within the onshore North Slope, State and Federal waters in the Beaufort Sea, and in the Western Canadian Arctic. These activities include exploration work, infrastructure development, construction, and maintenance, gravel mining, and production associated with existing wells. These activities are expected to continue under all alternatives.

Section 3.4.3, Subsistence Uses and Resources, identifies cumulative infrastructure development on the North Slope as a major impact to subsistence activities. This is corroborated by other analyses and 810 evaluations. In the NPR-A Integrated Activity Plan/EIS, the BLM (2012) indicated that, irrespective of the alternative selected, cumulative activity on the North Slope had the potential to significantly restrict subsistence access for a number of communities. Increased infrastructure has contributed to a feeling of being “boxed in” by development in and around Nuiqsut. Impacts to Nuiqsut’s ability to access subsistence resources, according to previous EISs, would be significant.

Similar to issues associated with development around Nuiqsut, ongoing and proposed oil and gas activities associated with Point Thomson and Liberty, together with Coastal Plain oil and gas activities, would impact lands in the vicinity of Kaktovik, and would potentially restrict subsistence activities and access to subsistence resources within their subsistence use area. Past, present, and future development would not mirror the scenario observed for Alpine-associated development and Nuiqsut. Future development within the program area beyond the surface disturbance limit of 2,000 acres would require additional action by Congress, and is not included in the hypothetical development scenario (**Appendix B**). Future development associated with the Leasing EIS would not surround Kaktovik, but residents may still feel surrounded if there is development to the west, south, and east of their traditional hunting areas[1]. This could occur under Alternative B. Future development associated with oil and gas activities could occur along the coast, where multiple ports or seawater treatment plants could be constructed, and within the important subsistence use area bounded by the Hulahula and Jago Rivers. It could also occur under Alternatives C, D1, and D2, as future on-the-ground development could occur on corporation lands directly south of Kaktovik.

Numerous measures would be adopted to mitigate potential impacts to subsistence access. Under all alternatives, Lease Stipulation 1 would implement NSO along rivers that are important for subsistence use by residents of Kaktovik. Lease Stipulation 9 would require lessees to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on subsistence users. ROPs 18, 20, and 23 would require that roads and other infrastructure be designed

[1]S. Braund, [Stephen R. Braund and Associates Senior Scientist], personal communication with E. Julianus [BLM Wildlife Biologist], EMPSi, [08 September 2018].

to avoid or minimize impacts to subsistence access to traditional hunting and fishing areas. ROPs 36-40 would require that lessees participate in extensive consultation with subsistence communities. Lessees would be required to coordinate directly with Kaktovik and seek input from local advisory councils such as the North Slope and Eastern Interior Subsistence Regional Advisory Council. They would be required to develop a plan to prevent unreasonable conflicts with subsistence activities, and to develop a subsistence access plan prior to beginning exploration or development. All future development plans would be subject to BLM review prior to approval.

Public testimony indicates that residents believe conflict avoidance and subsistence access plans mitigate potential impacts to subsistence. However, access patterns have changed in response to development on the North Slope, and residents still report feeling "boxed in" by existing development (SRB&A 2017). Potential impacts to subsistence access would likely be effectively mitigated under Alternatives B, C, D1, and D2. However, cumulative impacts associated with Point Thomson, Liberty, and other projects could result in extensive interference[2] of the ability of Kaktovik harvesters to reach and use active subsistence harvest sites. Therefore, cumulative impacts of oil and gas exploration, development, and construction could significantly impact Kaktovik's ability to access subsistence resources.

The BLM (2012) found that caribou availability for residents of Nuiqsut could be significantly impacted as a result of development in the vicinity of Alpine. Impacts to PCH caribou availability would not affect Nuiqsut, as their caribou subsistence use area does not overlap with the PCH range nor is there documented harvest of PCH caribou by Nuiqsut. Cumulative impacts to PCH caribou would not significantly impact residents of Nuiqsut under all alternatives.

Ongoing and future actions along the coast may contribute to some impacts to caribou availability. These impacts to caribou availability for Kaktovik are limited to aircraft and vehicle disturbance and are described below in *Transportation*.

Potential impacts from future oil and gas exploration, development, and production to CAH and PCH caribou abundance for residents of Kaktovik, Arctic Village, and Venetie under Alternatives B, C, D1, and D2, would be minor due to the lease stipulations and ROPs. Ongoing or future development are not expected to impact caribou abundance. Therefore, the cumulative impact, in conjunction with Alternatives B, C, D1, and D2, would not significantly restrict subsistence uses of PCH caribou.

Transportation

Surface, air, and marine transportation within Kaktovik and Nuiqsut's subsistence use areas would continue under all alternatives. This includes roads and vehicular traffic, shipping and barging, and aircraft traffic. Increased activity associated with future oil and gas developments would result in higher levels of vessel, ground, and air traffic. This increased activity is likely under Alternatives B, C, D1, and D2. Under each alternative, NSOs, TLs, and ROPs would be sufficient to effectively mitigate potential impacts of transportation associated with future on-the-ground oil and gas activities on subsistence resources. Potential impacts to subsistence resource abundance and availability for Kaktovik would not be significant under all alternatives. Roads and transportation activities would contribute to the potentially extensive interference of the ability of Kaktovik harvesters to reach and use subsistence harvest sites. Impacts to caribou availability due to development in the vicinity of Nuiqsut were found to be potentially significant for Nuiqsut. However,

[2] Significance threshold defined on page 7 of BLM Instruction No. AK-2011-008.

potential impacts to caribou from future oil and gas activities associated with all alternatives would not contribute to cumulative effects on Nuiqsut's resource availability.

Subsistence Activities

Subsistence activities on the North Slope would continue under all alternatives. Although subsistence practices are somewhat fluid and subject to annual variation, current and past hunting, gathering, fishing, and trapping activities would be similar in the types of activities and areas used by the communities in the program area in the foreseeable future. Subsistence activities would not vary by alternative and would not contribute to adverse effects on the abundance or availability of subsistence resources, nor would they impact subsistence users' ability to access subsistence resources.

Recreation and Tourism

Recreation and tourism would continue under all alternatives. Recreation and tourism activities would occur independent of development activities proposed under each of the proposed alternatives, and thus are not expected to vary by alternative. Although these activities occur across the North Slope, recreation and tourism are most concentrated in the Arctic Refuge and Kaktovik, where polar bear viewing is a popular activity. Recreation and tourism do have the potential to adversely affect the availability of subsistence resources if these resources are disturbed by aircraft conducting flightseeing tours. Such activities are carefully managed to avoid impacts to subsistence (USFWS 2015) and would not significantly affect the availability of subsistence resources. The abundance of subsistence resources would not be affected by recreation and tourism. Subsistence users' ability to access subsistence resources would not be affected.

Scientific Research

Scientific research is ongoing in the program area and within Kaktovik, Nuiqsut, Arctic Village, and Venetie's subsistence use areas. It is likely that scientific research would increase under Alternatives B, C, D1, and D2, particularly if mitigation measures are adopted that require companies to fund research documenting and monitoring impacts on specific resources, such has been done elsewhere (BLM 2012). Research activities typically involve vessel, air, and overland transport of researchers and equipment, and could contribute to cumulative effects. Research activities could affect the availability of subsistence resources under Alternatives B, C, D1, and D2. Caribou could be disturbed during aerial surveys, but impacts would be short-lived. The availability of subsistence resources would not be significantly impacted by research activities under the cumulative case if Alternatives B, C, D1, or D2 are adopted, nor would the abundance of or access to subsistence resources be significantly impacted.

Community Development

Community development projects would occur under all alternatives. The type and size of development projects could vary by alternative. Kaktovik would likely undertake community development projects if Alternatives B, C, D1, or D2 are selected. Comparatively more projects may occur in or near Kaktovik if Alternatives C, D1, or D2 are selected than under Alternative B. NSOs would be in place along the majority of the coast under these alternatives, creating a situation where seawater treatment plants or port and airport infrastructure may be more likely to be constructed or expanded in or near Kaktovik. Community development projects would not contribute to adverse impacts on the abundance or availability of subsistence resources, nor would they impact subsistence users' ability to access subsistence resources.

Climate Change

Climate change is an ongoing factor considered in cumulative effects analyses on the North Slope. Climate change could affect the habitat, behavior, distribution, and populations of fish and wildlife within the program area. It could also impact access to these resources. The trends in climate change that were described in BLM 2018 are expected to continue.

E.2.6.2 Evaluation of the Availability of Other Lands for the Purpose Sought to be Achieved

Evaluation of the availability of other lands is identical to that described under Alternative B (see **Section C.2.2.2**, above).

E.2.6.3 Evaluation of Other Alternatives that would Reduce or Eliminate the Use, Occupancy, or Disposition of Public Lands Needed for Subsistence

Evaluation of other alternatives is identical to that described under Alternative B (see **Section E.2.2.2**, above).

E.2.6.4 Findings

The cumulative case, when taken in conjunction with Alternatives B, C, D1, and D2, will not result in a significant restriction to subsistence uses for the communities of Nuiqsut, Arctic Village, and Venetie.

The cumulative case, when taken in conjunction with Alternatives B, C, D1, and D2, may result in a significant restriction to subsistence uses for the community of Kaktovik due to potential decrease in access to fish, marine mammals, and caribou. A positive determination pursuant to ANILCA Section 810 is required.

E.3 NOTICE AND HEARINGS

ANILCA Section 810(a) provides that there shall 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). The BLM provided notice in the *Federal Register* that the cumulative case presented in the EIS met the “may significantly restrict” threshold; therefore it made a positive finding pursuant to ANILCA Section 810. As a result, a public hearing was held in the potentially affected community of Kaktovik on February 5, 2019 in conjunction with the Draft EIS public meeting. Notice of this hearing was provided in the *Federal Register* and in local media, including the *Arctic Sounder* and KBRW, the Utqiagvik radio station with coverage to all villages on the North Slope. The meeting/hearing transcript is posted on BLM’s website at https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=152110.

E.4 SUBSISTENCE DETERMINATIONS UNDER THE ANILCA SECTION 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 USC 3120(a)(3)(A), (B), and (C)).

The BLM has found in this evaluation that the cumulative case considered in this EIS may significantly restrict subsistence uses for the community of Kaktovik. 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 community of Kaktovik.

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

BLM undertook the Leasing EIS to fulfill the Secretary of the Interior's responsibilities under ANILCA, the Federal Land Policy and Management Act (FLPMA), and PL 115-97. Section 20001(c)(1)(A) of PL 115-97 directs the Secretary to hold not fewer than two lease sales in the program area before December 22, 2024. In accordance with Section 20001(c)(1)(B), each sale must offer not fewer than 400,000 acres in areas with the highest hydrocarbon potential. Section 20001(c)(3) allows for up to 2,000 surface acres of Federal land in the program area to be covered by production and support facilities.

Alternative B, the preferred alternative, will provide the opportunity, subject to appropriate conditions developed through the NEPA process, to conduct at least two lease sales in the program area. These conditions include lease stipulations and ROPs that incorporate protective measures that would minimize impacts to important subsistence resources and subsistence use areas.

The cumulative case, in conjunction with the preferred alternative, could significantly restrict subsistence uses for the community of Kaktovik. The BLM determined that such a significant restriction is necessary, consistent with sound management principles for the use of the public lands, and for BLM to fulfill the Secretary of the Interior's responsibilities under PL 115-97, described above.

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 B involves the minimal amount of public lands necessary to accomplish the purpose and need of the Leasing EIS to: establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain area within the Arctic Refuge in accordance with the directives of PL 115-97. PL 115-97 limits the use of public lands for oil and gas infrastructure. Under all action alternatives, including Alternative B, no more than 2000 acres of public lands may be used for production and support facilities. Alternative B includes numerous oil and gas leasing stipulations and required operating procedures that apply across the Coastal Plain for protection of specific habitats and site-specific resources and uses, while allowing reasonable opportunity for necessary infrastructure to support oil and gas exploration and development. More restrictive alternatives that varied and offered less acres available for leasing or surface occupancy were analyzed, and it was determined Alternative B best meets the purpose and need of the oil and gas program. Important subsistence habitats along rivers and streams, as well as nearshore marine, lagoon, and barrier island habitats contain no surface occupancy restrictions, to ensure the habitat is protected for the important subsistence uses and resources.

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 NEPA scoping process, it internally identified subsistence as one of the major issues to be addressed. The information found within the analysis of impacts to subsistence, including access, harvests and traditional use patterns, as well as the results of workshops with the cooperating agencies, public scoping meetings in the villages, and meetings with tribal and local governments were used to craft Alternative B.

This information resulted in the development of several protective measures that minimize adverse impacts to subsistence uses and resources, such as:

- Lease Stipulation 1 specifically minimizes impacts on subsistence cabins and campsites, as well as the disruption of subsistence activities.
- Lease Stipulation 4 protects fish and wildlife habitat and minimizes impacts on subsistence activities.
- Required Operating Procedure 7 ensures that permitted activities do not create human health risks by contaminating subsistence foods.
- Required Operating Procedure 18 protects subsistence uses and access to subsistence hunting and fishing areas and minimize the impact of oil and gas activities on air, land, water, fish, and wildlife resources.
- Required Operating Procedure 20 protects subsistence use and access to subsistence hunting and fishing and anadromous fish and protect subsistence use and access to subsistence and non-subsistence hunting and fishing.
- Required Operating Procedure 23 minimizes disruption of caribou movement and subsistence use.

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 B includes reasonable steps to minimize adverse impacts on subsistence uses and resources.

E.5 References

BLM (US Department of Interior Bureau of Land Management). 2011. Bureau of Land Management instructions and policy for compliance with Section 810 of the Alaska National Interest Lands Conservation Act. Instruction Memorandum No. AK-2011-008. Internet website: https://www.blm.gov/policy/im-ak-2011-008.

_____. 2012. National Petroleum Reserve – Alaska Integrated Activity Plan/Final Environmental Impact Statement. Bureau of Land Management, Alaska State Office. 2012.

_____. 2018. Alpine Satellite Development Plan for the Proposed Greater Mooses Tooth 2 Development Project Final Environmental Impact Statement. Bureau of Land Management, Alaska State Office. September 2018. Anchorage, Alaska.

BLM GIS. 2018. GIS data used in the Coastal Plain Oil and Gas Leasing Program EIS alternatives, affected environment, and impact analysis. Alaska Bureau of Land Management.

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

Curatolo, J. A., and S. M. Murphy. 1986. The effects of pipelines, roads, and traffic on the movements of caribou, *Rangifer tarandus*. *Canadian Field-Naturalist* 100: 218–224.

George, J. C., L. M. Philo, K. Hazard, D. Withrow, G. M. Carroll, and R. S. Suydam. 1994. Frequency of killer whale attacks and ship collisions based on scaring on bowhead whales of the Bering-Chukchi-Beaufort Seas Stock. *Arctic* 47(3): 247–255.

Griffith, D. B., D. C. Douglas, N. E. Walsh, D. D. Young, T. R. McCabe, D. E. Russell, R. G. White, R. D. Cameron, and K. R. Whitten. 2002. Section 3: The Porcupine Caribou Herd. Pp. 8-37, in Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries (D. C. Douglas, P. E. Reynolds, and E. B. Rhode, editors). US Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR-2002-0001.

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.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. “Collisions between ships and whales.” *Marine Mammal Science* 17: 35–75.

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.

Murphy, S. M., and B. E. Lawhead. 2000. Caribou. Chapter 4, pp. 59–84, in *The Natural History of an Arctic Oil Field: Development and the Biota* (J. Truett and S. R. Johnson, editors). Academic Press, San Diego, California.

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

Russell, D.E., D. van de Wetering, R.G. White, and K.L. Gerhart. 1996. Oil and the Porcupine caribou herd-can we quantify the impacts?. *Rangifer* Special Issue 9: 255-257.

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

Stinchcomb, T. R. 2017. Social-ecological soundscapes: examining aircraft-harvester-caribou conflict in Arctic Alaska. M.S. Thesis. University of Alaska Fairbanks. Fairbanks, Alaska.

Truett, J. C., and S. R. Johnson. 2000. The Natural History of an Arctic Oilfield. Academic Press.

Tussing, A. R., and S. Haley. 1999. Drainage pierces ANWR in Alaska study scenario. Oil and Gas Journal 97: 71–84. Internet website: https://www.ogj.com/articles/print/volume-97/issue-27/special-report/drainage-pierces-anwr-in-alaska-study-scenario.html.

USFWS (US Fish and Wildlife Service). 2015. Arctic National Wildlife Refuge revised comprehensive conservation plan. US Fish and Wildlife Service, Final Environmental Impact Statement, Vol. 1. Internet website: https://www.fws.gov/home/arctic-ccp/.

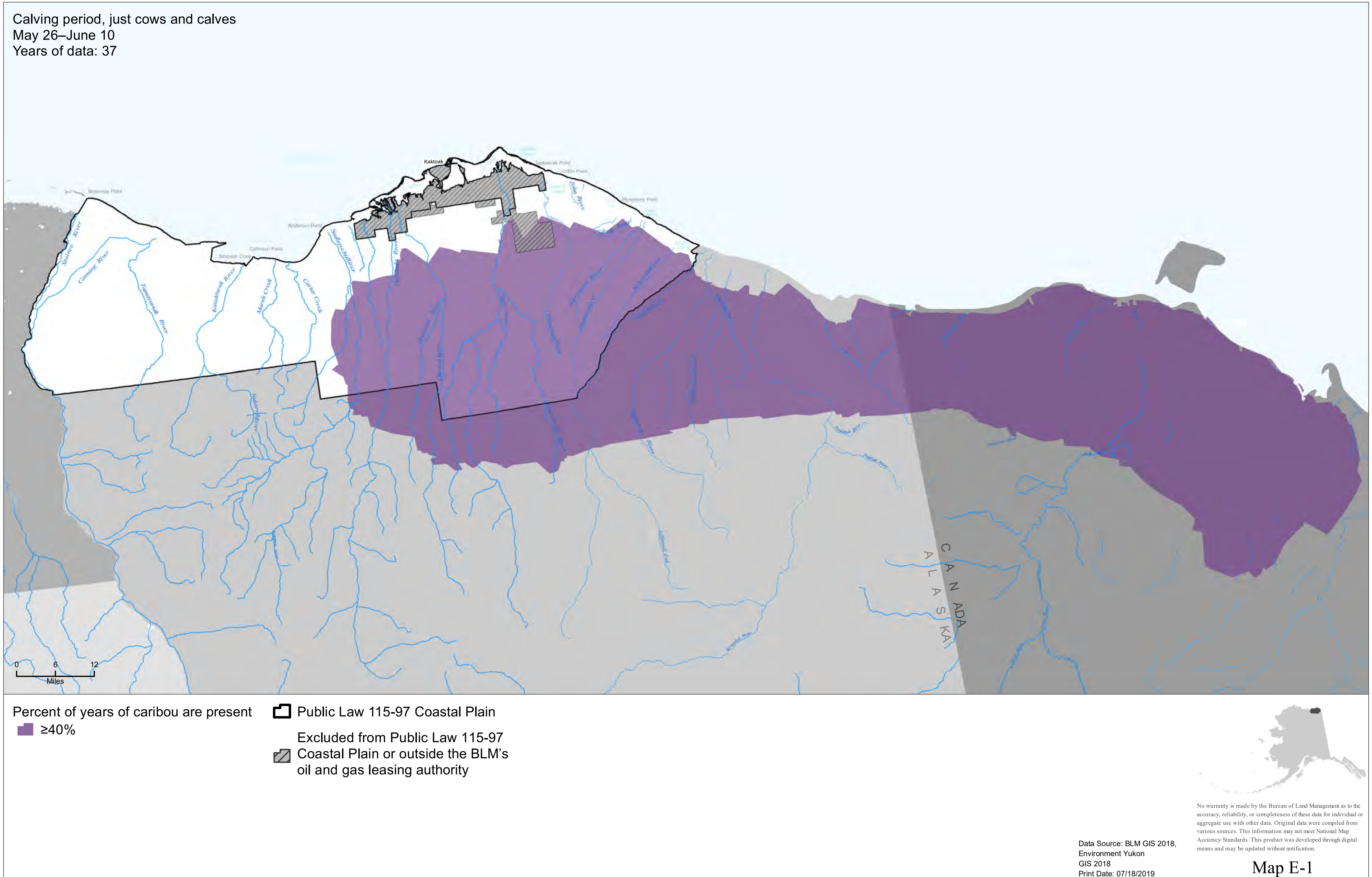
Valkenburg, P., and J. L. Davis. 1985. "The Reaction of Caribou to Aircraft: A comparison of two herds." Pp. 7–9, in Proceedings of the First North American Caribou Workshop, 1983 (A. H. Martell and D. E. Russell, editors). Canadian Wildlife Service, Whitehorse, Yukon.

Van Lanen, J. M., C. Stevens, C. Brown, B. K. Maracle, and D. Koster. 2012. Subsistence and Mammal Harvests and Uses, Yukon Flats, Alaska 2008–2010 Harvest Report and Ethnographic Update. Alaska Department of Fish and Game, Division of Subsistence, Anchorage.

Walsh, N.E., S.G. Fancy, T.R. McCabe, and L.F. Pank. 1992. Habitat use by the Porcupine caribou herd during predicted insect harassment. *Journal of Wildlife Management* 56: 465-473.

Young, D. D., T. R. McCabe, and M. S. Udezitz. 2002. Section 6: Predators. Pp. 51-53 in Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries (D. C. Douglas, P. E. Reynolds, and E. B. Rhode, editors). US Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR-2002-0001.

Yukon Environmental GIS. 2018. GIS data provided by Yukon Environmental, Mike Suitor, July 2018.



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Data Source: BLM GIS 2018, Environment Yukon GIS 2018
Print Date: 07/18/2019

Map E-1

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Table E-1
Lease Restrictions in High-Use Porcupine Caribou Herd Calving Area (acres)

Lease Stipulations	Alternative A	Alternative B	Alternative C	Alternative D1	Alternative D2
No surface occupancy/not offered for lease sale	728,300	135,500	631,200	713,900	722,100
Timing limitation	0	564,900	83,400	0	5,800
Controlled surface use	0	0	0	5,400	5,400
Subject to required operating procedures only	0	27,900	13,700	8,900	3,400

Source: BLM GIS 2018

Table E-2
Summary of Impacts on Abundance and Availability of Major Subsistence Resources for Kaktovik, Nuiqsut, Arctic Village, and Venetie

Resource	Impact	Context	Alternative A		Alternative B		Alternative C		Alternative D1		Alternative D2		Cumulative	
			Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability
Fish	Habitat loss or alteration	Site-specific	0	0	1	1	1	1	0	0	0	0	1	2
Fish	Disturbance or displacement	Regional	0	0	1	1	1	1	0	0	0	0	1	2
Fish	Injury or mortality	Site-specific	0	0	1	1	1	1	0	0	0	0	1	2
Marine mammals	Injury or mortality	Site-specific	0	0	1	0	1	0	1	0	1	0	2	0
Marine mammals	Disturbance or displacement	Regional	0	0	0	1	0	1	0	1	0	1	0	2
Caribou	Habitat loss or alteration	Site-specific	0	0	0	1	0	1	0	1	0	1	0	2
Caribou	Mortality or injury	Site-specific	0	0	1	0	1	0	1	0	1	0	1	0
Caribou	Altered movement	Local	0	0	0	2	0	1	0	2	0	2	2	2
Caribou	Altered behavior	Local	0	0	0	2	0	2	0	1	0	1	2	2
Caribou	Displacement of maternal caribou	Regional	0	0	2	0	2	0	1	0	1	0	2	2

Notes:
1. Table does not specify the degree to which each community is affected.
2. Gray (0) indicates no impact, yellow (1) indicates minor impact, orange (2) indicates moderate impact, and red (3) indicates major impact.

Table E-3
Summary of Impacts on Access to Major Subsistence Resources for Kaktovik, Nuiqsut, Arctic Village, and Venetie

Resource	Potential Effect	Context	Alternative A		Alternative B		Alternative C		Alternative D1		Alternative D2		Cumulative	
			Legal	Physical	Legal	Physical	Legal	Physical	Legal	Physical	Legal	Physical	Legal	Physical
Fish	Use of traditional fishing areas	Local	0	0	1	1	0	0	0	0	0	0	2	3
Marine mammals	Use of traditional marine mammal hunting areas	Local	0	0	1	1	0	0	0	0	0	0	2	3
Caribou	Use of traditional caribou hunting areas	Local	0	0	1	1	1	1	0	0	0	0	2	3

Notes:
1. Table does not specify the degree to which each community is affected.
2. Gray (0) indicates no impact, yellow (1) indicates minor impact, orange (2) indicates moderate impact, and red (3) indicates major impact.

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Appendix F
Approach to the Environmental Analysis

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TABLES

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Appendix F. Approach to the Environmental Analysis

F.1 Introduction

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of Public Law (PL) 115-97 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, issuance of a lease represents an irretrievable commitment of oil and gas resources for potential future exploration and development activities, subject to further environmental review and authorization, that would result in impacts on the environment. The impacts of such future exploration and development activities that may occur because of the issuance of leases 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 Coastal Plain. Therefore, the analysis in Chapter 3 is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.

The methodology for the impact assessment conforms to the guidance found in the following sections of the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (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. Since the action alternatives presented in this environmental impact statement (EIS) offer specific areas of the Coastal Plain as available for lease sale (subject to applicable laws, terms, conditions, and stipulations of the lease, as well as project specific environmental review and permits), rather than project-level exploration and development of oil and gas, the focus of the analysis is on the potential impacts of these future phases, which may follow leasing.

F.2 Direct and Indirect Impacts

Direct and indirect impacts are considered in **Chapter 3**, consistent with direction provided in 40 CFR 1502.16.

> **Direct Effects**—Effects that are caused by the proposed action and occur at the same time and place (40 CFR 1508.8). Examples of direct effects are filling of wetlands through the placement of gravel pads, and direct mortality of wildlife or vegetation.

> **Indirect Effects**—Effects that 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 GIS and other applications; in the absence of quantitative data, best professional judgment prevailed. 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 potential impact would 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 affect most or all of the program area, and regional impacts would extend beyond the program area boundaries.

Duration—Describes the length of time 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.

Intensity—Impacts are discussed using quantitative data where possible.

F.2.1 Social Costs of GHG Emissions

A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with greenhouse gas (GHG) emissions was developed by a federal Interagency Working Group on Social Cost of Carbon (IWG), to assist agencies in addressing Executive Order (EO) 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, BLM has received requests to expand the use of SCC estimates to program and project-level National Environmental Policy Act (NEPA) analyses.

The decision was made not to expand the use of the SCC protocol for the oil and gas leasing actions discussed in this Leasing EIS for several reasons. Most notably, these leasing actions are not rulemaking for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued EO 13783 which, among other actions, directed that the IWG be disbanded and that the technical support documents upon 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 social cost of carbon and greenhouse gases 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 (OMB) 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 OMB 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 program decisions like this Leasing EIS.

Further, NEPA does not require a cost-benefit analysis (40 CFR Section 1502.23), although NEPA does require consideration of "effects" that include "economic" and "social" effects (40 CFR 1508.8(b)). Without a complete monetary cost-benefit analysis, which would include the social benefits of the proposed action to society as a whole and other potential positive benefits, including only an SCC cost analysis would be unbalanced, potentially inaccurate, and not useful to the decisionmaker. The economic analysis in this EIS, as discussed in **Section 3.4.10**, Economy, is a regional economic impact analysis utilizing input-output modeling. Regional economic impact analyses describe effects that agency activities may have on economic conditions and local economic activity, generally expressed as projected changes in employment, labor income, and economic output (Watson et al. 2007). 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 that they desire to have occur whereas another person may view increased economic activity as negative or undesirable due to 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 and was not performed in this EIS.

The fact that climate impacts associated with GHG emissions were not quantified in terms of monetary costs does not mean that climate impacts were ignored in this EIS. The EIS refers readers to Sections 3.1.1.1 and 3.1.1.2, respectively, of the Greater Mooses Tooth 2 (GMT2) Development Project Final Supplemental Environmental Impact Statement (SEIS) (BLM 2018) for descriptions of climate change trends in the Arctic and on the North Slope. Also, regarding the potential effects of climate change on the region, the reader is referred to Section 3.1.1.3 of the GMT2 SEIS (BLM 2018). In addition to the qualitative climate change discussions discussed above, the BLM quantified the direct and indirect GHG emissions associated with potential energy development that could result from post-leasing oil and gas activities discussed in this EIS (see **Tables 3-3** and **3-4**). Furthermore, **Table 3-2** provides an inventory of recent GHG emissions at various geographic scales, in units of million metric tons per year, for which development-related emissions can be compared against to provide an estimate of the relative contribution of such emissions at various geographic scales.

The BLM took the approach of referencing climate change trends and potential climate impacts at different scales and calculating direct and indirect GHG emissions 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 and 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 one metric ton increase in a single year—and includes, but is not limited to, 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, especially given that there are no current criteria or thresholds that determine a level of significance for social cost of carbon monetary values.

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; however, when they are 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 as follows:

> …the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

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 reasonably foreseeable future actions, could interact or accumulate over time and space, either through repetition or combined with other impacts, and 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**.
- Describe the potential direct and indirect effects of future oil and gas exploration, development, and production. As noted above, issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 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, issuance of a lease represents an irretrievable commitment of oil and gas resources for potential future exploration and development activities, subject to further environmental review and authorization, that would result in impacts on the environment. The impacts of such future exploration and development activities that may occur because of the issuance of leases 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 Coastal Plain. Therefore, the analysis in Chapter 3 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 timeframe may vary between resources depending on the historical data available and the relevance of past events to the current baseline.
- Identify past, present, and reasonably foreseeable future actions (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 in nature. 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 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 reasonably foreseeable future actions, 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 timeframe for cumulative impacts analysis spans from the 1970s through full realization of the hypothetical development scenario (**Appendix B**), which is anticipated to occur approximately 50 years after the Record of Decision for this EIS is signed, recognizing the timeframe for production could be more or less than 50 years given the speculative nature of the hypothetical development scenarios. The geographic scope generally encompasses the program area and the North Slope but extends beyond these areas for some resources (e.g., terrestrial wildlife), including into Canada. 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 Reasonably Foreseeable Future Actions

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 natural events. Past actions were identified using agency documentation, NEPA analyses, reports and resource studies, peer-reviewed literature, and best professional judgment.

The term reasonably foreseeable future action (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 50 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 timeframe of the EIS. Projects and activities considered in the cumulative effects analysis are summarized in **Table F-1** and are discussed in more detail below.

Table F-1
Past, Present, and Reasonably Foreseeable Future Actions Considered in the Cumulative Effects Analysis

Category	Area	Actions/Activities	Description
Oil and gas exploration, development, and production	● Onshore North Slope ● State and federal waters (Beaufort Sea) ● Western Canadian Arctic	● Geological and geophysical surveys ● Infrastructure development ● Gravel mining ● Geotechnical borehole surveys ● Construction and maintenance ● Exploration activities ● Production wells ● Surface, air, and marine traffic ● Scientific research for avian studies, bathymetry, cultural resources, and fisheries (directly related to oil and gas)	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/barging to Kaktovik ● Aircraft traffic	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.
Subsistence Activities	● Kaktovik ● Nuiqsut ● Arctic Village ● Venetie ● Western Canadian Arctic	● Hunting ● Trapping ● Fishing ● Whaling ● Sealing ● Traveling ● Berry Picking	Anticipate a continuation of traditional past and present subsistence practices (See **Section 3.4.3**, Subsistence Uses and Resources) 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/Scenic viewing and photography ● Sport/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**, Recreation). See below for an additional discussion.
Scientific Research	● Onshore North Slope ● Nearshore waters ● OCS waters ● Arctic National Wildlife Refuge	● Arctic National Wildlife Refuge 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.

Category	Area	Actions/Activities	Description
Community Development	• Kaktovik • Arctic Village • Venetie • Utqiaġvik • North Slope Borough	• 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 GMT2 SEIS (BLM 2018 Section 3.2.4) and are projected to continue and interact with other reasonably foreseeable future actions within 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

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 over the summer [May-August]), using 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 include 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. The discussion does not include small discoveries and undiscovered resources that are unlikely to be developed within the temporal scope of this EIS. The following reasonably foreseeable future onshore oil and gas projects are included in the cumulative effects analysis:

- **SAExploration 3-Dimensional (3D) Seismic Exploration Surveys**—Proposed 3D seismic exploration of the Coastal Plain of the Arctic Refuge if approved by the BLM would begin in winter 2019/2020. The project would include access to the program area from Deadhorse, storage of fuel, and up to two mobile camps, each capable of housing up to 160 people. It is expected that there would be a total of 360 miles of snow trails associated with moving up to two camps across the program area. There would be approximately 50 trailers including support trailers that make up a camp. Fuel would be delivered daily by ground vehicle to camps. Crew changes would occur twice weekly, either by aircraft or ground vehicle. Seismic operations would be conducted using 12 to15 rubber-tracked vibrators and 20,000 to 25,000 wireless autonomous recording devices for each of the two crews. Vibroseis vehicles would be positioned between 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**—The Liberty Prospect is located 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 construction of 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**—Point Thomson is a gas condensate field that is producing condensate that is shipped via a 22-mile oil pipeline 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**—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 and a Central Processing Facility, 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 (US) for screeding at the Oliktok Dock.
- **Alpine CD-5**—This Alpine field satellite development drill site is on Alaska Native Claims Settlement Act (ANCSA) corporation lands near Nuiqsut and is the first commercial oil production from the National Petroleum Reserve in Alaska (NPR-A). CD-5 went into production in late 2015. As a satellite to the Alpine Central Processing Facility (CPF), CD-5 has only minimal on-site processing facilities; however, it required 6 miles of gravel road, four bridges, and 32 miles of pipelines including completion of a gravel road and natural gas pipeline from Alpine CPF into Nuiqsut. ConocoPhillips Alaska, Inc. plans to continue drilling an additional 18 wells at CD-5 after the original 15 wells are completed for an eventual total of 33 wells.
- **Greater Mooses Tooth**—The Greater Mooses Tooth-1 (GMT1) project is the first commercial development on federal lands in the NPR-A; first oil production was achieved 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 existing CD-5 road and pipeline extension. The drilling pad can support up to 33 wells; initially it will only have nine wells. Production from GMT1 is expected to peak at 25,000 to 30,000 barrels of oil per day. The Greater Mooses Tooth-2 (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 8.2-mile gravel road and pipeline will connect through GMT1 and on to Alpine CPF through the existing CD-5 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**—The Willow oil and gas prospect is located on Federal oil and gas leases ConocoPhillips holds within 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 a central processing facility, infrastructure pad, up to five drill pads with up to 50 wells on each pad, access and infield roads, an airstrip, pipelines, and a gravel mine on BLM-managed lands within the NPR-A. The Master Development Plan/EIS being prepared by the BLM will analyze the connected action of a temporary island to facilitate module delivery via sealift barges which would occur within waters managed by the State of Alaska. First production is currently anticipated around 2024-2025.
- **Greater Prudhoe Bay/Kuparuk**—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.
- **Beaufort Sea Outer Continental Shelf (OCS) Oil and Gas Lease Sale**—The Bureau of Ocean Energy Management is developing an EIS for the 2019–2024 National OCS Oil and Gas Leasing Draft Proposed Program. It provides for three OCS oil and gas lease sales in Alaska's Beaufort Sea,

one each in 2019, 2021, and 2023. Even though the planning process has begun for these potential lease sales, a decision has not yet been made as to whether the sales will actually be held. The area identified for the potential lease sale includes the entire Beaufort Sea OCS planning area.

- **Alaska LNG Project**—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 is an alternative to the Alaska Standalone Gas Pipeline, below, so it is noted that only one of these projects would create potential impacts.
- **Alaska Stand Alone Gas Pipeline**—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 5 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 West Dock would likely require improving the dock facilities and dredging to deepen the navigational channel to the dock head.
- **Arctic Strategic Transportation and Resources (ASTAR)**—The ASTAR 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 synergies between public and private projects.

  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.

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 in the Arctic Refuge and 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.

Subsistence Activities

Subsistence activities occur throughout the program area and in the surrounding areas, including the western Canadian Arctic. Subsistence hunters primarily use off-highway vehicles, boats, and snowmachines for access. The types of subsistence uses and activities that were described in **Section 3.4.3**, Subsistence Uses and Resources, are expected to continue. Current and past hunting, gathering, fishing, and trapping subsistence activities 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

Until recently, recreation and tourism activities are generally pursued by non-resident visitors to the program area and surrounding areas. While a very small number of local residents have historically participated in recreational guiding and tourism, since 2010 residents have developed tourism around polar bear viewing, and in 2017 over 50 percent of the visitors to the program area are served by locally-owned tourism businesses. With the exception of adventure cruise ships that transit the Beaufort Sea coast in small numbers, there is a concentration of air sightseeing traffic in the Arctic Refuge. The types of recreation and tourism that were described in **Section 3.4.6**, Recreation, are expected to continue. Current and past sport hunting and fishing, or other recreation or tourism-related activities would be similar in the types of activities and areas used by the communities in the analysis area in the foreseeable future. Transport associated with recreation and tourism includes aircraft and powered and non-powered vessel traffic.

Scientific Research

There are scientific research programs that take place in the program area and the Arctic Refuge. These activities involve vessel, air, and overland transport of researchers and equipment, and 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 new airport in Kaktovik 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. Climate change could affect the habitat, behavior, distribution, and populations of fish and wildlife within 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 SEIS (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 which seem unlikely to occur within 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.

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 ANCSA corporations. Although there are no present plans to develop these non-federal lands for oil and gas, leasing in the Coastal Plain could result in exploration and development of recoverable hydrocarbons. Future NEPA analyses associated with Coastal Plain 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 have cascading or synergistic impacts on other resources. For example, water quality affects fish populations, which in turn influences subsistence harvests, which can have implications for other human outcomes such as health and sociocultural systems. As a result, there is some overlap among the resource sections in **Chapter 3** 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
Emissions of greenhouse gases from exploration, production, processing, and consumption of oil and gas.	Cumulative addition to global atmospheric concentrations of GHGs, potentially contributing to climate change.	Mass per year (tons per year or metric tons per year) of greenhouse gas (GHG) emissions from petroleum production.

Impact Analysis Area

- Direct/Indirect—Program area; development/production GHG emissions estimates.
- Cumulative—Coastal Plain GHG emissions compared with Alaska, the US, and global total GHG emissions.

Analysis Assumptions

- Coastal Plain oil production will not significantly increase the global market, that is, it would not significantly alter global demand and consumption of fossil fuels.

F.4.2 Air Quality

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Leasing	Direct	• Exceedances of National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS) • Impacts on Air-quality Related Values (AQRVs)
Fuel combustion in construction equipment, aircraft, vehicles, and machinery such as drill rigs, generators, pumps, and compressor by phase	Indirect, short term (seismic surveys and exploratory drilling) Indirect, long term (buildout of develop units and production)	• Exceedances of NAAQS/AAAQS • Impacts on AQRVs
Construction of ice roads and airstrips to access and construct the central processing facilities (CPFs) and satellite well pads. Development of gravel pits, which are not included in the 2,000-acre surface disturbance cap, to provide materials for road and pad construction	Indirect, long term Localized, intermittent, and temporary	• Exceedances of NAAQS/AAAQS
Operation of gravel pits	Indirect, long-term Localized, temporary	• Exceedances of NAAQS/AAAQS
Use of roads	Indirect, long-term Localized	• Exceedances of NAAQS/AAAQS
Regional sources of air emissions	Cumulative	• Exceedances of NAAQS/AAAQS • Impacts on AQRVs

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—North Slope

Analysis Assumptions

- Because the location, timing, and level of future oil and gas development in the Coastal Plain is unknown at this time, the BLM has determined that a qualitative assessment is the appropriate form of analysis for this EIS.
- Future on-the-ground actions requiring BLM approval will require further NEPA analysis based on specific and detailed information about what kind of activity is proposed and where it will take place. Additional site-specific terms and conditions that may be required before any oil and gas activity is authorized will be determined as part of this future site-specific NEPA analysis.

F.4.3 Acoustic Environment

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Noise generated by drilling • Noise generated by aircraft used in fluid minerals activities • Noise generated in the construction and operation of roads, well pads, and other ancillary support activities	Noise disturbance to people and wildlife	• Sound intensity index—the relationship of background noise to an introduced sound level. • Distance to inaudibility • Number of flights per day • Acres closed to leasing and designated NSO

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area and community of Kaktovik

Analysis Assumptions

- Ambient noise levels are approximately 35 decibels (dB) in the Coastal Plain.
- Decibels typically attenuate at a rate of 6 dB per doubling of distance.
- Relationships of sound differences and audibility tables tabulated for the GMT2 SEIS analysis (BLM 2018) are generally representative of this EIS.

F.4.4 Physiography

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Temporary structures along coast • Gravel infrastructure • Gravel mines	Coastal erosion and deposition is both a direct and an indirect impact. Gravel infrastructure and mines are a direct impact on topography.	• Footprint of gravel fill, in acres • Size of gravel mines, in acres

Impact Analysis Area

- Direct/Indirect—Hypothetical development footprint for future gravel infrastructure and gravel mining within the program area
- Cumulative—Program area

Analysis Assumptions

- None

F.4.5 Geology and Minerals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Gravel fill at locations of important bedrock exposures • Development could affect the risk of some geologic hazards • No impacts on mineral resources other than petroleum and aggregate resources, which are addressed in other sections	Direct impacts on important bedrock exposures	Discussion is qualitative

Impact Analysis Area

- Direct/Indirect—Hypothetical development footprint for future gravel infrastructure and gravel mining within the program area
- Cumulative—Program 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	n/a

Impact Analysis Area

- Direct/Indirect—Reduction in oil and gas resources available in the program area.
- Cumulative—Program area

Analysis Assumptions

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

F.4.7 Paleontological Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Ground disturbance caused by facilities development ● Gravel fill at locations of bedrock exposures with high potential fossil yield classification (PFYC) rankings ● Gravel extraction ● Drilling	If gravel fill is placed over certain bedrock outcrops identified as having high paleontological yield potential, it would make them inaccessible for research. Infrastructure and increased human access would increase access to paleontological resources, which could result in potential looting and removal as well as adding to the identification and scientific body of knowledge of resources in the area.	● PFYC ranking of mapped units ● Proximity to mapped units with assigned PFYC rankings

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumption

- PFYC rankings of 3, 4, 5, and U will require further field investigation for individual exploration projects.

F.4.8 Soil Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
● Material resources extraction sites ● Access roads, pads, staging areas, and airstrips (gravel fill or ice) ● Off-tundra travel ● Construction of structures, such as pipeline vertical support members, and building foundations ● Reclamation of embankments and pads	● Direct surface disturbance to vegetation ● Removal of surface-insulating organics to cause thaw of frozen soils and destruction of surface landforms ● Sand and gravel mining in streams affecting stream structure ● Placement of fill for construction of pads and roads ● Installation of piling for vertical support members and infrastructure foundations	● Acres of disturbance to soil and permafrost ● Changes to soil and permafrost from placing fills for embankments and pad ● Changes to erosion of soil from placement of fills for embankments and pad ● Extent of fugitive dust ● Changes in drainage patterns due to permafrost thaw and redirection by embankments

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Up to 2,000 acres of disturbance will occur on/across frozen soils under each action alternative.
- Pads and roads will be constructed to minimize potential thaw of frozen soils (use of thicker embankments or insulation).

- Water ponding will occur at base of embankments.
- Ice roads will be used to access material sites.
- Roads and pads will be reclaimed.

F.4.9 Sand and Gravel Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Material resources extraction sites • Ice access roads • Reclamation	• Direct surface disturbance to vegetation; removal of surface-insulating organics to cause frozen soils to thaw and destruction of surface landforms • Sand and gravel mining in streams • Placement of fill for construction of pads and roads • Changes in surface drainage and water impoundment • Changes in erosion where surface vegetation is removed.	• Acres/volume of material removed

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program 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 included in 2,000-acre development limitation.

F.4.10 Water Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Sand and gravel mining	• Removal of subsurface material • Alteration of surface water flow patterns • Creation of thaw bulbs in permafrost • Placement of gravel fill, disrupting recharge • Increased sedimentation	• Change to surface water flow • Change to water levels • Change to surface water quality • Change to groundwater
Camps and facilities	• Lower water levels from potable water, fire suppression, and maintenance activities • Discharge of treated domestic wastewater	• Change to surface water quality • Change to water levels • Change to surface water flow
Construction and maintenance of gravel pads, roads and air access facilities	• Alteration of flow patterns • Oil spills	• Change to surface water flow • Change to surface water quality • Change to water levels • Change to groundwater levels • Change to marine water quality

Action Affecting Resource	Type of Impact	Impact Indicators
Installation of culverts and bridges	• Alteration to stream hydraulics and drainage patterns • Inundation and starvation of areas	• Change to surface water flow • Change to surface water quality
Pipeline construction	• Increased sedimentation during construction • Water contamination due to oil spills	• Change to surface water flow • Change to surface water quality
Snow roads	• Alteration of natural drainage patterns	• Change to surface water flow
Ice roads, bridges, pads, and airstrips	• Alteration of natural drainage patterns • Lower lake levels • Ice jamming during breakup	• Change to surface water flow • Change to surface water quality • Change to water levels
Barge docks and seawater treatment plant construction and operation	• Increased turbidity during construction • Oil spills • Coastal erosion from barge waves	• Change to marine water quality • Change to surface water flow • Change to surface water quality
Drilling and operation	• Disturbance of tundra soils • Oil spills • Lower water levels from hydrostatic testing	• Change to surface water flow • Change to surface water quality • Change to groundwater level • Change to marine water quality

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- The eastern and western program area boundaries follow the Staines River to the west and Aichilik River to the east.
- Impacts on water resources are similar to those described in the GMT2 SEIS (BLM 2018) and other North Slope EISs. Discussions of impacts will be modified where data specific to the program area is available.
- The hypothetical development scenarios have similar impact but vary in scale and intensity, depending on what project is ultimately developed.
- No specific developments or infrastructure needs have been identified beyond the scenarios identified in **Appendix B**.

F.4.11 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/facility construction Introduction of contaminants including petroleum products caused by: ● Spills ● Vehicle accidents/rollovers ● Well blowouts ● Pipeline leaks ● Tank overfills Disposal of unregulated nonhazardous fluids ● Injection of nonhazardous fluids through Class I UIC	● Introduction of contaminants including petroleum products and heavy metals caused by the development and operation of facilities ● Temporary and permanent storage of solid waste generated from activities (storage area, landfill, or monofill) ● Air quality impacts from burning solid waste ● Design and implementation of wastewater facilities ● Creation of landfill, monofill, other ● Management of spills ● Underground injection well ● Staging and storage areas ● Underground injection control (Class I or II wells)	● Solid waste cubic yards per day (based on annual average ● Solid waste generated per day, calculations for air emissions of burning solid waste. ● Sewage lagoon to be x acres to treat y volume per day (based on annual average). ● Underground injection control wells depth of discharge and quantity

Impact Analysis Area

- Direct/Indirect—Direct impacts evaluated for the geographic extent of hypothetical future development areas (up to 2,000 acres of development) within the program area. The indirect impacts area is 0.25 mile outside of the direct impact geographic area.
- Cumulative—Cumulative impacts are evaluated for the same geographic area as the indirect impacts area.

Analysis Assumptions

- Projects will require a stormwater pollution prevention plan (SWPPP), a SPCC, a solid waste general permit, and an ODPCP.
- Facilities will require a facility response plan to operate.
- Wastewater design will require approval from the DEC.
- Class I or II underground injection wells will require a permit/authorization from DEC.
- Storage of greater than 55 gallons (individual 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.
- Access to the landfill or sewage lagoon will be controlled.

F.4.12 Vegetation and Wetlands

Impacts and Indicators—Vegetation

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration: Development of exploration vehicle or other all-terrain vehicle (ATV) trails	Vegetation and plant community alteration from exploration vehicle or ATV traffic	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Exploration drilling: Ice placement for ice roads and pads	Vegetation and plant community alteration from ice placement and operation of ice roads	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Exploration drilling: Water withdrawal from lakes to support ice road and ice pad construction and other uses	Lacustrine (emergent) vegetation alteration from changing water levels	No quantitative indicator available
Project construction: Direct effects of gravel mining	Permanent loss of vegetation types	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Project construction: Direct effects of gravel placement for roads and pads	Permanent loss of vegetation types	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Project operations: Indirect effects of gravel roads and pads and pipeline corridors	Vegetation and plant community alteration from drifted snow and altered drainage patterns	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Project operations: Traffic on gravel roads	Vegetation and plant community alteration from gravel spray and dust fallout	Acreages of vegetation types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.

Action Affecting Resource	Type of Impact	Impact Indicators
Project construction and operations: All disturbances with the capacity to introduce nonnative, invasive species	Changes to plant community structure, with the potential introduction of invasive or noxious nonnative plants	No indicator available to assess possible plant community changes
Project construction and operations: Oil and contaminant spills	Vegetation and plant community alteration from tundra spills	No indicator available to assess possible spill locations in relation to vegetation types

Impacts and Indicators—Wetlands

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic exploration Development of exploration vehicle or other ATV trails	Alteration of wetland types from exploration vehicle or ATV traffic	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Exploration drilling: Ice placement for ice roads and pads	Alteration of wetland types from ice placement and operation of ice roads	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Exploration drilling: Water withdrawal from lakes to support ice road and ice pad construction and other uses	Lacustrine fringe and aquatic wetland alteration from changing water levels	Qualitative discussion
Project construction: Gravel mining	Permanent loss of wetlands and Waters of the US	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Project construction: Direct effects of gravel placement for roads and pads	Permanent loss of wetlands and Waters of the US	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.

Action Affecting Resource	Type of Impact	Impact Indicators
Project operations: Indirect effects of gravel roads and pads and pipeline corridors	Alteration of wetland types from drifted snow and altered drainage patterns	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Project operations: Traffic on gravel roads	Alteration of wetland types from gravel spray and dust fallout	Acres of wetlands and water types in accessible areas for each alternative, stratified by oil potential and EIS-specific development stipulations; site-specific acreages were not used due to hypothetical anchor development location and poor data quality.
Project construction and operations: All disturbances with the capacity to introduce nonnative, invasive species	Changes to plant community structure in wetlands, with the potential introduction of invasive or noxious nonnative plants	Qualitative discussion on possible plant community changes
Project construction and operations: Oil and contaminant spills	Wetland and plant community alteration from spills on tundra	Qualitative discussion on possible spill locations in relation to wetland types

Impact Analysis Area—Vegetation and Wetlands

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions—Vegetation and Wetlands

- The final footprint of the anchor development, consisting of 1 CPF, roads connecting to six satellite pads, a seawater treatment plant and access road, comprises approximately 750 acres for consideration of direct effects. The indirect area was calculated by buffering the 750-acre gravel footprint by 328 feet for an indirect effects area of 6,607 acres.
- The relative proportions for each area open for development under the alternatives and development stipulations will be affected in similar proportions under the anchor footprint. This is because spatially explicit information about where potential projects might be developed was absent for this programmatic EIS format.

F.4.13 Fish and Aquatic Species

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic Surveys: Use of exploration vehicles or other ATVs Use of vibroseis to image the subsurface	Habitat Alteration—Flow alteration and fish passage: Compaction of ice over and surrounding waterbodies could cause short-term delays in melt. Disturbance, injury, or mortality—Increased sound pressure in unfrozen waterbodies, including springs, could disturb, injure, or kill fish.	Qualitative discussion based on best available information.
Water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses	Alteration or loss of winter and summer aquatic habitat due to water withdrawal activities may include the following: ● Changes in water levels ● Ice compaction ● Changes in water chemistry – Declines in dissolved oxygen – Increases in solutes ● Alteration of water flow during breakup (seasonal changes to water quantity and quality) ● Changes in permafrost or groundwater sources ● Loss of littoral habitat and wet meadow zones due to shallowing ● Increased freeze down of substrate used by some aquatic invertebrates Injury or mortality of fish from entrainment or impingement at water intake.	Types and extent of effects by aquatic habitat (lakes, rivers, springs) Describe stream miles and acreage that could be affected
Water withdrawal from marine or brackish water (Seawater Treatment Plant [STP])	Alteration or loss of aquatic habitat due to water withdrawal activities, may include changes in local salinity. Injury or mortality of fish from entrainment or impingement at water intake.	Type of habitat around STP intake offshore. Changes to water quality baseline because of water withdrawal described in **Section 3.2.10**, Water Resources

Action Affecting Resource	Type of Impact	Impact Indicators
Onshore STP facility construction	● Alteration of marine or brackish water habitat (sedimentation) during construction. ● Disturbance (temporary alteration of fish migratory route), injury, or mortality of fish due to ice trenching (winter construction) for intake pipe placement.	General footprint of ice trenching within 0.5-mile buffer zone (to be confirmed from water quality or water resource section) to account for: ● noise effects ● sedimentation
STP discharge to marine waters	Changes to salinity or other water quality from discharge of brine from saltwater treatment plant	● Changes to water quality baseline described in **Section 3.2.10**, Water Resources ● Acres of expected mixing zone.
Gravel mining for road and pad construction	● Alteration or loss of aquatic habitat ● Creation of deep aquatic habitat in gravel pits ● Changes in water quality, including turbidity and mobilization of contaminants ● Direct mortality, if mining occurs in water bodies	Acres of potential habitat affected by mining (acres of gravel sites, assuming all acres would be in rivers), and acres of gravel sites in the 50-year floodplain (indirect impacts on aquatic habitat).
New gravel roads, pads, culverts, and bridges	Direct aquatic habitat loss or blockage of fish passage Indirect aquatic habitat alteration from: ● Gravel dust and spray ● Temporary and periodic turbidity, sedimentation, and contaminant mobilization during gravel placement, compaction, and grading ● Changes in natural drainage patterns, such as water impoundment and ice damming	Describe direct and indirect effects by aquatic habitat types and their context on the landscape.
Vehicle traffic on ice or gravel infrastructure	Displacement of fish due to blocked fish 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	Describe ice infrastructure effects and their context on the landscape. Acres within 328 feet of gravel infrastructure that would be altered by dust or gravel spray. Changes resulting from erosion or thermokarst described in **Section 3.2.8**, Soils

Action Affecting Resource	Type of Impact	Impact Indicators
Barging of materials	Disturbance and displacement of fishes during barging Invasive invertebrate and fish species introduced from released ballast water Accidental spills in marine waters	General description of noise associated with barging.
Barge landing or dock	Potential alteration of rearing or nearshore foraging habitat Disturbance and displacement of fishes	Acres of fill required, type of infrastructure required (such as overwater structure or sea wall) Number of barge trips required
Pipeline construction ● Trenching for optic cable at stream and road-crossings (assumes trenching in, under, or next to pipe)	Loss or alteration of habitat	Describe direct and indirect effects of placing VSMs in the water column by aquatic habitat types and their context on the landscape.
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 assume all work in winter and thus no in-water work) Disturbance, injury, or mortality of fish due to noise or vibration during bridge construction	Describe fish-bearing streams that could require bridges, describe overwintering habitat at or near those waterbodies.
Ice roads and snow management	Displacement of fish or alteration of habitats due to changes in hydrology, melt, and runoff	Miles of ice road anticipated, if known General snow management practices
Potential spills from: ● storage, use, and transport of waste and hazardous materials (including crude oil, fuels, salt water, drilling fluids, and other chemicals). ● wells, pipelines, or other infrastructure.	Habitat alteration or loss due to spills or leaks Injury or mortality of fish from spilled material if it enters water bodies	Described on broad level by habitat type (e.g., nearshore, mountain streams, and springs) and species affected
ATV activity on tundra (for operations, pipeline maintenance, and spill preparedness and planning)	Habitat alteration due to compression or damage to vegetation resulting in soil exposure, sediment runoff, and contaminant mobilization	Qualitatively describe by habitat type (e.g., mountain streams and springs) and species affected.

Impact Analysis Area

- Direct/Indirect—The program area plus the upstream extent of overwintering habitat for fishes. The nearshore area within the barge route, STP mixing zone, or other connected actions.
- Cumulative—Many of the species have life histories that include migrations from the program area west to Utqiagvik, east to the Mackenzie River, and upstream into freshwaters of the larger Arctic Coastal Plain

Analysis Assumptions

- The BLM leases are for onshore development; offshore activities could be considered connected actions, but the analysis does not include offshore infrastructure.
- A barge landing or dock will be part of the alternatives.
- There is more fish and aquatic invertebrate use of program area waters than have been confirmed to date (use over a broader area and by a higher number of species).
- There are contradictions in known ranges for certain species, such as Pink salmon, and slimy sculpin. These species are present and use the program area.
- Alternatives will include water withdrawal either from freshwater sources or, more likely, from marine waters via an onshore STP.

F.4.14 Birds

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic surveys by exploration vehicles in winter	Compaction of snow and vegetation, delayed melt in rolligon footprints	Habitat affected (qualitative)
Gravel placement for roads and pads	Habitat loss	Acres of habitat affected
Gravel placement (roads and pads) and construction of pipeline corridors	Habitat alteration from drifted snow and altered drainage patterns	Acres of habitat affected (use dust fallout buffer)
Road traffic on gravel roads	Habitat alteration from gravel spray and dust fallout	Acres of habitat affected (use dust fallout buffer)
Ice placement for ice roads and pads to support winter exploration and construction	Habitat alteration by ice roads and pads	Habitat affected (qualitative)
Water withdrawal from lakes to support ice road construction, water supply, dust suppression, and other uses	Habitat alteration by reduced/fluctuating water levels, loss of nesting sites on lakeshores, and reduced water quality and fish availability	Describe extent of effect in qualitative terms by aquatic habitat (lakes, rivers, springs)
Water withdrawal from and discharge to the marine environment (STP)	Alteration of aquatic habitat (salinity) for fish (consumed by birds) and potential injury to or mortality of fish at intake	Describe changes in water quality (refer to **Section 3.2.10**, Water Resources) and area of potential mixing zone
Gravel mining	Habitat loss: with rehabilitation after abandonment, potential creation of avian habitats previously absent on that site for some species	Habitat affected (qualitative)
Road traffic, air traffic, noise, and human activities	Disturbance and displacement of birds from affected areas	Acres of habitat affected (noise buffer)

Action Affecting Resource	Type of Impact	Impact Indicators
Road traffic	Injury and mortality from accidental collisions	Describe potential for vehicle collisions
Potential spills from: ● storage, use, and transport of waste and hazardous materials (including crude oil, fuels, salt water, drilling fluids, and other chemicals). ● wells, pipelines, or other infrastructure.	Injury and mortality from accidental releases, discharges, or insecure containment Habitat alteration or loss due to spills or leaks	Describe potential for accidental exposure for individuals and habitats
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
Barging materials and modules	Disturbance and displacement of birds from nearshore habitats, potential alteration of aquatic habitats by open-water dredging	Describe potential displacement of birds
Human activities, including road and air traffic	Disturbance and displacement of large flocks of staging snow geese	Potential disturbance and displacement (no estimate of distance effect)

Impact Analysis Area

- Direct/Indirect—Program area and adjacent marine habitats;
- Cumulative—North Slope from NPR-A east to Arctic Refuge and Canada border

Analysis Assumptions

- For many actions, impacts can be described qualitatively either because resource and impact data are unavailable, or project details are uncertain or unknown at the time of this preliminary analysis. For most types of habitat impacts and for some types of behavioral disturbance, semi-quantitative estimates of areas affected are possible.
- Habitat Loss and Alteration (including disturbance and displacement): An upper limit of 2,000 acres is set by the Public Law 115-97.
  - Using a drawing of a standardized anchor field footprint (one CPF and six radiating access roads to six drill pads, one STP pad and 30-mile access road, totaling 750 acres), estimate the area within 328 feet (for impacts of dust fallout, gravel spray, thermokarsting, and impoundments) and within 656 feet (for impacts of disturbance and displacement).
  - Extrapolate to a footprint of 2,000 acres using the proportional increase in area that was calculated for each buffer area based on the 750-acre footprint.

F.4.15 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, other ungulates, carnivores (including denning grizzly bears), and small mammals	Area (acres or square miles [mi²]) available for seismic activity under different alternatives
Ice placement for ice roads and pads to support winter exploration and construction	Habitat alteration by ice roads and pads	Area (acres or mi²) available for ice road placement by habitat type and alternative, and by high, medium, low oil potential
Gravel placement for roads and pads	Direct habitat loss	Area (acres or mi²) available for gravel road placement by habitat type and alternative, and by high, medium, low oil potential
Traffic on gravel roads	Habitat alteration from gravel spray and dust fallout	Area (acres or mi²) of affected habitat, by habitat type
Gravel mining	Direct habitat loss With rehabilitation after abandonment Indirect habitat loss by disturbance during mining	Area (acres or mi²) of affected habitat, by habitat type
Road traffic, air traffic, noise, and human activities	Disturbance and displacement of caribou and other species from affected areas	Proportion of years that areas are used by PCH per season.
Roads and pipelines	Potential obstructions to caribou movements to and from insect-relief habitat Habitat loss due to spills or leaks	Proportion of CAH caribou using the program area alternatives by season (based on percent of seasonal use density from kernel density) Proportion of years areas are used by PCH caribou by season
Road traffic	Injury and mortality from accidental collisions	Qualitative assessment
Potential spills from: ● storage, use, and transport of waste and hazardous materials (including crude oil, fuels, salt water, drilling fluids, and other chemicals). ● wells, pipelines, or other infrastructure.	Injury and mortality from accidental releases and discharges or insecure containment	Describe potential accidental exposure for individuals and habitats
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

Action Affecting Resource	Type of Impact	Impact Indicators
Roads and pads	Increased or altered access for subsistence hunters, non-local hunters, and other recreationists	Qualitative assessment

Impact Analysis Area

- Direct/Indirect—Program area (non-marine habitats)
- Cumulative—Annual ranges of the PCH and CAH caribou herds.

Analysis Assumptions

- Subsistence hunting will be allowed along gravel roads.
- Access approvals for recreation or non-subsistence uses within the program area will be dealt with at the APD phase when users apply for use permit.
- Oil development may be more likely in the high oil potential area, less likely in the low oil potential area.
- 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 3 weeks, based on research in North Slope oilfields.
- Roads and pipelines may deflect and delay caribou movements, but those effects can be mitigated by appropriate design features (pipeline height 7 feet or more, pipeline/road separation 500 feet or more) and management of human activities, as developed in the existing North Slope oilfields.
- Occupied grizzly bear dens will be avoided by at least 0.5 mile, as stipulated by the State of Alaska.

F.4.16 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/blasting, hauling, and placement	Direct habitat loss of polar bear critical habitat and potential maternal denning habitat from gravel mining and placement Alteration of habitat and temporary loss of use of polar bear critical habitat and potential maternal denning habitat from construction of ice roads and pads Behavioral disturbance of polar bears, especially denning females. Possible den abandonment and loss of cubs Temporary alteration of ringed seal habitat, including lair habitat Behavioral disturbance of ringed seals	Acreage of critical and maternal polar bear denning habitat affected by seismic exploration Apply distance buffer of 1 mile around maternal dens from literature-based assessment of disturbance from equipment operation and noise, and regulatory requirements under ITRs Acreage of nearshore, coastal habitat (less than 3m bathymetry limit) possibly used as lair sites for ringed seals that could be affected by seismic exploration Apply NMFS-approved distance buffer around known ringed seal lairs

Action Affecting Resource	Type of Impact	Impact Indicators
Marine vessel traffic during open-water season	Behavioral disturbance of marine mammals by vessel passage and off-loading during open-water season Behavioral disturbance to polar bears onshore related to landings of marine vessels	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 from vehicle strikes	Apply distance buffer of 1 mile from literature-based assessment of disturbance from equipment operation and noise, and 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 or mortality of some polar bears Injury and mortality from accidental releases and discharges or insecure containment	Qualitative assessment, considering ROPs for waste handling and human/bear interaction plans

Impact Analysis Area

- Direct/Indirect—Program 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 only, except for those 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 the Biological Assessment and Biological Opinion, which are being prepared separately.
- Maternal den surveys for polar bears will be conducted before any activities occur in the program area, so that occupied dens can be avoided by at least 1 mile during exploration and development. All dens may not be identified during den surveys.
- An average of two barge landings per year is anticipated; the number of transports would vary based on ice conditions and the large equipment needed for upcoming development phases.
- Barge landings may require benthic 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).

F.4.17 Landownership and Use

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas open/closed to leasing and infrastructure development • Protective measures that influence the placement or design of uses	Restrictions on infrastructure development, including type, location, and design	• Acres made available for lease sale where new oil and gas related uses could be developed • Acres where protection measures would influence the design, location, and season or type of use
Landownership changes	Conveyance of lands out of federal ownership	Acres of landownership

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- 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 ownership as part of this EIS.

F.4.18 Cultural Resources

Impacts and Indicators

Note: Types of impact are not mutually exclusive and may occur across all actions impacting 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/loss of context • Vulnerability to erosion • Theft and vandalism	• Number of previously documented AHRS and TLUI sites in potentially affected area • Eligibility status of cultural resource sites • Traditional knowledge of culturally sensitive areas and traditional use areas and sites
Proposed operational infrastructure: • CPFs • Drill rigs and pads • Pipelines/VSMs • Roads • Material sites	• Change in character and setting • Change in use or access to traditional sites • Proximity of proposed Project components to culturally sensitive areas	• Same as above
Operations: • Traffic • Human presence • Maintenance and security activities • Proposed program policies	• Introduction of vibration, noise, or atmospheric elements, such as visual, dust, and olfactory • Increased access to culturally sensitive areas	• Same as above
Oil Spills	• Physical destruction or damage, including issues with dating damaged artifacts	• Same as above

Action Affecting Resource	Type of Impact	Impact Indicators
General Development	• Loss of cultural identity with a resource • Impacts on beliefs and traditional religious practices • Neglect of a cultural resource that causes its deterioration • Lack of access to traditional use areas and impacts on broader cultural landscape	• Same as above

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—North Slope

Analysis Assumptions

- All unsurveyed areas of the program area could contain cultural resources. Furthermore, past surveys have been cursory and likely did not adequately identify cultural resources.
- Cultural resource sites are treated as eligible for listing on the NRHP, until they are sufficiently evaluated as determined by the BLM.

F.4.19 Subsistence Uses and Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Noise, traffic, and human activity: • Construction noise • Gravel mining • Air traffic • Ground traffic • Seismic activity • Barge traffic • Drilling noise • 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 avoiding development and human activity Increased competition with outsider populations	• Results of **Section 3.3.4**, Terrestrial Mammals and **Section 3.3.5**, Marine Mammals regarding impacts of noise, traffic, and human activity on wildlife • Percent of harvests coming from program area (where data are available) • Percent of harvesters using the program area, by resource • Analysis of material and cultural importance of subsistence species • Analysis of Alaska Wildlife Harvest database—Requires data sharing agreement and estimate 1 month or more to develop agreement and analyze data. • Traditional knowledge regarding impacts on subsistence uses, resources, and activities.

Action Affecting Resource	Type of Impact	Impact Indicators
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 avoiding development infrastructure Increased user access due to use of project roads for subsistence activities Increased competition along new hunting corridors (roads)	● See above
Contamination ● Oil spills ● Air pollution ● Release, discharge, or insecure containment of hazardous materials or wastes	Reduced resource availability due to changes in resource abundance Reduced resource availability due to harvester avoiding contaminated resources Reduced user access due to harvester avoidance because of concerns about contamination	● Results of **Section 3.3.4**, Terrestrial Mammals and **Section 3.3.5**, Marine Mammals regarding impacts of oil spills on wildlife ● Results of **Section 3.2.2**, Air Quality and **Section 3.4.11**, Public Health and Safety regarding impacts of air pollution on wildlife and human health ● 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/personnel Reduced resource availability due to inability to hunt in or around certain infrastructure	● Percent of harvests coming from study area (where data are available) ● Percent of harvesters using the study area, by resource ● Traditional knowledge

Action Affecting Resource	Type of Impact	Impact Indicators
Increased Employment/Revenue	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 **Section 3.4.10**, Economy ● Traditional knowledge
General development	Impacts on cultural practices, values, and beliefs	● Traditional knowledge

Impact Analysis Area

- Direct/Indirect—All areas used by the 22 Alaskan caribou study communities and seven Canadian user groups subsistence study communities
- Cumulative—Same as direct/indirect analysis area

Analysis Assumption

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

F.4.20 Sociocultural Systems

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Changes in income and employment levels	● No economic activity associated with regional or village corporation to many Arctic Village and Venetie residents ● Influx of cash and impacts on social ties and political organizations ● Hiring super household hunters ● Lack of time for subsistence activities ● Increased cash to support subsistence activities	● Results of **Section 3.4.10**, Economy regarding potential changes in employment and income ● Results of **Section 3.4.3**, Subsistence Uses and Resources ● Traditional knowledge
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 resulting from changes in subsistence providers ● Loss of traditional use areas and knowledge associated with those places	● Results of **Section 3.4.3**, Subsistence Uses and Resources regarding impacts on subsistence ● Traditional knowledge

Action Affecting Resource	Type of Impact	Impact Indicators
Influx of non-resident temporary workers associated with project	• Conflicts between subsistence users and workers • Discomfort hunting in traditional use areas	• Results of economy chapter regarding outside workers • Results of **Section 3.4.3**, Subsistence Uses and Resources • 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 **Section 3.4.6**, Recreation • Results of **Section 3.4.11**, Public Health and Safety • Traditional knowledge
Changes in available technologies	• Changes in equipment for subsistence • Changes in transportation routes • Changes in social ties, sharing, and interactions	• Results of **Section 3.4.10**, Economy regarding potential changes in employment and income • Traditional knowledge
General development	• Impacts on belief systems • Impacts on cultural identity	• Traditional knowledge

Impact Analysis Area

- Direct/Indirect—All of the subsistence study communities (Kaktovik, Nuiqsut, Arctic Village, and Venetie).
- Cumulative—Same as direct/indirect analysis area

Analysis Assumption

- There will eventually be oil and gas exploration, development, and production activities in the Coastal Plain similar to other developments on the North Slope

F.4.21 Environmental Justice

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development/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 EO 12898

Impact Analysis Area

- Direct/Indirect—All of the subsistence study communities (Kaktovik, Nuiqsut, Arctic Village, and Venetie).
- 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, and/or Alaska Native tribal entities. This could include such effects identified in any specific resource analysis, but primarily with subsistence, sociocultural, economics, and public health and safety.

- Minority populations and low-income populations are be defined by CEQ guidance on the implementation of EO 12898. The general reference population for this analysis is the State of Alaska.
- Communities specifically included in the local and regional analyses of direct and indirect Environmental justice effects are Kaktovik, Nuiqsut, Arctic Village, and Venetie. These communities have been identified based on the results of the subsistence, sociocultural, economic, and/or public health and safety analyses in conjunction with community demographic information establishing minority and/or low-income population status.

F.4.22 Recreation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Disturbance in priority recreation areas (direct)	• 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, including specially permitted commercial activities • Change in the social setting due to a concentration of users in a smaller area	• Acres of areas made available for lease sales that overlap popular recreation areas and are not subject to NSO stipulations • Acres of surface disturbance that overlap popular recreation areas
Noise, lights, and human activity (direct and indirect)	• Change in the quality of the recreation setting and/or user experiences • Displacement of recreation opportunities (from surface disturbance)	• Acres where protective measures that minimize impacts on recreation would apply
Change in resource values (e.g., wildlife) that contribute to the quality of the recreation setting (indirect)	Change in the quality of the recreation setting and/or user experiences	• Acres where protective measures that minimize impacts on the resource and that contribute to recreation settings and experiences would apply

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Current recreation in the planning area will continue.
- The potential for user interactions between all types of users will increase with increasing use.

F.4.23 Special Designations

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
<u>Marine Protected Areas</u> Lease Stipulation 4 – Nearshore marine, lagoon and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic National Wildlife Refuge Lease Stipulation 9 – Coastal Area <u>Wild and Scenic Rivers</u> Lease Stipulation 1 – Rivers and Streams <u>Wilderness</u> Lease Stipulation 10 – Wilderness Boundary	TL stipulation on major coastal waterbodies and coastal islands between May 15 and until the later of November 1 or sea ice is within 10 miles of the coast of each season, whichever is later. NSO stipulation on coastal waters, lagoons or barrier islands within the boundaries of the Arctic Refuge Coastal Plain area or 2 miles inland of the coast. NSO stipulation for WSRs in the program area within the setback distances outlined in Chapter 2, Alternatives. NSO stipulation within 3 miles of the southern and eastern boundaries of the Coastal Plain adjacent to the Mollie Beattie Wilderness Area.	• Natural Heritage, the primary conservation focus • ORVs, tentative classification, and free-flowing nature of the river segment or corridor • Changes to the untrammeled and naturalness of the program area, opportunities for solitude or primitive and unconfined recreation, and unique or supplemental values

Impact Analysis Area

- Direct/Indirect
  - MPAs—All marine waters and lagoons located within and off the northern coast of the program area.
  - WSRs—Up to 4 miles of either side of the ordinary high water mark of the eligible or suitable rivers in the program area.
  - Wilderness Characteristics, Quality, and Values—Program area.
- Cumulative
  - MPAs—All marine waters and lagoons located within the Arctic Refuge and off the northern coast of the program area.
  - WSRs—Up to 4 miles of either side of the ordinary high water mark of the eligible or suitable rivers in the Arctic Refuge.
  - Wilderness Characteristics, Quality, and Values—All lands in the Arctic Refuge, with an emphasis on the Mollie Beattie Wilderness Area.

Analysis Assumptions

- The MPA in the program area will continue to be managed in accordance with EO 13158, Marine Protected Areas, May 26, 2000, and guidance from the National Oceanic and Atmospheric Administration on their website: https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/
- Any eligible or suitable rivers in the program area will be managed under interim protective measures required by the WSR Act until Congress makes a decision regarding WSR designation into the NWSRS.

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

F.4.24 Visual Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbances, gravel mining, and construction of structures, including pipelines	New structures and disturbances that do not resemble other elements in an undeveloped landscape	Changes to the form, line, color, and texture of landform, vegetation, and water, as well as changes to dark skies and wildlife

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Visual resources in the program area will become more sensitive to visual change; in other words, they will increase in value over time.
- Visual resources will become increasingly important to residents of and visitors to the area.
- Residents of, and visitors to the program area are sensitive to changes in visual quality and to the overall scenic quality of the area that contributes to living conditions and the visitor experience.
- Activities that cause the most contrast and are the most noticeable to the viewer will have the greatest impact on scenic quality.
- As the number of acres of disturbance increase, the amount of impacts on 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 pipelines; 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 of the surrounding viewsheds.
- Best management practices and project design, avoidance, or mitigation can reduce but not entirely prevent impacts on visual resources.
- Due to the slow rate of recovery of vegetation and surface conditions, all impacts on visual resources from surface disturbances will be long-term.
- The BLM visual resource management system/visual resource contrast rating process (BLM Handbook H-8431-1) will be used for site-specific actions.

F.4.25 Transportation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Areas available or unavailable for new transportation infrastructure • Seasonal or other timing-related restrictions on access	• Change in the location or type of new transportation infrastructure allowed	• Acres made available for leasing that are not subject to NSO stipulations where transportation infrastructure could be placed • Acres subject to CSU or TLs that could influence the type, location, or design of transportation infrastructure
New infrastructure limiting public or subsistence access	Change in the level (increase or decrease) of access for public or subsistence use	Acres made available for leasing that are not subject to NSO stipulations where transportation infrastructure could increase or decrease the level of access for the public or subsistence user

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—Program area

Analysis Assumptions

- Roads developed for oil and gas development will not be available for public use but could be seasonally available for subsistence users.
- Commercial and visits from non-residents will continue to increase, thereby increasing the demand for public access
- 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 snowmachine (winter).

F.4.26 Economy

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
• Exploration phase activities • Development/construction phase activities • Operations phase activities • Production of oil and gas resources	• Direct and indirect effects • Employment effects • Income effects • Fiscal effects • Effects on public infrastructure and services • Effects on relevant/selected economic sectors	• Average part-time and full-time jobs (number of jobs) • Income (wages in dollars) • Government revenues (dollars) • Qualitative discussion of potential increase or decrease in economic activity in various economic sectors

Impact Analysis Area

- Direct/Indirect—Local (Kaktovik), regional (NSB), State
- Cumulative—Same as direct/indirect

Analysis Assumptions

- Description of potential oil and gas activities and time frames under each alternative—The RFD assumptions regarding exploration, development, and production activities are the basis for quantifying the magnitude and scale of economic impacts.
- Production volumes by year—Oil production data are used to calculate potential royalty payments and other State and the federal government tax payments.
- Oil price forecasts—The oil price forecast from the Energy Information Administration (EIA) Annual Energy Outlook 2018 was used to quantify the potential royalty payments and other fiscal effects of the proposed project.
- Construction costs and construction schedule—This information was used to calculate direct and indirect (or multiplier) employment and income effects of construction spending, as well as potential government revenues, including oil and gas property taxes and State corporate income taxes. The MAG-PLAN model and data from previous oil and gas development studies in the North Slope served as the basis for developing rough order of magnitude cost estimates.
- Annual operations and maintenance costs of the facilities—This information was used to calculate direct and indirect (or multiplier) employment and income effects of operations and maintenance spending, as well as potential government revenues, including State corporate income taxes. Prevailing operations costs in other North Slope fields were the basis for developing rough order of magnitude cost estimates.
- Tariffs and transportation costs—This information was used to calculate royalty payments. Data on existing tariffs and transportation costs in the North Slope were obtained from the ADOR Revenue Sources Book.

F.4.27 Public Health

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 • Change in Kaktovik resident travel patterns for subsistence harvest
Oil and gas development	Increased construction and vehicle traffic	Change in traffic injury rates
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 use of cabins and camps for subsistence harvesting.
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

Action Affecting Resource	Type of Impact	Impact Indicators
Oil and gas development	Change in demand for the Kaktovik public health system	• Change in unintentional accidents and injuries • Change in oil and gas revenue for the North Slope Borough and Kaktovik
Oil and gas development	Influx of workers into the program area	• Change in infectious disease rates • Increase in drug, alcohol, tobacco rates
Oil and gas development	Economic impacts on health	Change in oil and gas revenue for Kaktovik residents, the North Slope Borough, and Kaktovik
Oil and gas development	Accidents and safety	Changes in Kaktovik resident travel patterns for subsistence harvest

Impact Analysis Area

- Direct/indirect—Program area, including Kaktovik; food, nutrition, and subsistence activities analysis includes the villages of Arctic Village, Nuiqsut, and Venetie. Transboundary impacts are the NWT Gwich'in people, Vuntut Gwich'in people, and Inuvialuit villages in western Canada.
- Cumulative—Program area, including Kaktovik; Food, Nutrition, And Subsistence Activities Analysis includes the villages of Arctic Village, Nuiqsut, and Venetie. Transboundary impacts are the NWT Gwich'in people, Vuntut Gwich'in people, and Inuvialuit villages in western Canada.

Analysis Assumptions

- A health impact assessment will be required for specific oil and gas developments once the lease sale is complete.

F.5 References

BLM (US 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.

Etkin, D., and E. Ho. 2007. Climate change: Perceptions and discourses of risk. Journal of Risk Research 10(5): 623-641.

EO (Executive Order) 13783. 2017. Promoting Energy Independence and Economic Growth. Signed March 28, 2017.

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.

Kotchen, M. J. 2011. Cost-benefit analysis. Chapter in: Encyclopedia of climate and weather, Second edition. Schneider, S.H., editor-in-chief. New York, Oxford University Press: pp 312-315.

NRC (National Research Council). 2009. Informing decisions in a changing climate: Washington D.C., The National Academies Press.

_____. 2010. Informing an effective response to climate change: Washington D.C.., The National Academies Press.

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, CA: Report #3002004657.

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.

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Appendix G

Potential Fossil Yield Classification System

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Appendix G. Potential Fossil Yield Classification System

G.1 INTRODUCTION

The Potential Classification Yield Classification (PFYC) system allows Bureau of Land Management (BLM) employees to make initial assessments of paleontological resources; to analyze potential effects of a proposed action under the National Environmental Policy Act (NEPA); and to conduct other BLM resource-related activities. The PFYC system can also highlight the areas for paleontological research efforts or predict illegal collecting. The system provides a consistent and streamlined approach to determine if a potential action may affect paleontological resources.

The PFYC system provides baseline guidance for assessing paleontological resources. The classification should be considered early in an analysis and should be used to assist in determining the need for further assessment or actions. When considering proposed actions, the PFYC system should be used in conjunction with a map of known fossil localities.

Occurrences of paleontological resources are known to be correlated with mapped geologic units (i.e., formations). The PFYC is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that occur in that geological unit. PFYC assignments should be considered as only a first approximation of the potential presence of paleontological resources, subject to change, based on ground verification.

In the PFYC system, geologic units are assigned a class based on the relative abundance of significant paleontological resources and their sensitivity to adverse impacts. This classification is applied to the geologic formation, member, or other mapped unit. The classification is not intended to be applied to specific paleontological localities or small areas in units. Although significant localities of paleontological resources may occasionally occur in a geologic unit that has been assigned a lower PFYC classification, widely scattered important fossils or localities do not necessarily indicate a higher class assignment. Instead, the overall abundance of scientifically important localities is intended to be the major determinant for the assigned classification.

The descriptions for the class assignments below serve as guidelines rather than as strict definitions. Knowledge of the geology and the paleontological potential for individual geological units are considered when developing PFYC assignments. These assignments must be developed using scientific expertise with input from a BLM paleontologist; however, they may include collaboration and peer review from outside researchers who are knowledgeable about both the geology and the nature of paleontological resources that may be found in each geological unit. Each state has unique geologic maps and unique PFYC assignments. It is possible, and occasionally desirable, to have different assignments for a similar geologic unit across separate states.

G.1.1 Class 1—Very Low

These are geologic units that are not likely to contain recognizable paleontological resources. Units assigned to Class 1 typically have one or more of the following characteristics:

- Geologic units are igneous or metamorphic, excluding air-fall and reworked volcanic ash units.
- Geologic units are Precambrian in age.

Management concerns for paleontological resources in Class 1 units are usually negligible or not applicable. Paleontological mitigation is unlikely to be necessary, except in very rare or isolated circumstances that result in the unanticipated presence of paleontological resources, such as unmapped geology contained in a mapped geologic unit. For example, young fissure-fill deposits often contain fossils but are too limited in extent to be represented on a geological map; a lava flow that preserves evidence of past life, or caves that contain important paleontological resources. (Such exceptions are the reason that no geologic unit is assigned a Class 0.)

Overall, the probability of affecting significant paleontological resources is very low, and further assessment of paleontological resources is usually unnecessary. An assignment of Class 1 normally does not trigger a further analysis, unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized, in order to accommodate an unanticipated discovery.

G.1.2 Class 2—Low

This is assigned to geologic units that are not likely to contain paleontological resources. Such units typically have one or more of the following characteristics:

- Field surveys have verified that significant paleontological resources are not present or are very rare.
- Units are generally younger than 10,000 years before present.
- There are recent aeolian (wind-driven) deposits.
- Sediments exhibit significant physical and chemical changes (i.e., diagenetic alteration) that make fossil preservation unlikely.

Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary, except in occasional or isolated circumstances. Paleontological mitigation is necessary only where paleontological resources are known or found to exist.

The probability of affecting significant paleontological resources is low. Localities containing important paleontological resources may exist, but they are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized to accommodate unanticipated discoveries.

G.1.3 Class 3—Moderate

This is assigned to sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Units assigned to Class 3 have some of the following characteristics:

- Fossils are marine in origin, with sporadic known occurrences of paleontological resources.
- Paleontological resources may occur intermittently, but abundance is known to be low.
- Units may contain significant paleontological resources, but these occurrences are widely scattered.

- The potential for an authorized land use to affect a significant paleontological resource is known to be low-to-moderate.

Management concerns for paleontological resources are moderate because the existence of significant paleontological resources is known to be low. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for casual collecting.

Paleontological mitigation strategies will be proposed, based on the nature of the proposed activity.

This classification includes units of moderate or infrequent occurrence of paleontological resources. Management considerations cover a broad range of options that may include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Surface-disturbing activities may require assessment by a qualified paleontologist to determine whether significant paleontological resources occur in the area of a proposed action and whether the action could affect the paleontological resources.

G.1.4 Class 4—High

This is assigned to geologic units that are known to contain a high occurrence of paleontological resources. Units assigned to Class 4 typically have the following characteristics:

- Significant paleontological resources have been documented but may vary in occurrence and predictability.
- Surface-disturbing activities may adversely affect paleontological resources.
- Rare or uncommon fossils, including nonvertebrate (such as soft body preservation) or unusual plant fossils, may be present.
- Illegal collecting may affect some areas.

Management concerns for paleontological resources in Class 4 are moderate to high, depending on the proposed action.

Paleontological mitigation strategies will depend on the nature of the proposed activity, but field assessment by a qualified paleontologist is normally needed to assess local conditions.

The probability for affecting significant paleontological resources is moderate to high and depends on the proposed action. Mitigation planners must consider the nature of the proposed disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access that could result in looting. Detailed field assessment is normally required and on-site monitoring or spot-checking may be necessary during land-disturbing activities. In some cases, avoiding known paleontological resources may be necessary.

G.1.5 Class 5—Very High

These are highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources. Units assigned to Class 5 have some or all the following characteristics:

- Significant paleontological resources have been documented and occur consistently.
- Paleontological resources are highly susceptible to adverse impacts from surface-disturbing activities.
- The unit is frequently the focus of illegal collecting.

Management concerns for paleontological resources in Class 5 areas are high to very high.

A field survey by a qualified paleontologist is almost always needed. Paleontological mitigation may be necessary before or during surface-disturbing activities.

The probability for affecting significant paleontological resources is high. The area should be assessed before land tenure adjustments. Pre-work surveys are usually needed, and on-site monitoring may be necessary during land use activities. Avoidance or resource preservation through controlled access, designation of areas of avoidance, or special management designations should be considered.

G.1.6 Class U—Unknown Potential

These are such geologic units that cannot receive an informed PFYC assignment. Characteristics of Class U may include the following:

- Geological units may exhibit features or preservation conditions that suggest significant paleontological resources could be present, but little information about the actual paleontological resources of the unit or area is known.
- Geological units represented on a map are based on lithologic character or basis of origin but have not been studied in detail.
- Scientific literature does not exist or does not reveal the nature of paleontological resources.
- Reports of paleontological resources are anecdotal or have not been verified.
- The area or geologic unit is poorly or under studied.
- BLM staff has not yet been able to assess the nature of the geologic unit.

Until a provisional assignment is made, geologic units that have an unknown potential have medium to high management concerns.

Lacking other information, field surveys are normally necessary, especially before a ground-disturbing activity is authorized. An assignment of Class U may indicate the unit or area is poorly studied, and field surveys are needed to verify the presence or absence of paleontological resources. Literature searches or consultation with professional colleagues may allow an unknown unit to be provisionally assigned to another PFYC, but the geological unit should be formally assigned to a class after adequate survey and research is performed to make an informed determination.

G.1.7 Class W—Water

This class is assigned to any surface area that is mapped as water. Most bodies of water do not normally contain paleontological resources; however, shorelines should be carefully considered for uncovered or transported paleontological resources. Reservoirs are a special concern because important paleontological resources are often exposed during low water intervals. In karst areas, sinkholes and cenotes[1] may trap animals and contain paleontological resources. Dredging river systems may disturb sediments that contain paleontological resources.

G.1.8 Class I—Ice

Includes any area that is mapped as ice or snow. Receding glaciers, including exposed lateral and terminal moraines, should be considered for their potential to reveal recently exposed paleontological resources.

[1]Deep sinkholes formed by the collapse of limestone cavities and having a pool at the bottom fed by groundwater.

Other considerations are melting snow fields that may contain paleontological resources, with possible soft-tissue preservation.

G.1.9 Special Notes

When developing PFYC assignments, the following should be considered:

- Standard stipulations should always be in place before any land use action is authorized, in order to accommodate an unanticipated discovery.
- Class 1 and 2 and Class 4 and 5 units may be combined for broad applications, such as large-scale planning or programmatic assessments, or when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations will need to be addressed when actual land-disturbing activities are proposed.
- Where large projects affect multiple geologic units with different PFYCs, field surveys and monitoring should be applied appropriately. For example, the BLM Authorized Officer may determine that on-the-ground (pedestrian) surveys are necessary for the Class 4 and 5 formations but not for Class 2 formations.
- Based on information gained by surveys, the BLM may adjust PFYC assignments appropriately. Actual survey and monitoring intensities, as well as the extent of discoveries, should be included in any assessment, mitigation, or permit report so the BLM may reevaluate PFYC assignments.
- A geologic unit may receive a higher or lower classification in specific areas where the occurrence of fossils is known to be higher or lower than in other areas where the unit is exposed.
- Some areas are difficult to evaluate, such as talus, colluvium, tailings, fill, borrow, and other mapped features. A PFYC assignment should be made for each area using available information, or the area should be assigned to Class U.
- The BLM-wide PFYC assignments are maintained and periodically updated by the BLM paleontology team and may be obtained by contacting the BLM state or regional paleontologist assigned to an area.

G.2 Coastal Plain Geologic Units' PFYC Descriptions

The PFYC model for Alaska is in development as of November 2018; the excerpts below are preliminary PFYC rankings and descriptions for selected units in the program area.[2] Final rankings, descriptions, and associated citations will be incorporated when the PFYC model is complete.

G.2.1 Unconsolidated and Poorly Consolidated Surficial Deposits

PFYC: 2-3

Most Quaternary, Pleistocene, and uppermost Tertiary deposits have not been given formation names and are frequently mapped based on lithologic character and estimated age. Care should be taken with these deposits with regard to fossil resources, as it is very hard to predict which deposits might be fossiliferous. Many of these types of deposits contain significant flora and fauna, although the distribution of fossils is often spotty. These deposits should not be underestimated for their fossil potential. Recent Holocene and disturbed deposits are ranked very low potential.

[2]B. Breithaupt, BLM Regional Paleontologist, email to Anna Kohl, HDR environmental scientist, on July 30, 2018, regarding preliminary PFYC rankings and unit descriptions for the program area.

G.2.2 Sagavanirktok Formation (Tertiary)

PFYC: 3-4

This formation contains floral fossils (Gryc et al. 1951). Fossil flora were collected from the Sagwon Member of this formation (*Metasequuoia occidentalis*, *Trapa microphylla*, and *Cinnamononum ficoides*; Spicer et al. 1994). There were no fossils from the Franklin Bluffs Member and it is not likely to produce any; the Nuwok Member contains mollusc fossils and prolific microfauna (foraminifers and ostracodes; Detterman et al. 1975). Mull et al. (2003) added the White Hills Member in addition to the Sagwon, Franklin Bluffs, and Nuwok Members. Mollusc fossils were found in what used to unofficially be called the Nuwok Formation (MacNeil 1957).

G.2.3 Jago River Formation (Upper Cretaceous)

PFYC: 3

This formation contains palynomorphs and plant fossils (Buckingham 1987; Molenaar et al. 1987). The Bathtub Graywacke is included in this formation, which does not contain any invertebrate fossils but has some plant fossils; however, the only identifiable material was an equisetum and a few fragments of the marine algae *Tyttodiscus* (Detterman et al. 1975).

G.2.4 Canning Formation (Cretaceous-Tertiary)

PFYC: 2-3

Palynomorphs were used to decide age (Bird and Molenaar 1987).

G.2.5 Seabee Formation (Upper Cretaceous)

PFYC: 4

Marine fossils found are *Scaphites delicatulus*, Borissjakoceras (ammonites), and Inoceramus (Gryc et al. 1951). Pelecypod and ammonite megafauna and microfauna were found in the lower part of the formation, Foraminifera and palynomorphs in upper part (Mull et al. 2003). Pelecypods, ammonites, fish scales, and vertebrae (Lindsey 1986) were also found. The Arctos database listed a therapod or small bird trace fossil (footprint).

G.2.6 Hue Shale (Lower Cretaceous)

PFYC: 3

This includes a bed that is rich in Inoceramus bivalve prisms and fish remains; more Inoceramus prisms are found higher in the formation, along with palynomorphs (Molenaar et al. 1987).

G.2.7 Kemik Sandstone (Lower Cretaceous)

PFYC: 2-3

The was previously a member of the Kongakut Formation. Molenaar (1988) mentions some marine mollusc fossils that were collected below this formation but not that they are from this formation particularly. Trace fossils were Skolithos, Dioplocraterion, Arenicolites, and Ophiomorpha (Reifenstuhl 1995). Arctos database lists: belemnite guards.

G.2.8 Wahoo Limestone (Lisburne Group) (Carboniferous)

PFYC: 3

Lower part of the unit has a brachiopod-bryozoan assemblage and corals; the upper part contains brachiopods (Brosgé et al. 1962). It contains some rugose and tabulate corals, but they are not very abundant (Armstrong and Mamet 1977). Colonial corals *Corwenia jagoensis* and *Lithostrotionella wahooensis* were found (Armstrong 1972).

G.2.9 Alapah Limestone (Lisburne Group) (Carboniferous)

PFYC: 3

Lithostrotionoid corals, broken shells, and fish teeth were found (Bowsher and Dutro 1957), along with molluscs, brachiopods, corals, and gastropods (Dutro 1987) and ammonites, plants, Nautiloids (Lindsey 1986).

G.2.10 Ivishak Formation (Sadlerochit Group) (Triassic)

PFYC: 3

This formation contains ammonoids (Keller et al. 1961). It includes the Kavik Member, Ledge Sandstone Member, Fire Creek Siltstone Member (Detterman et al. 1975). The Kavik Member contains ammonites, pelecypods, and a few microfossils; the Ledge Sandstone Member has sparse brachiopods and ammonites, most of which are fragmentary; and the Fire Creek Siltstone Member contains sparse Euflemingites ammonites and Lingula brachiopods (Detterman et al. 1975).

G.2.11 Echooka Formation (Sadlerochit Group) (Permian)

PFYC: 3

Keller et al. (1961) say this formation is fossiliferous, but they do not say what kinds of fossils. They were raised to the formation level and divided into two members by Detterman et al. (1975). The upper part of the Joe Creek Member is abundantly fossiliferous with brachiopods, and the lower part has more sparse fossils; the upper part of the Joe Creek Member also contains abundant bryozoans and corals and some trilobites and pelecypods (Detterman et al. 1975).

G.2.12 Kongakut Formation (Lower Cretaceous)

PFYC: 2-3

There are buchia shells, some poorly preserved pelecypods, and some microfossils that indicate a similarity to Barremian rocks of the Richardson Mountains in the Yukon Territory (Detterman et al. 1975).

G.2.13 Kingak Shale (Jurassic)

PFYC: 3

Crinoids, bivalves, cephalopods, and ammonites are found in this shale (Leffingwell 1919).

Also included are marine molluscs (bivalves, ammonites, cephalopods, and ammonites) and crinoids (Payne et al. 1951). Early Jurassic fossils in northeast Alaska are sparse but include pelecypods; crinoids are also present in the formation, as well as ammonites and microfossils associated with pelecypods and ammonites (Detterman et al. 1975). There are ammonites from the early Jurassic, but they are not abundant or well preserved (Lindsey 1986). Arctos database: guards from Belemnoidea.

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Appendix H
Water Resources

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Appendix H. Water Resources

Table H-1
Average Monthly Air Temperatures at Barter Island, Toolik Lake, and Kuparuk

	Barter Island Station: Average Monthly Temperature (°F)	Toolik Lake Station: Average Monthly Temperature (°F)	
Month	**2015**	**2017**	**2018**
Jan	no data	no data	no data
Feb	no data	no data	9.2
Mar	no data	no data	8.1
Apr	no data	no data	9.7
May	no data	no data	29.1
Jun	no data	no data	41.6
Jul	no data	no data	no data
Aug	no data	no data	no data
Sep	no data	32.7	no data
Oct	5.2	17	no data
Nov	no data	8.9	no data
Dec	no data	10.3	no data

Adapted from *Global Summary of the Month Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-1 *(continued)*
Average Monthly Air Temperatures at Barter Island, Toolik Lake, and Kuparuk

Kuparuk Station: Average Monthly Air Temperature (°F)																		
Month	**Years**																	
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Jan	-14.4	-11.8	-20.6	-12	-14	-11	-16	-18	-21	-18	-19	-14	23.8	22.5	7.4	0.9	8.6	10.7
Feb	-16.7	-5.7	-22.6	-17	-29	-17	-6.6	-14	-19	-17	-13	-9.5	1	2.3	-10	-16	-8.2	3.9
Mar	-15.5	-19.7	-4.8	-14	-20	-9.3	-19	-21	-21	-22	-13	-8.9	-18	-10	-13	-4.5	-6	-9.3
Apr	-1.8	0.8	3.3	7.1	-1	1.1	-4.5	7.6	9.2	3.6	11	-2.5	-18	-14	-6.3	-5.4	-12	0.8
May	15.3	12.4	27.9	23.8	23.8	23.3	26.2	18.5	27.1	26.7	21.7	23.1	-25	-8.2	-9.8	-7.4	-9.3	-2.2
Jun	43.9	39.2	39.3	37.7	44.7	37.5	46.6	39.6	44.6	39	38.3	-26	-11	4.2	7.6	10.5	4.5	3.6
Jul	46	47.1	45.2	48.5	49.4	40.4	47.6	46.8	49.7	47.5	49.2	-14	-2.9	29.2	31	30.1	25.8	21.2
Aug	41.8	41.5	43.4	40.6	48.1	44.8	40.2	45.8	41.3	45.3	47.4	-29	20.6	38.5	48.1	43.6	38.8	34.5
Sep	32.8	35.1	38.9	33.1	33.8	34.9	39.7	38	34	34.8	37.5	2.2	44.1	45.3	44.4	49.2	52.2	no data
Oct	14.5	8.6	20.2	23.9	18.8	19.2	24.9	19.2	16.9	25	22.2	22	49.3	42.4	41.1	45.4	45.1	no data
Nov	-2.3	-2.4	7.1	-0.3	-1.4	-13	-1	10.7	0.9	-3.2	12.1	41.8	45.8	34.2	30.3	35.3	36.8	no data
Dec	-7.2	-11.8	-3.8	-9.8	-12	-5.9	-4.3	-4.5	-3.1	-3.4	-17	51.4	31.9	22.1	20.3	24.9	21.3	no data

Adapted from *Global Summary of the Month Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation.

Table H-2
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Toolik Lake Station: Average Monthly Precipitation (Inches)		
Month	**Years**	
	2017	**2018**
Jan	no data	0.12
Feb	no data	0.44
Mar	no data	0.2
Apr	no data	0.06
May	no data	0.9
Jun	no data	1.45
Jul	no data	no data
Aug	no data	no data
Sep	0.69	no data
Oct	0.81	no data
Nov	0.62	no data
Dec	0.12	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation.

Table H-2 *(continued)*
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Kuparuk Station: Average Annual Monthly Precipitation (Inches)																		
Month	Years																	
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan	0.09	0.01	0.21	0.09	0.01	0.2	0.19	0.45	0.04	0	0.21	0.22	1.02	0.29	0.5	0.27	0.81	0.83
Feb	0.12	0	0.15	0.13	0.3	0.09	0.11	0.02	0.19	0.17	0.11	0.26	0.36	0.41	0.76	0.05	0.13	0.74
Mar	0.06	0	0.12	0.02	0.3	0.03	0.01	0.06	0.08	0	0.21	0.03	0.15	0.04	0.16	0.21	0.39	0.23
Apr	0.07	0.01	0.14	0.18	0.04	0.05	0.31	0.14	0.09	0.2	0.12	0.07	0.02	0.12	0.3	0.08	0.52	0.37
May	0	0.03	0	0.19	0	0.14	0.04	0.29	0.56	0.04	0.08	0.51	0.02	0.01	0.15	0.2	0.09	0.11
Jun	0.16	0.35	1.05	0.01	0.4	0.01	0.78	0.22	0.43	0	0.05	0.17	0.2	0.09	0.31	0.1	0.11	0.12
Jul	1.12	0.26	1.1	2.22	1.02	1.06	1.67	0.22	1.07	0.45	1.22	0.07	0.91	0.76	0.09	0.11	0.18	0.25
Aug	0.38	1.35	1.93	0.67	0.61	0.5	1.07	0.11	0.62	2.13	0.4	0.1	0.43	0.49	0.14	1.1	0.01	0.3
Sep	0.14	0.25	1.67	0.4	0.97	0.62	0.12	0.01	0.2	0.67	0	0.12	0.31	1.09	0.28	0.81	0.67	no data
Oct	0.13	0.28	0.46	0.87	0.5	0.21	0.35	0.15	0.52	0.33	0.34	0.09	1.77	0.44	2.58	1.63	2.16	no data
Nov	0.03	0.17	0.04	0.11	0.16	0.5	0.23	0.4	0.29	0.11	0.56	0.03	0.89	0.5	0.33	1.63	1.02	no data
Dec	0.05	0.08	0.44	0.14	0.28	0.25	0.27	0.09	0.19	0.15	0.17	0.1	1.02	1.42	0.22	0.28	0.87	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-3
Average Annual Monthly Snowfall at Kuparuk

Kuparuk Station: Average Annual Monthly Snowfall (Inches)																		
Month	**Years**																	
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Jan	4.1	0.6	4	2.4	0.2	3.5	4.3	5.3	1	0.4	7.4	0.6	7.1	5.2	5.1	4.5	17.2	11.2
Feb	5.5	1	1.4	4.8	2.7	2	2.6	0.5	3.4	5.4	3	1.9	3.5	5.2	11.7	1.7	2.5	5.2
Mar	3.3	0.9	1	2.1	5.1	1	0.8	1.2	2.6	0	4.8	0.8	1.7	1	4.1	3.9	1.8	5.2
Apr	4	1.2	1.8	4	1.5	1.3	5.5	3.9	7.2	2.7	2.6	1.9	0.9	2	3.3	1.1	6.3	6.3
May	2	7.4	0	6.5	0	3.7	0.8	10.3	0.8	1.6	0.3	1.3	1	1.5	3.4	5	3.3	1.5
Jun	0	0	1.8	0	0	0.2	0.3	0	0	0	0.3	2.2	4	4.1	10.2	1.3	2.9	0.9
Jul	0	0	0	0	0	0	0	0	0	0	0	1.4	8.9	4.4	0.2	0	0.8	4.3
Aug	1.7	0.1	0	0	0	0	0	0	0	0	0	1.3	4.7	1.4	1	2.5	0	0
Sep	1.5	1.9	3.4	2.8	4.4	0.3	0	0	0.5	3.5	0	3	0	0	0	0	0	no data
Oct	5.5	7.5	15.3	7.9	8	4.7	6.5	5.1	17.3	6.9	9.3	1.6	0	0	0	0	0	no data
Nov	0.7	7.1	2.7	3.3	2	10.2	4.8	15.1	7.5	4.4	13.5	0	0	0.6	3.1	0.2	0	no data
Dec	1.1	4.2	9.3	5.4	2.7	5.3	5.5	3.7	4.3	4.2	4.4	0	6	7	2.8	1.1	3	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/datatools/findstation

Table H-4
Summary of Drainage Basins and Streams in the Coastal Plain

Drainage Basin	Water Bodies (Notable Streams)	Headwater Origin	Receiving Water	Drainage Area (Square Miles)	Length (Miles)
Aichilik River	None	Romanzof Mountains	Beaufort Lagoon	—	75
Akutoktak (Akootoaktuk) River	None	Romanzof Mountains	Okpilak River	97	11.8
Angun River	None	Tundra Drainage	Angun Lagoon, Beaufort Sea	745	30
Canning River	Marsh Fork	Franlin Mountains	Camden Bay	1930	125
Hulahula River	None	Romanzof Mountains	Camden Bay	685	90
Itkilyariak Creek, West Fork	Itkilyariak Creek, Salderochit River	Sadlerochit Mountains	Camden Bay	27	14.8
Jago River	None	McCall Glacier on Mt. Isto, Romanzof Mountains	Jago Lagoon, Beaufort Sea	798	90
Marsh Fork-Canning River	Canning River	Philip Smith Mountains	Canning River	—	50
Niguanak River	None	Tundra drainage	Oruktalik Lagoon	136	14.1
Okpilak	Akutoktak River	Okpilak Glacier, Brooks Range	Camden Bay	—	70
Sadlerochit River	Peters River	Franklin Mountains, Brooks Range	Camden Bay	520	0.2
Sadlerochit Spring Creek	Itkilyariak Creek, Salderochit River	Eastern Sadlerochit Mountains	Camden Bay	0.5	—
Sikrelurak River	None	Tundra drainage	West Fork Sikrelurak River	75	18.5
Tamayariak River	Upper Main Stem, Lower West Fork, Middle Fork, and Upper West Fork of Tamayariak River, Canning River	Sadlerochit Mountains	Beaufort Sea	350	19.3

Adapted from *Water Resource Inventory and Assessment* by the US Dept. of the Interior (1987–1992, Table 2), https://www.fws.gov/alaska/water/arctic.htm, and https://alaska.guide/Rivers.
Re-created from *National Hydrography Dataset: flowlines GIS data*. by the US Geological Survey and https://alaska.guide/Rivers.

Table H-5
Surface Water Discharge

Akutoktak River																
Recording Period	Average Daily Value (Cubic Feet/Second)									Period Measurement Summary						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM*)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 19-Sep 26 1988	280	1000	20	10	20	5.9	33	111	5.5	89	6.03	119*	8/23/1988	23046	0.91	4.45
Jul 6- Aug 20 1989	295	1020	10	129	719	2.4	—	608	66	233	3.57	1703	8/20/1989	29096	2.4	5.62
May 18-Sep 19 1990	27	134	6.9	3	8	1.0	3	11	0.80	38	0.93	215	6/20/1990	9454	0.39	1.83
May 17-Sep 24 1991	255	1230	31	45	314	3.1	36	100	11	111	3.77	768	6/14/1991	28717	1.14	5.55
May 28–Sep 21 1992	180	630	11	10	29	4.3	105	943	7.5	104	5.57	1818	8/27/1992	24202	1.07	4.67

*Cubic Feet per Second per Square Mile
Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service.

Table H-5 *(continued)*
Surface Water Discharge

Itkilyariak Creek, West Fork																
Recording Period	Average Daily Value (Cubic Feet/Second)									Period Measurement Summary						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
1988	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May 27–Sep 22 1989	42	90	4.9	49	320	0.0	101	554	25.0	59	1.88	1419	8/20/1989	13909	2.19	9.69
May 13–Sep 19 1990	30	89	4.9	7.6	49	0.0	5.0	21	1.2	54	0.53	160	6/19/1990	13921	2.01	9.70
May 18–Sep 24 1991	202	1120	37	11	37	6.0	25	173	4.1	85	2.89	276	6/14/1991	19624	3.14	13.68
May 29–Sep 21 1992	78	710	7.7	—	24	15	80	679	3.7	91	—	1255	8/27/1992	14740	3.37	10.27

*Estimate
Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service.

Table H-5 *(continued)*
Surface Water Discharge

Niguanak River (in cubic feet/second unless noted otherwise)																
Recording Period	Average Daily Value (Cubic Feet/Second)									Period Measurement Summary						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
1988	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jun 9–Sep 22 1989	518	1360	53	76	311	18	193	1148	50	259	39.50	2071	8/21/1989	60670	1.90	8.35
May 11–Sep 19 1990	65	138	26	—	21	0.7	—	1	0.0	111	0.00	—	—	29170	0.82	4.02
May 17–Sep 24 1991	716	2000	215	123	515	41	22	52	9.3	282	4.11	1319	6/14/1991	73199	2.07	10.08
May 28- Jul 7 1992	321	1109	90	—	203	92	—	—	—	—	—	—	—	—	—	—

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service.

Table H-5 *(continued)*
Surface Water Discharge

Sadlerochit River																
Recording Period	Average Daily Value (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jul 21–Sep 27 1988	—	—	—	—	846	342	—	1937	695	—	92.91	2194	8/22/1988	—	—	—
Jun 19–Sep 23 1989	—	3315	923	1672	4124	649	159	4385	572	1414	313.63	5733	8/4/1989	271966	2.72	9.80
Jun 11–Sep 3 1990	1333	2678	177	943	1429	633	432	662	271	833	333.05	4857	6/18/1990	140419	1.60	5.06
Jun 4–Sep 24 1991	1793	3715	365	1317	9190	399	692	1732	380	1035	122.67	21000	7/21/1991	203142	1.99	7.32
Jun 2 to Sep 21 1992	1563	2614	123	1670	5656	625	1034	4216	362	1240	88.97	9506	7/26/1992	280395	2.38	10.11

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Sadlerochit Spring Creek																
Recording Period	Average Daily Value (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jul 22–Sep 30 1988	38	40	33	39	40	37	41	44	37	36	28	55	8/16/1988 8/19/1988	25795	—	967
Oct 1 1988–Sep 30 1989	37	42	32	43	52	38	58	81	46	41	28	108	8/20/1989	29334	—	1100
Oct 1 1989–Sep 30 1990	39	40	36	37	40	36	36	36	35	37	28	41	8/18/1990 8/19/1990	26825	—	1006
Oct 1 1990–Sep 30 1991	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oct 1 1991–Sep 30 1992	38	40	36	42	45	40	45	51	45	36	28	61	8/27/1992	26075	—	978

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service.

Table H-5 *(continued)*
Surface Water Discharge

Sikrelurak River																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jun 8–Sep 22 1988	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jun 8–Sep 22 1989	336	1220	16	19	72	1.7	62	235	13	126	4.38	282	8/20/1989	28518	1.69	7.16
May 18–Sep 19 1990	22	47	11	2.2	9.2	1.7	0.3	1.5	0.0	42	0.00	117	9/7/1990	10386	0.56	2.61
May 17–Sep 24 1991	310	1480	44	33	118	13	11	28	4.6	108	3.14	1787	6/4/1991	28004	1.44	7.03
May 28–Sep 14 1992	767	930	15	6	26	1.3	1.4	2.0	1.3	99	1.35	1057	6/10/1992	19654	1.33	4.93

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River																		
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Table								
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)		
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff		
May 26–Sep 26 1988	563	1400	160	70	140	18	312	1039	120	279	21.07	1996	8/12/1988	68526	2.05	9.44		
Jun 1–Sep 22 1989	696	2140	114	242	823	53	338	778	138	383	93.54	997	7/17/1989	86571	2.81	11.93		
May 11 to Sep 19 1990	197	794	88	56	146	30	116	1100	21	247	23.57	4099	9/6/1990	64748	1.82	8.92		
May 17–Sep 24 1991	681	2000	139	288	1400	66	279	2442	72	381	62.13	3244	8/22/1991	98928	2.80	13.63		
May 27–Aug 26 1992	385	1032	109	65	154	32	1777	68	25	217	27.69	2856	8/27/1992	39564	1.59	5.45		
Jun 1–Sep 20 2008	173	347	60	87	457	27	238	1340	27	a	—	—	—	—	—	—		
Oct 1 2008-Sep 30 2009	595	1550	117	68	239	20	172	533	32	94	0.00	2250	6/5/2009	67840	0.63	8.54		
Oct 1 2009-Sep 30 2010	330	704	116	119	310	48	220	1000	39	70	0.00	1570	8/7/2010	50360	0.47	6.34		
Oct 1 2010–Sep 30 2011	311	615	76	71	203	40	57	180	30	88	0.00	3230	5/26/2011	63280	0.587	7.96		
Oct 1 2011–Sep 30 2012	286	775	76	82	249	38	181	465	74	72	0.00	1190	5/31/2012	52070	0.48	6.55		

Note: a denotes statistics not provided by USGS due to partial water year.
Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service and *USGS Water Data Reports 2008–2012 Station 15960000 Tamayariak R near Kaktovik, Alaska.*

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River, Lower West Fork																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 28–Sep 26 1988	403	1380	50	20	40	11	114	392	9.4	155	10.17	496	9/5/1988	38123	1.58	7.28
Jun 1–Sep 20 1989	525	1880	10	115	345	43	153	477	44	221	25.14	647	8/21/1989	49204	2.26	9.40
May 18–Sep 19 1990	43	110	20	11	20	6.1	3.8	6.1	2.2	133	2.41	2455	9/6/1990	32981	1.36	6.30
May 17–Sep 24 1991	493	2050	135	129	960	24	50	241	19	206	21.50	1750	7/23/1991	53649	2.10	10.25
Oct 1991–Sep 1992	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987-\–1992): Appendix A* by the US Fish and Wildlife Service

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River, Middle Fork																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 26–Sep 26 1988	384	1300	50	8.6	40	2.2	100	351	1.4	139	2.02	618	9/5/1988	34185	2.27	10.46
Jun 5–Sep 20 1989	454	1780	26	70	255	14	127	282	43	193	18.87	303	8/21/1989	42889	3.15	13.12
May 11–Sep 19 1990	39	151	12	3.5	11	0.82	0.78	4.7	0.41	69	0.46	637	9/6/1990	18165	1.13	5.56
May 17–Sep 24 1991	373	1580	38	90	800	14	34	225	6.9	144	6.11	1867	6/4/1991	37507	2.35	11.47
May 28–Sep 15 1992	90	470	12	3.7	17	0.80	65	1026	0.60	73	0.71	1455	8/27/1992	16024	1.19	4.90

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service.

Table H-5 *(continued)*
Surface Water Discharge

Tamayariak River, Upper West Fork																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
May 26–Sep 26	439	1490	60	9.4	50	0.8	85	271	1.1	144	0.92	404	8/13/1988	35536	2.94	13.54
Jun 1–Sep 20 1989	418	2050	24	55	220	3.4	126	530	37	175	10.89	1478	8/20/1989	38785	3.55	14.78
May 18–Sep 19 1990	26	130	6.0	1.9	6.2	0.00	17	323	0.00	79	0.00	1328	9/6/1990	19597	1.61	7.47
May 17–Sep 24 1991	350	1820	82	99	681	9.1	38	202	6.3	145	2.70	1219	8/22/1991	37794	2.96	14.40
May 28–Aug 25 1992	154	890	6.6	11	40	4.0	0.73	4.0	0.00	89	0.00	996	6/10/1992	16042	1.81	6.11

Adapted from *Water Resource Inventory and Assessment Arctic National Wildlife Refuge (1987–1992): Appendix A* by the US Fish and Wildlife Service.

Table H-5 *(continued)*
Surface Water Discharge

Canning River																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
Jun 23–Sep 30 2008	—	—	—	4779	13200	1990	4317	12800	1180	a	—	—	—	—	—	—
Oct 1 2008–Sep 31 2009	11260	28900	4550	4435	11200	2240	2505	5040	1370	1961	0.00	32700	6/10/2009	1420000	1.02	13.79
Oct 1 2009–Sep 31 2010	4555	9000	1760	4906	15300	2190	6315	16900	2520	1629	20	19200	7/31/2010	1180000	0.84	11.46
Oct 1 2010–Sep 31 2011	3749	10300	1300	3811	11900	1970	2588	6610	1310	1502	20	a*	a	1088000	0.78	10.57
Oct 1 2011–Sep 31 2012	5161	10200	2410	4713	10900	2400	4094	9390	1830	1541	2	13000	7/26/2012	1118000	0.80	10.87

*Denotes statistics not calculated by US Geological Survey.
Adapted from USGS Water Report 2008–2012 15955000 Canning River Above Staines River Near Deadhorse AK

Table H-5 *(continued)*
Surface Water Discharge

Hulahula River																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)				(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF	IPF Date	Total Runoff	Average Runoff	Total Runoff
Oct 1 2010–Sep 31 2011	1157	4960	257	1869	5720	765	945	3690	362	489	0.00	12800	5/24/2011	354200	0.71	9.70
Oct 1 2011–Sep 31 2012	1783	3930	523	2329	4940	1420	1234	2650	545	535	0.00	6640	7/25/2012	388300	0.78	10.63
Oct 1 2012–Sep 31 2013	3198	9500	429	2766	6780	1290	1933	4840	576	745	0.00	12700	6/17/2013	539300	1.09	14.77
Oct 1 2013–Sep 31 2014	2366	4090	1390	2399	4630	847	1176	2760	784	563	0.00	6240	7/04/2014	a*	0.82	11.2
Oct 1 2014–Sep 31 2015	1259	2510	324	1571	3310	690	1466	3170	732	492	0.00	4830 b	5/26/2015	a	0.72	9.76
Oct 1 2015–Sep 31 2016	2580	8750	293	2299	8890	666	1584	2800	731	653	0.00	13500	7/08/2016	a	0.95	13.0
Oct 1 2016–Sep 31 2017	1392	2440	722	2089	4950	1440	2150	3140	1380	579	0.00	6870	7/24/2017	a	0.85	11.5
Oct 1 2017–Sep 30 2018	1753	5150	249	2880	5570	1100	1374	3180	425	639	0.00	5570	7/29/2018	a	0.933	12.7

*Denotes statistics not calculated by USGS. b denotes discharge due to snowmelt, ice jam, or debris breakup
Adapted from *USGS Water Report 2011–2017 15980000 Hulahula River Near Kaktovik, AK* and *USGS Water-Data Report 2018 15980000 Hulahula River Near Kaktovik, AK*

Table H-6
Summary of Data for Lakes in Regions of the Program Area

Ice Depth		0 Feet (Ft) Ice		4 Ft Ice (Jan 4)		7 Ft Ice (Apr 16)	
Region	**No. Lakes**	**Volume (Acre-Ft)**	**Percent of Total**	**Volume (Acre-Ft)**	**Percent of Total**	**Volume (Acre-Ft)**	**Percent of Total**
Canning	43	35,541	64.2	12,378	69.7	2,669	79.3
Katakturuk	2	339	0.6	93	0.5	6	0.2
Sadlerochit	34	9,959	18.0	2,504	14.1	186	5.5
Jago	40	9,543	17.2	2,783	15.7	505	15.0
Totals	**119**	**55,382**	**100.0**	**17,758**	**100.0**	**3,366**	**100.0**

Re-created from *Distribution and quantification of water within the lakes of the 1002 Area, Arctic National Wildlife Refuge, Alaska*: *Table 1* (USFWS 2015).

H.1 REFERENCE

USFWS (US Fish and Wildlife Service). 2015. Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan. US Fish and Wildlife Service, Final Environmental Impact Statement, Vol. 1. Internet website: https://www.fws.gov/home/arctic-ccp/.

Appendix I

Solid and Hazardous Waste

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Appendix I. Solid and Hazardous Waste

Table I-1
Facilities Registered with the EPA and ADEC in the Vicinity of the Coastal Plain

EPA or ADEC Registry ID	Facility Name	Description	Location
110067059523	Bill Sands Camp	Mobile camp; various sites	Beaufort Lagoon
110064792112	USFWS Arctic Refuge: Griffin Point DEW Line Staging Site	—	Griffin Point
110003039104	Kaktovik Department of Municipal Services	Conditional exempt small quantity generator	Kaktovik
110030898544	Kaktovik Wastewater Treatment Facility	Wastewater treatment facility	Kaktovik
110006878129	US Air Force LRRS - Barter Island	Various facilities DEW Line and LRRS	Kaktovik
110006877610	USFWS Nuvagapak DEW Line Site	—	Nuvagapak Point
AKG573038	Kaktovik Sewage Lagoon	File not available	Kaktovik
POA-2001-1081-M11	Beaufort Sea Exxon Point Thomson Project	Placement of fill in wetlands and streams	Kaktovik
AKG572024	Kaktovik Wastewater Treatment Facility	Authorization to discharge effluent into a mixing zone in Kaktovik Lagoon	Kaktovik
2016DB0001-0023	Point Thomson Central Pad	Injection of nonhazardous wastes in a Class I Underground Injection Control Well	Kaktovik
POA-2001-1082-M1	Beaufort Sea Exxon Point Thomson Project	File not available	Kaktovik
POA-2011-1092	Beaufort Sea NSB Material Site	Placement of fill in 105.04 acres of wetland	Kaktovik
POA-2011-957	Beaufort Sea NSB Airport	Placement of fill in 31.36 acres of wetland	Kaktovik
POA-2004-8	Kaktovik Lagoon Kaktovik Subdivision	Placement of fill in 7.6 acres of wetland	Kaktovik

Sources: EPA 2018; ADEC GIS 2018

Table I-2
Solid Waste Facilities in the Vicinity of the Coastal Plain

Facility Name	Classification	Location	Status
Kaktovik Landfill	Class III landfill[1]	Kaktovik	Closed
Kaktovik Community Tank Farm	Tank farm	Kaktovik	Active
Kaktovik Barter Island LRRS Hanger	Military	Kaktovik	Active
Kaktovik Barter Island LRRS Refueling Area	Polluted soil	Kaktovik	Active
Kaktovik 1.9 SE Landfill	Class III landfill	Kaktovik	Active
Barter Island LRRS-C&D GP	Inert monofill	Kaktovik	Retired
Barter Island LRRS Biosolids Land Application	Land application site	Kaktovik	Retired
Barter Island (Kaktovik) LRRS (BAR-Main DEWline)	Class III camp landfill	Kaktovik	Retired

Source: ADEC 2018a

Table I-3
ADEC Identified Contaminated Sites in the Vicinity of the Coastal Plain

ADEC Hazard ID	Site Name	Status
737	Brownlow Point/DERP	Cleanup complete
739	South Barter Island barrel dump	Cleanup complete
752	Barter Island DEW—POL catchment	Cleanup complete
753	Barter Island DEW—old dump site (LF019)	Cleanup complete
754	Barter Island Dew—heated storage (SS013)	Cleanup complete, institutional controls
755	Barter Island Dew—garage (SS014)	Cleanup complete, institutional controls
756	Barter Island DEW—weather station	Cleanup complete
757	Barter Island DEW—POL tanks	Cleanup complete, institutional controls
759	Barter Island DEW—JP-4 spill (SS021)	Cleanup complete
760	Barter Island DEW—old landfill (LF001)	Cleanup complete
761	Barter Island DEW—runway Dump	Cleanup complete
801	Barter Island DEW—contamination ditch (SD008)	Cleanup complete
802	Barter Island DEW—White Alice (SS016)	Cleanup complete
1431	Waldo arms fuel	Cleanup complete
1679	Collinson Point DEW Line—Sitewide	Informational
1681	Griffin Point/DERP	Cleanup complete
1921	Kaktovik Kaveolook School	Cleanup complete
2306	NSB Kaktovik power plant tank farm	Active
2307	NSB Kaktovik tank farm terminal	Active
2327	NSB Kaktovik KIC pad	Active
3085	Barter Island—staging area	Cleanup complete
3825	Jago River drum site	Cleanup complete
4036	Barter Island DEW—air terminal (SS011)	Cleanup complete, institutional controls
4037	Barter Island DEW—fuel tanks (ST018)	Cleanup complete, institutional controls
4038	Barter Island DEW—dump area NW (LF009)	Cleanup complete
4222	Barter Island LRRS refueling area (CG002)	Cleanup complete

[1]Rural landfills often not connected by road to a larger landfill or are more than 50 miles by road from a larger landfill. The landfill serves fewer than 1,500 people.

ADEC Hazard ID	Site Name	Status
4229	Barter Island LRRS hangar (SS022)	Active
25328	Collinson Point DEW Line POL pipeline corridor	Active
25329	Collinson Point DEW Line AST pad and AST pond	Active
25330	Collinson Point DEW Line Quonset hut #3	Active
25331	Collinson Point DEW Line shop building area	Active
25332	Collinson Point DEW Line composite building area	Active
25333	Nuvagapak Point DEW Line AST pad area	Active
25335	Nuvagapak Point DEW Line dump site D	Active
25336	Nuvagapak Point DEW Line debris pile A (Grid Area)	Active
25337	Nuvagapak Point DEW Line Kogotpak River dump site E	Active
26827	NSB Kaktovik transformer	Active

Source: ADEC 2018b, 2018c

Table I-4
ADEC 1995–2018 Database Spill Records for Areas near Kaktovik, Alaska

Year	Number of Spill Records	Annual Cumulative Spill Volume (Gallons)	Substance Spilled
1996	1	150	Diesel
1999	3	545	Diesel and engine lube oil
2004	4	621	Used oil and diesel
2005	2	*56 pounds*	Other
2006	1	100	Diesel
2008	5	2,120	Gasoline and diesel
2009	1	75	Ethylene glycol (antifreeze)
2010	2	2,456	Diesel
2011	1	25	Engine lube oil
2014	3	355	Glycol and propylene glycol
2015	1	5,250	Diesel
2016	4	201	Ethylene glycol, process water, diesel, and other
2017	6	4,415	Diesel, ethylene glycol, and unknown

Source: ADEC 2018c

Table I-5
ADEC 1995–2018 Database Spill Records for the North Slope, Alaska

Year	Number of Spills	Very Small Spills[1]	Small Spills[2]	Medium Spills[3]	Large Spills[4]	Very Large Spills[5]
1995	222	129	59	20	14	0
1996	434	222	152	48	12	0
1997	467	220	159	67	20	1
1998	430	213	158	45	14	0
1999	375	206	115	43	11	0
2000	392	222	117	41	12	0
2001	535	315	149	56	15	0
2002	504	313	134	38	19	0
2003	423	259	106	45	13	0
2004	428	253	114	47	14	0
2005	442	231	129	68	14	0
2006	500	261	135	88	13	3
2007	581	348	139	75	19	0
2008	546	331	125	72	17	1
2009	484	290	121	53	20	0
2010	380	192	116	67	5	0
2011	340	211	83	35	11	0
2012	379	253	75	44	7	0
2013	331	197	80	39	14	1
2014	377	238	82	44	13	0
2015	368	229	92	42	5	0
2016	311	177	72	29	33	0
2017	247	148	66	26	7	0
2018	228	135	61	24	8	0

Source: ADEC 2018d
[1]Less than 0.24 barrels (10 gallons)
[2]0.24–2.4 barrels (10–99 gallons)
[3]2.4–24 barrels (100–999 gallons)
[4]24–2,380 barrels (1,000–100,000 gallons)
[5]More than 2,380 barrels (100,000 gallons)

I.1 REFERENCES

ADEC (Alaska Department of Environmental Conservation). 2018a. Solid Waste Information Management System. Internet website: http://dec.alaska.gov/Applications/EH/SWIMS/Search.aspx.

_____. 2018b. Division of Spill Prevention and Response Contaminated Sites. Internet website: http://dec.alaska.gov/spar/csp.aspx. Last updated November 2017.

_____. 2018c. ADEC Drinking Water Protection Areas. Internet website: https://www.arcgis.com/home/webmap/viewer.html?webmap=13ed2116e4094f9994775af9a62a1e85. Last updated May 2018.

_____. 2018d. ADEC Prevention Preparedness and Response Spills Database Search. Internet website: https://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch.

ADEC GIS. 2018. Contaminated sites, Alaska Department of Conservation. Internet website: https://dec.alaska.gov/spar/csp.aspx.

EPA (US Environmental Protection Agency). 2018d. EnviroMapper. Internet website: https://geopub.epa.gov/myem/efmap/index.html?ve=10&pText=.

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Appendix J

Vegetation and Wetlands, Birds, Terrestrial Mammals, and Marine Mammals

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Appendix J. Vegetation and Wetlands, Birds, Terrestrial Mammals, and Marine Mammals

J.1 Vegetation and Wetlands

The vegetation mapping chosen to quantify the coverage of each vegetation type in the program area (**Map 3-10**, Vegetation, in **Appendix A**) was prepared by the Alaska Center for Conservation Science (ACCS) (ACCS 2016; Boggs et al. 2016). This mapping was developed for the entire North Slope by applying a common hierarchical classification to various data sources (Boggs et al. 2016). The primary data source used for the program area was a moderate resolution (30-meter pixel) raster vegetation mosaic map compiled by multiple contributors including the North Slope Science Initiative, United States (US) Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), National Park Service (NPS) Alaska Center for Conservation Science (ACCS), Ducks Unlimited, Inc., Spatial Solutions Inc., and Michigan Tech Research Institute (Ducks Unlimited 2013).

The intent of the 2013 mapping was to update existing vegetation maps to more recent Landsat Thematic Mapper imagery where available. There are a variety of other land cover maps available that cover the program area and provide information at various scales. These maps typically are based on a range of Landsat imagery products, but the ACCS map provides the best combination of land cover mapping review and a vegetation classification suitable for use in this Environmental Impact Statement (EIS). The advantage of using the ACCS (2016) map is that (1) the vegetation classes are easily recognizable and relate well to the classes described in the commonly used Alaska Vegetation Classification (Viereck et al. 1992), and (2) the mosaic source data were vetted by a committee and represent the best available vegetation data layers for the program area (Boggs et al. 2016).

Common species found in the vegetation or land cover types listed in **Table J-1** are listed below.

Table J-1
Vegetation and Land Cover Types in the Program Area[1]

Vegetation or Land Cover Type	Area (Acres)	Percent of Coastal Plain
Freshwater or saltwater	134,900	9
Herbaceous (marsh)	6,000	<1
Herbaceous (wet-marsh) (tidal)	2,800	<1
Herbaceous (wet)	252,100	16
Herbaceous (mesic)	477,600	31
Tussock tundra (low shrub or herbaceous)	400,400	26
Dwarf shrub	7,800	1
Dwarf shrub-lichen	<100	<1
Low shrub	242,300	15
Tall shrub (open-closed)	<100	<1
Sparse vegetation	29,300	2
Fire scar[2]	<100	<1
Bare ground	10,200	1
Total area	**1,563,400***	**100.0**

Source: Boggs et al. 2016
[1]From broad-scale land cover mapping for northern, western, and interior Alaska, prepared by Boggs et al. (2016)
[2]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.
*Rounded to nearest 100 acres

Table J-2
Vegetation Type Descriptions in the Program Area[1]

Vegetation Class	Description	Typical Species
Freshwater or saltwater	Distribution: Marine nearshore water and estuarine waters along the Beaufort Sea coast and freshwater lakes and ponds and permanently flooded riverine channels throughout the program area Soils: N/A Hydrology: Subtidal, tidal or permanently flooded Slope: N/A Permafrost: Absent Patch size: Small to large Vegetation: Unvegetated	N/A
Herbaceous (marsh)	Distribution: Widespread in the lowlands of program area; less common in southeast portion where the terrain is gently rolling; margins of ponds and lakes, low-centered polygons, beaded streams Soils: Muck or mineral Hydrology: Semipermanently (sometimes seasonally) flooded, water >10 cm 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 are *Carex aquatilis*, *Eriophorum angustifolium*, and *Hippuris vulgaris* Other emergent species that may occur: *Carex utriculata*, *C. rotundata, C. saxatilis, Eriophorum russeolum, E. scheuchzeri, Menyanthes trifoliata,* and *Equisetum fluviatile*
Herbaceous (wet-marsh)(tidal)	Distribution: Form primarily as a narrow fringe along the coastline, tidal river channels, and tidal lagoons protected by barrier islands Soils: Hydrology: Semipermanently flooded Slope: Flat Permafrost: Typically present Patch size: Small to moderate, often linear Vegetation: Total vascular cover ≥10%; sites subject to regular to frequent tidal inundation, including storm surges	Shrubs: *Salix ovalifolia* Sedges: *Carex subspathacea, C. ursina* Grasses: *Dupontia fisheri, Puccinellia phryganodes, P. andersonii, Deschampsia cespitosa, Arctagrostis latifolia, Alopecurus magellanicus* Other herbaceous: *Cochlearia officinalis, Stellaria humifusa, Sedum rosea, Chrysanthemum bipinnatum*
Herbaceous (wet)	Distribution: Margins of ponds, lakes, and streams in floodplains; low-centered polygons in the lowlands of the coastal plain; water tracks in undulating terrain and valley bottoms 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 herbaceous species is ≥20%, or cover of Carex aquatilis is >20%;	Shrubs: *Betula, Salix fuscescens, Vaccinium uliginosum, Andromeda polifolia,* Sedges: *Carex aquatilis, C. chordorrhiza, Eriophorum angustifolium* Mosses: *Scorpidium scorpioides, Drepanocladus* spp., *Sphagnum* spp.

Vegetation Class	Description	Typical Species
Herbaceous (mesic)	Distribution: Throughout the program area, flat to gently rolling terrain Soils: Calcareous to acidic Hydrology: Dry to mesic Slope: Moderate Permafrost: Typically present Patch Size: Small to large Vegetation: Herbaceous cover is ≥25%; 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 and liverworts: *Hylocomium splendens, Aulacomnium turgidum, Scorpidium cossonii, Sanionia uncinatum, Ptlidium ciliare*
Tussock tundra	Distribution: Common on ancient river terraces, sideslopes, alluvial fans, mesic high-centered polygons, valley bottoms, 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 matrix forming Vegetation: Total cover of shrubs >20 cm tall is ≥25%; dominated by species other than alder and willow.	Shrubs: *Betula nana, Salix pulchra, Ledum decumbens, Vaccinium uliginosum, V. vitis-idaea, Empetrum nigrum* Sedges: *Eriophorum vaginatum, Carex bigelowii* Other herbaceous: *Equisetum arvense, Rubus chamaemorus* Mosses: *Sphagnum* spp., *Hylocomium splendens, Aulacomnium turgidum*
Dwarf shrub and dwarf shrub lichen	Distribution: Along rivers and streams within the program area; low-centered polygons, flat wetlands, water tracks in tussock tundra Soils: Hydrology: Mesic to wet Slope: Flat to steep Permafrost: Patch Size: Small to large, often linear in shape. Vegetation: Total cover of shrubs <20 cm tall is ≥25%; lichen cover ranges from below 20% for Dwarf Shrub and >20% for Dwarf Shrub Lichen	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, S. rotundifolia* Sedges: *Carex bigelowii* Other herbaceous: *Equisetum* spp., *Hierochlöe alpina, Arnica lessingii* Mosses: *Aulacomnium* spp., *Hylocomium splendens, Rhytidium rugosum, Racomitrium lanuginosum* Lichens: *Cetraria* spp., *Cladina* spp.
Low shrub	Distribution: Primarily in the Brooks Range foothills along the Colville River; on floodplains, bluffs above floodplains, sand dunes, and rolling hills Soils: Hydrology: Mesic to wet Slope: Flat to steep Permafrost: Patch size: Small to large Vegetation: Total shrub cover is ≥25%, dominated by alder. On wetter sites, tussock tundra is common in the gaps between alder patches.	Shrubs: *Betula nana, Salix pulchra, S. glauca, Ledum decumbens, Dryas octopetala* Sedges (in polygon troughs): *Carex aquatilis, Eriophorum angustifolium, E. russeolum* Other herbaceous: *Hierochlöe alpina* Lichens: *Cladonia rangiferina*

Vegetation Class	Description	Typical Species
Tall shrub	Distribution: Recently deposited alluvium or recently disturbed river channels in floodplains and deltas; coastal dunes 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%; bryophyte cover may be ≥25%. Lichen-dominated sites are uncommon in the region and were included in this class.	Shrubs: *Salix alaxensis, S. glauca, S. pulchra, S. niphoclada, S. richardsonii* Sedges: *Eriophorum angustifolium, Carex aquatilis*
Sparse vegetation	Distribution: Recently deposited alluvium or recently disturbed river channels in floodplains and deltas; coastal dunes Soils: Thin and well drained 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 <10%; bare ground cover >50%	Shrubs: *Dryas octopetala, D. integrifolia, Empetrum nigrum, Loiseleuria procumbens Cassiope tetragona, Arctostaphylos alpina, Vaccinium uliginosum, Salix reticulata* Other herbaceous: *Antennaria alpine, Hierochloe alpine, Minuartia obtusiloba, Carex scirpoidea, C. podocarpa, C. microchaeta and Festuca altaica* Lichens: *Sphaerophorus globusus, Nephroma arcticum, Flavocetraria* spp., *and Alectoria ochroleuca*
Fire scar	Burned areas dominated by burned vegetation, problematic spectral class with poor field data	N/A
Bare ground	Distribution: Recently deposited alluvium or recently disturbed river channels in floodplains and deltas; coastal dunes, high elevation rock/gravel areas Soils: Weathered parent material or bedrock Hydrology: Dry Slope: Flat to steep Permafrost: Typically absent Patch size: Small Vegetation 90% cover of unvegetated ground	N/A

[1]From ACCS Vegetation map (Boggs et al. 2016)

Table J-3
Wetland Class Descriptions in the Program Area[1]

Wetland Class	Fine-Scale Wetland Types	General Description	Dominant Vegetation	Hydrology
Estuarine and marine deepwater	E1UBL, M1UBL	Open saltwater along the Bearing Sea coast; estuaries are protected in places by barrier islands	Unvegetated	Subtidal
Estuarine and marine wetland	E2EM1/USN, E2EM1/USP, E2EM1P, E2US/EM1P, E2USN, E2USP, M2USN, M2USP	Saltmarshes with interspersed emergent vegetation and unvegetated mudflat and marine beaches composed of unconsolidated material	Unvegetated or salt-tolerant sedges and grasses	Regularly or irregularly flooded due to daily tidal fluctuations or seasonal storm surges
Lake	L1UBH, L2EM2H, L2UBH, L2USC	Limnetic and littoral open bodies of freshwater, aquatic emergent vegetation, and beaches composed of unconsolidated material	Unvegetated or aquatic emergent graminoid communities	Permanently flooded freshwater or seasonally flooded unconsolidated shorelines
Freshwater pond	PUB/EM1F, PUB/EM2H, PUBH, PUS/EM1E, PUS/SS1A, PUSC	Shallow bodies of freshwater under 20 acres, either unvegetated or supporting emergent vegetation; also includes unvegetated mud surfaces where waters have dried	Unvegetated or aquatic emergent graminoid communities	Permanently flooded open waters or semi-permanently flooded vegetated communities
Riverine	R1UBV, R1USQ, R2EM2/UBH, R2EM2F, R2EM2H, R2UB/EM2H, R2UBF, R2UBG, R2UBH, R2USA, R2USC, R3UBH, R3UBH, R3USA, R3USC, R4SBC, R5UBH	Includes tidal, lower, upper, and intermittent rivers and streams, with vegetated or unvegetated mid-stream and side channel bars	Unvegetated or aquatic emergent graminoid communities	Permanently flooded flowing waters and seasonally flooded or tidal mid and side channel bars
Freshwater emergent wetland	PEM1/2F, PEM1/FOCh, PEM1/SS1A, PEM1/SS1Ad, PEM1/SS1B, PEM1/SS1D, PEM1/SS1E, PEM1/SS1F, PEM1/SSB, PEM1/UBF, PEM1/USA, PEM1/USC, PEM1/USE, PEM1A, PEM1B, PEM1E, PEM1F, PEM1S, PEM1/1F, PEM2/UBH, PEM2H	Wetlands dominated by emergent vegetation, typically occupying inland flat and gently rolling terrain beyond saltwater influence	Emergent graminoid species with a broad-leaved evergreen component	Includes a range of hydrologic regimes, from saturated to semi-permanently flooded meadows
Freshwater forested/shrub wetland	PSS1/EM1A, PSS1/EM1B, PSS1/EM1E, PSS1/EM1C, PSS1/EM1F, PSS1/UBF, PSS1/USA, PSS1/USC, PSS1/USS, PSS1A, PSS1B, PSS1C, PSS1E, PSS1F	Wetlands dominated by deciduous shrubs, occurring on abandoned alluvial surfaces or bluffs at the edges of basins	Dominated by deciduous broad-leaved shrubs, most commonly low, <160 cm	Includes seasonally flooded types typically associated with riparian corridors and wet semi-permanently flooded shrub communities

[1]From broad-scale land USFWS NWI mapping USFWS (2018)
[2]The classification into fine scale wetland codes follows guidance in Cowardin et al. 1979.

Table J-4
Rare[1] Vascular Plant Species with Documented Occurrences in the Program Area

Taxa	State Rank[2]	Global Rank[2]	Federal Status[3]
Cardamine blaisdellii	S2	G3G4	BLM watch
Carex atherodes	S3S4	G5	—
Chrysosplenium rosendahlii	S1S2	G4G5Q	—
Draba subcapitata	S1S2	G4	—
Festuca viviparoidea ssp. *viviparoidea*	SU	G4G5	—
Papaver gorodkovii	S2S3	G3	BLM sensitive
Puccinellia andersonii	S1S2	G3G5	—
P. vahliana	S3	G4	BLM watch
Saxifraga rivularis ssp. *arctolitoralis*	S2	G5T2T3	—
Smelowskia media	S2S3	GNR	—
Symphyotrichum pygmaeum	S2	G2G4	BLM sensitive
Erigeron murii	S2S3	G2G3	BLM sensitive
E. porsildii	S3S4	G3G4	BLM watch
Trisetum sibiricum ssp. *litorale*	S3	G5T4Q	—

[1]Vascular plant species with documented occurrences in the Program Area tracked through the Alaska Center for Conservation Science Rare Plant Data Portal (ACCS 2018) with a state ranking of S3 or higher and/or a global rank of G4 or higher
[2] State and Global rankings per ACCS and NatureServe ranking methodologies.
[3]Sensitive and watch plant species from the BLM Alaska Special Status Species List – 2019.

Table J-5
Acreages of Coarse-Scale Vegetation Types Under Alternative B Stratified by Land Use Category and Hydrocarbon Potential

Vegetation Type in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Category	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Category	Low Hydrocarbon Potential	Percent Low HCP in Land Use Category
No surface occupancy	**142,200**	**100**	**120,900**	**100**	**96,300**	**100**
Freshwater or saltwater	52,500	37	40,600	34	9,100	10
Herbaceous (marsh)	2,900	2	<100	<1	<100	<1
Herbaceous (wet-marsh) (tidal)	700	1	100	<1	200	<1
Herbaceous (wet)	31,800	22	17,300	14	14,700	15
Herbaceous (mesic)	23,300	16	32,600	27	25,400	26
Tussock tundra	3,200	2	12,500	10	21,900	23
Dwarf shrub	1,900	1	600	1	<50	<1
Dwarf shrub-lichen	<50	<1	—	—	—	—
Low shrub	3,400	2	11,000	9	21,300	22
Tall shrub (open-closed)	<50	<1	—	—	—	—
Sparse vegetation	21,700	15	1,800	2	200	<1
Fire scar[1]	<50	<1	—	—	<50	<1
Bare ground	800	1	4,300	4	3,200	3
Standard terms and conditions only	**285,700**	**100**	**287,300**	**100**	**45,600**	**100**
Freshwater or saltwater	8,500	3	7,700	3	100	<1
Herbaceous (marsh)	3,000	1	100	<1	—	—
Herbaceous (wet-marsh) (tidal)	700	<1	400	<1	—	—
Herbaceous (wet)	38,500	14	34,600	12	2,000	4
Herbaceous (mesic)	114,100	40	93,500	33	11,100	24
Tussock tundra	96,800	34	105,200	37	23,300	51
Dwarf shrub	2,500	1	700	<1	200	<1
Dwarf shrub-lichen	<100	<1	—	—	—	—
Low shrub	16,400	6	44,500	16	8,700	19
Tall shrub (open-closed)	—	—	<50	<1	—	—
Sparse vegetation	5,100	2	400	<1	100	<1
Fire scar[1]	<50	<1	<50	<1	—	—
Bare ground	100	<1	300	<1	<50	<1

Vegetation Type in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Category	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Category	Low Hydrocarbon Potential	Percent Low HCP in Land Use Category
Timing Limitations	**—**	**—**	**250,141.0**	**100.0**	**335,287.9**	**100**
Freshwater or saltwater	—	—	11,400	5	5,000	2
Herbaceous (marsh)	—	—	<50	<1	<100	<1
Herbaceous (wet)	—	—	64,500	26	48,700	15
Herbaceous (wet-marsh) (tidal)	—	—	400	<1	200	<1
Herbaceous (mesic)	—	—	106,200	43	71,400	21
Tussock tundra	—	—	37,400	15	100,200	30
Dwarf shrub	—	—	300	<1	1,200	<1
Dwarf shrub-lichen	—	—	—	—	—	—
Low shrub	—	—	29,300	12	107,500	32
Tall shrub (open-closed)	—	—	—	—	<50	<1
Sparse vegetation	—	—	—	—	<50	<1
Fire scar[1]	—	—	—	—	—	—
Bare ground	—	—	500	<1	1,100	<1
Grand total	**427,900**	**—**	**658,300**	**—**	**477,200**	**—**

Source: BLM GIS 2018

Note: Tables were generated by intersecting multiple GIS datasets, using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded alternative summary acreage tables.

[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Table J-6
Acreages of Coarse-Scale Wetland Types Under Alternative B Stratified by Land Use Category and Hydrocarbon Potential

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
No surface occupancy	**140,900**	**100**	**113,400**	**100**	**90,800**	**100**
Estuarine and marine deepwater	33,700	24	30,500	27	4,400	5
Lake	2,500	2	500	<1	200	<1
Freshwater pond	1,600	1	300	<1	100	<1
Riverine	26,100	19	10,200	9	6,10	7
Estuarine and marine wetland	5,400	4	2,500	2	100	<1
Freshwater emergent wetland	59,800	42	55,000	49	71,400	79
Freshwater forested/shrub wetland	11,800	8	14,400	13	8,500	9
Standard terms and conditions only	**284,600**	**100**	**283,300**	**100**	**44,800**	**100**
Estuarine and marine deepwater	2,200	1	500	<1	100	<1
Lake	4,700	2	2,100	1	—	—
Freshwater pond	1,100	<1	1,100	<1	3	<1
Riverine	4,300	2	1,600	1	400	1
Estuarine and marine wetland	600	<1	500	<1	<50	<1
Freshwater emergent wetland	243,900	86	258,100	91	41,700	93
Freshwater forested/shrub wetland	27,700	10	19,500	7	2,600	6
Timing limitations	**—**	**—**	**228,800**	**100**	**322,200**	**100**
Estuarine and marine deepwater	—	—	35	<1	<50	<1
Lake	—	—	1,900	1	400	<1
Freshwater pond	—	—	1,200	1	400	<1
Riverine	—	—	2,100	1	2,600	1
Estuarine and marine wetland	—	—	200	<1	300	<1
Freshwater emergent wetland	—	—	218,100	95	310,300	96
Freshwater forested/shrub wetland	—	—	5,300	2	8,100	3
Grand total	**425,500**	**—**	**625,600**	**—**	**457,700**	**—**

Source: BLM GIS 2018
Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables.

Table J-7
Acreages of Coarse-Scale Vegetation Types Under Alternative C Stratified by Land Use Category and Hydrocarbon Potential

Vegetation Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
No surface occupancy	**194,000**	**100**	**328,200**	**100**	**410,200**	**100**
Freshwater or saltwater	57,100	29	51,500	16	14,100	3
Herbaceous (marsh)	4,400	2	15	<1	6	<1
Herbaceous (wet-marsh) (tidal)	1,300	1	900	<1	400	<1
Herbaceous (wet)	47,700	25	72,800	22	60,500	15
Herbaceous (mesic)	40,500	21	118,000	34	89,500	22
Tussock tundra	9,000	5	43,300	13	115,800	28
Dwarf shrub	2,800	2	900	<1	800	<1
Dwarf shrub-lichen	<50	<1	—	—	—	—
Low shrub	7,000	4	34,200	10	124,900	31
Tall shrub (open-closed)	<50	<1	—	—	—	—
Sparse vegetation	23,300	12	1,800	<1	200	<1
Fire scar[1]	<50	<1	—	—	<50	<1
Bare ground	800	<1	4,700	1	4,000	1
Standard terms and conditions only	**184,500**	**100**	**129,400**	**100**	**74**	**100**
Freshwater or saltwater	3,900	2	5,400	4	74	100
Herbaceous (marsh)	1,500	1	<50	<1	—	—
Herbaceous (wet-marsh) (tidal)	100	<1	<50	<1	—	—
Herbaceous (wet)	20,200	11	24,800	19	—	—
Herbaceous (mesic)	69,000	37	48,300	37	—	—
Tussock tundra	75,700	41	37,400	29	—	—
Dwarf shrub	1,300	1	400	<1	—	—
Low shrub	9,300	5	12,600	10	—	—
Tall shrub (open-closed)	—	—	<50	<1	—	—
Sparse vegetation	3,400	2	200	<1	—	—
Fire scar[1]	<50	<1	<50	<1	—	—
Bare ground	<50	<1	200	<1	—	—

Vegetation Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
Timing limitations	**49,400**	**100**	**200,800**	**100**	**66,900**	**100.0**
Freshwater or saltwater	<50	<1	2,800	1	76	<1
Herbaceous (marsh)	<50	<1	<50	<1	—	—
Herbaceous (wet-marsh) (tidal)	—	—	—	—	—	—
Herbaceous (wet)	2,400	5	18,800	9	4,900	7
Herbaceous (mesic)	27,800	56	66,100	33	18,400	27
Tussock tundra (low shrub or herbaceous)	15,200	31	74,300	37	29,600	44
Dwarf shrub	300	1	400	<1	900	1
Low shrub	3,500	7	38,100	19	12,700	19
Tall shrub (open-closed)	—	—	—	—	<50	<1
Sparse vegetation	100	<1	100	<1	100	<1
Fire scar[1]	—	—	—	—	—	—
Bare ground	—	—	200	<1	300	<1
Grand total	**427,900**	**—**	**658,300**	**—**	**477,200**	**—**

Source: BLM GIS 2018
Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables.
[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Table J-8
Acreages of Coarse-Scale Wetland Types Under Alternative C Stratified by Land Use Category and Hydrocarbon Potential

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
No surface occupancy	**192,600**	**100**	**316,600**	**100**	**394,900**	**100**
Estuarine and marine deepwater	35,100	18	30,900	10	4,500	1
Lake	4,500	2	2,400	1	600	<1
Freshwater pond	2,100	1	1,200	<1	400	<1
Riverine	27,400	14	12,000	4	8,300	2
Estuarine and marine wetland	6,100	3	3,100	1	400	<1
Freshwater emergent wetland	97,000	50	250,700	79	365,800	93
Freshwater forested/shrub wetland	20,400	11	16,300	5	15,000	4
Standard terms and conditions only	**183,800**	**100.0**	**128,800**	**100**	**100**	**100**
Estuarine and marine deepwater	700	<1	19	<1	<50	59
Lake	2,800	2	1,800	1	—	—
Freshwater pond	600	<1	1,000	1	—	—
Riverine	2,900	2	800	1	—	—
Estuarine and marine wetland	<50	<1	<50	<1	<50	41
Freshwater emergent wetland	158,700	86	119,500	93	—	—
Freshwater forested/shrub wetland	18,100	10	5,600	4	—	—
Timing limitations	**49,100**	**100**	**180,100**	**100**	**62,800**	**100**
Freshwater emergent wetland	47,900	98	160,900	90	57,600	92
Lake	—	—	400	<1	—	—
Freshwater pond	<50	<1	400	<1	<50	<1
Riverine	200	<1	1,100	1	900	1
Freshwater forested/shrub wetland	3,000	6	17,400	10	4,300	7
Grand total	**425,500**	**—**	**625,600**	**—**	**457,700**	**—**

Source: BLM GIS 2018
Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables

Table J-9
Acreages of Coarse-Scale Vegetation Types Under Alternative D1 Stratified by Land Use Category and Hydrocarbon Potential

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
Controlled surface use	**32,400**	**100**	**80,500**	**100**	**11,000**	**100**
Freshwater or saltwater	<50	<1	200	<1	—	—
Herbaceous (marsh)	<50	<1	1	<1	—	—
Herbaceous (wet)	800	3	2,000	3	300	3
Herbaceous (mesic)	19,600	61	23,000	29	1,700	15
Tussock tundra	10,300	32	38,500	48	6,500	59
Dwarf shrub	200	1	300	<1	<50	<1
Low shrub	1,300	4	16,500	21	2,500	23
Sparse vegetation	100	<1	100	<1	—	—
No surface occupancy	**256,300**	**100**	**384,400**	**100**	**67,900**	**100**
Freshwater or saltwater	60,600	24	48,500	13	5,000	7
Herbaceous (marsh)	5,300	2	100	<1	<50	<1
Herbaceous (wet-marsh) (tidal)	1,400	1	900	<1	<50	<1
Herbaceous (wet)	57,700	23	69,900	18	6,000	10
Herbaceous (mesic)	63,100	25	129,600	34	19,200	28
Tussock tundra	26,400	10	82,200	21	24,600	36
Dwarf shrub	3,400	1	1,000	<1	900	1
Dwarf shrub-lichen	<50	<1	—	—	—	—
Low shrub	12,500	5	46,400	12	11,200	17
Tall shrub (open-closed)	<50	<1	—	—	<50	<1
Sparse vegetation	25,000	10	2,000	1	300	1
Fire scar[1]	<50	<1	<50	<1	<50	<1
Bare ground	800	<1	3,800	1	600	1

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
Standard terms and conditions only	**131,900**	**100**	**72,800**	**100**	**<50**	**100**
Freshwater or saltwater	200	<1	3,900	5	<50	25
Herbaceous (marsh)	300	<1	<50	<1	—	—
Herbaceous (wet-marsh) (tidal)	—	—	<50	<1	—	—
Herbaceous (wet)	10,200	8	15,700	22	<50	<1
Herbaceous (mesic)	50,800	39	30,200	42	<50	<1
Tussock tundra	62,900	48	16,100	22	<50	50
Dwarf shrub	700	1	200	<1	<50	<1
Low shrub	5,800	4	6,500	9	<50	25
Tall shrub (open-closed)	—	—	<50	<1	—	—
Sparse vegetation	1,000	1	100	<1	—	—
Fire scar[1]	<50	<1	<50	<1	—	—
Bare ground	<50	<1	<50	<1	<50	<1
Grand total	**420,544.2**	**—**	**537.700**	**—**	**78,900**	**—**

Source: BLM GIS 2018

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables.

[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Table J-10
Acreages of Coarse-Scale Wetland Types Under Alternative D1 Stratified by Land Use Category and Hydrocarbon Potential

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP within Land Use Categories
Controlled surface use	**32,400**	**100**	**79,200**	**100**	**11,000**	**100**
Lake	—	—	<50	<1	—	—
Freshwater pond	<50	<1	<50	<1	3	<1
Riverine	100	<1	200	<1	69	1
Freshwater emergent wetland	31,700	98	71,000	90	10,600	97
Freshwater forested/shrub wetland	500	2	7,900	10	300	2
No surface occupancy	**254,500**	**100**	**353,900**	**100**	**62,300**	**100**
Estuarine and marine deepwater	35,800	14	31,000	9	4,200	7
Lake	7,200	3	2,000	1	—	—
Freshwater pond	2,600	1	1,300	<1	40	<1
Riverine	28,600	11	9,500	3	1,300	2
Estuarine and marine wetland	6,100	2	3,200	1	100	<1
Freshwater emergent wetland	148,100	58	281,800	80	51,800	83
Freshwater forested/shrub wetland	26,200	10	25,200	7	4,700	8
Standard terms and conditions only	**131,300**	**100**	**72,500**	**100**	**<50**	**100**
Estuarine and marine deepwater	18	<1	<50	<1	—	—
Lake	95	<1	1,200	2	—	—
Freshwater pond	123	<1	800	1	—	—
Riverine	1,100	1	200	<1	<50	25
Estuarine and marine wetland	<50	<1	<50	<1	—	—
Freshwater emergent wetland	118,000	90	68,600	95	<50	75
Freshwater forested/shrub wetland	11,800	9	1,800	2	<50	<1
Grand total	**418,200**	**—**	**505,700**	**—**	**73,200**	**—**

Source: BLM GIS 2018
Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables.

Table J-11
Acreages of Coarse-Scale Vegetation Types Under Alternative D2 Stratified by Land Use Category and Hydrocarbon Potential

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
Controlled surface use	**32300**	**100**	**72,800**	**100**	**<50**	**—**
Freshwater or saltwater	<50	<1	200	<1	—	—
Herbaceous (marsh)	<50	<1	<50	<1	—	—
Herbaceous (wet)	800	2	1,700	2	<50	—
Herbaceous (mesic)	19,600	61	21,600	30	<50	—
Tussock tundra	10,300	32	34,400	47	<50	—
Dwarf shrub	200	1	300	<1	—	—
Low shrub	1,300	4	14,500	20	<50	—
Sparse vegetation	100	0	100	<1	—	—
No surface occupancy	**256200**	**100**	**249,400**	**100**	**<50**	**—**
Freshwater or saltwater	60,600	24	32,800	13	<50	—
Herbaceous (marsh)	5,300	2	<50	<1	—	—
Herbaceous (wet-marsh) (tidal)	1,400	1	<50	<1	—	—
Herbaceous (wet)	57,700	23	36,300	15	<50	—
Herbaceous (mesic)	63,100	25	77,000	31	<50	—
Tussock tundra (low shrub or herbaceous)	26,400	10	63,600	26	<50	—
Dwarf shrub	3,400	1	800	<1	<50	—
Dwarf shrub-lichen	<50	<1	—	—	—	—
Low shrub	12,500	5	34,100	14	<50	—
Tall shrub (open-closed)	<50	<1	—	—	<50	—
Sparse vegetation	25,000	10	1,900	1	<50	—
Fire scar[1]	<50	<1	<50	<1	<50	—
Bare ground	800	<1	2,900	1	<50	—

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
Timing limitations	**131,900**	**100**	**5,7100**	**100**	**<50**	**—**
Freshwater or saltwater	200	<1	2,400	4	<50	—
Herbaceous (marsh)	300	<1	<50	<1	—	—
Herbaceous (wet-marsh) (tidal)	—	—	<50	<1	—	—
Herbaceous (wet)	10,200	8	9,700	17	<50	—
Herbaceous (mesic)	50,800	39	23,300	41	<50	—
Tussock tundra	62,900	48	15,200	27	<50	—
Dwarf shrub	700	1	100	0	<50	—
Low shrub	5,800	4	6,200	11	<50	—
Tall shrub (open-closed)	—	—	<50	<1	—	—
Sparse vegetation	1,000	1	100	<1	—	—
Fire scar[1]	<50	<1	<50	<1	—	—
Bare ground	<50	<1	<50	<1	<50	—
No lease sale offered	**7,400**	**100**	**279,100**	**100**	**477100**	**100**
Freshwater or saltwater	100	1	24,400	9	14,200	3
Herbaceous (marsh)	300	4	<50	<1	<50	<1
Herbaceous (wet-marsh) (tidal)	—	—	900	0	400	0
Herbaceous (wet)	1,600	22	68,600	25	65,400	14
Herbaceous (mesic)	3,800	51	110,400	40	107,900	23
Tussock tundra	400	5	41,900	15	145,300	30
Dwarf shrub	100	1	500	0	1,700	0
Low shrub	300	4	30,100	11	137,600	29
Tall shrub (open-closed)	—	—	<50	<1	<50	<1
Sparse vegetation	800	11	100	0	300	<1
Fire scar	—	—	—	<1	<50	<1
Bare ground	<50	<1	2,200	1	4,300	1
Grand total	**427,800**	**—**	**658,400**	**—**	**477,100**	**—**

Source: BLM GIS 2018

Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables.

[1]The areas for the pixels mapped as fire scars were reviewed on satellite imagery and appear to be incorrectly classified.

Table J-12
Acreages of Coarse-Scale Wetland Types Under Alternative D2 Stratified by Land Use Category and Hydrocarbon Potential

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
Controlled surface use	**32,300**	**100**	**71,600**	**100**	**<50**	**100**
Lake	—	—	100	<1	—	—
Freshwater pond	<50	<1	<50	<1	—	—
Riverine	100	<1	200	<1	—	—
Freshwater emergent wetland	31,700	98	63,900	89	<50	<1
Freshwater forested/shrub wetland	500	2	7,400	10	—	—
No surface occupancy	**254,600**	**100**	**227,900**	**100**	**<50**	**100**
Estuarine and marine deepwater	35,800	14	21,800	10	—	—
Lake	7,200	3	1,100	0	—	—
Freshwater pond	2,600	1	700	0	—	—
Riverine	28,600	11	7,100	3	<50	<1
Estuarine and marine wetland	6,100	2	2,300	1	—	—
Freshwater emergent wetland	148,100	58	175,200	77	<50	<1
Freshwater forested/shrub wetland	26,200	10	19,700	9	<50	<1
Timing limitations	**131,300**	**100**	**56,900**	**100**	**<50**	**100**
Estuarine and marine deepwater	18	<1	0	0	—	—
Lake	95	<1	900	2	—	—
Freshwater pond	123	<1	500	1	—	—
Riverine	1,100	1	200	0	<50	<1
Estuarine and marine wetland	<50	<1	0	0	—	—
Freshwater emergent wetland	118,000	90	53,500	94	<50	<1
Freshwater forested/shrub wetland	11,800	9	1,800	3	<50	<1

Wetland Types in Land Use Categories	High Hydrocarbon Potential	Percent High HCP in Land Use Categories	Medium Hydrocarbon Potential	Percent Medium HCP in Land Use Categories	Low Hydrocarbon Potential	Percent Low HCP in Land Use Categories
No lease sale offered	**7300**	**100**	**269,300**	**100**	**457,600**	**100**
Estuarine and marine deepwater	—	—	9,100	3	4,500	1
Lake	—	—	2,400	1	600	0
Freshwater pond	<50	<1	1,400	1	400	0
Riverine	600	8	6,400	2	9,100	2
Estuarine and marine wetland	—	—	900	0	400	0
Freshwater emergent wetland	5800	79	238,600	89	423,400	93
Freshwater forested/shrub wetland	900	12	10500	4	19200	4
Grand total	**425,300**	**—**	**625,700**	**—**	**457,600**	**—**

Source: BLM GIS 2018
Note: Tables were generated by intersecting multiple GIS datasets using acreages calculated in GIS and rounded to the nearest 100 acres; totals may not match the rounded Alternative summary acreage tables.

J.2 BIRDS

Table J-13
Status, Abundance, and Conservation Listings of Bird Species on the Arctic Refuge Coastal Plain

Species Group: Waterbirds			Conservation Listings							
Common Name	Scientific Name	Status and Abundance[a]	ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Greater White-fronted goose	*Anser albifrons*	Breeder: uncommon Migrant: common (spring, fall)	—	—	—	—	—	—	—	—
Snow goose	*A. caerulescens*	Visitor: rare (summer) Migrant: common (spring), abundant (fall)	—	—	—	—	—	—	—	—
Ross's goose	*A. rossii*	Migrant: casual (spring), possible (fall)	—	—	—	—	—	—	—	—
Brant	*Branta bernicla*	Breeder: uncommon Migrant: common (coast)	—	—	—	—	—	—	Y	—
Cackling goose	*B. hutchinsii*	Breeder: common Migrant: common (spring, fall)	—	—	—	—	—	—	Y	—
Trumpeter swan	*Cygnus buccinator*	Breeder and visitor: casual	—	—	—	—	—	—	—	—
Tundra swan	*C. columbianus*	Breeder: common	—	—	—	—	—	—	—	—
Northern shoveler	*Spatula clypeata*	Possible breeder: uncommon Visitor: uncommon	—	—	—	—	—	—	—	—
Gadwall	*Mareca strepera*	Visitor: casual	—	—	—	—	—	—	—	—
Eurasian wigeon	*M. penelope*	Visitor: casual	—	—	—	—	—	—	—	—
American wigeon	*M. americana*	Migrant: uncommon	—	—	—	—	—	—	—	—
Mallard	*Anas platyrhynchos*	Breeder: rare (inland), uncommon (rest of coastal plain)	—	—	—	—	—	—	—	—
Northern pintail	*A. acuta*	Breeder and migrant: common	—	—	—	—	—	—	—	—
Green-winged Teal	*A. crecca*	Breeder: uncommon (inland), rare (coast) Migrant: rare (coast)	—	—	—	—	—	—	Y	—
Canvasback	*Aythya valisineria*	Visitor: casual	—	—	—	—	—	—	—	—
Greater scaup	*A. marila*	Breeder: rare (inland) Visitor: uncommon (coast) Migrant: uncommon (coast)	—	—	—	—	—	—	R	—
Lesser scaup	*A. affinis*	Breeder: rare (inland) Visitor: rare (inland)	—	—	—	—	—	—	—	—

Species Group: Waterbirds			Conservation Listings							
Common Name	Scientific Name	Status and Abundance[a]	ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Steller's eider	*Polysticta stelleri*	Visitor: rare (coast)	T	—	S	A	—	—	R	VU
Spectacled eider	*Somateria fischeri*	Breeder: rare (coast) Visitor: uncommon (coast)	T	—	S	A	—	—	R	NT
King eider	*S. spectabilis*	Breeder: fairly common (coast) Migrant: uncommon (coast)	—	—	—	—	—	—	Y	—
Common eider	*S. mollissima*	Breeder: common (barrier islands) Migrant: common (coast)	—	—	—	—	—	—	—	NT
Harlequin duck	*Histrionicus histrionicus*	Breeder: rare (inland)	—	—	—	—	—	—	—	—
Surf scoter	*Melanitta perspicillata*	Possible breeder: uncommon (inland) Migrant: uncommon (coast)	—	—	—	—	—	—	—	—
White-winged scoter	*M. fusca*	Possible breeder: rare (inland) Migrant: common (coast)	—	—	—	—	—	—	—	—
Black scoter	*M. americana*	Migrant: uncommon (coast)	—	—	—	A	—	—	R	NT
Long-tailed duck	*Clangula hyemalis*	Breeder: common Migrant: abundant (coast) in fall	—	—	—	—	—	—	—	VU
Common goldeneye	*Bucephala clangula*	Visitor: rare	—	—	—	—	—	—	—	—
Smew	*Mergellus albellus*	Visitor: accidental	—	—	—	—	—	—	—	—
Common merganser	*Mergus merganser*	Visitor: casual (inland)	—	—	—	—	—	—	—	—
Red-breasted merganser	*M. serrator*	Breeder: fairly common (inland), rare (coast) Migrant: fairly common (coast)	—	—	—	—	—	—	—	—
Horned grebe	*Podiceps auritus*	Possible breeder: uncommon (inland) Visitor: casual	—	—	—	—	—	—	—	VU
Red-necked grebe	*P. grisegena*	Visitor: casual	—	—	—	—	—	—	R	—
Sandhill crane	*Antigone canadensis*	Breeder: rare Summer resident: uncommon	—	—	—	—	—	—	—	—
Red-throated loon	*Gavia stellata*	Breeder: fairly common (coast) Migrant: fairly common (coast)	—	C	S	A	—	—	—	—
Pacific loon	*Gavia pacifica*	Breeder: common Migrant: common (coast)	—	—	—	—	—	—	—	—
Common loon	*G. immer*	Visitor: rare (coast)	—	—	—	—	—	—	—	—
Yellow-billed Loon	*G. adamsii*	Migrant: uncommon (coast), rare (inland)	—	C	S	A	—	—	R	NT

Species Group: Shorebirds			Conservation Listings							
Common Name	**Scientific Name**	**Status and Abundance[a]**	**ESA[b]**	**USFWS BCC[c]**	**BLM[d]**	**ADFG[e]**	**US SCPP[f]**	**PIF[g]**	**AUD[h]**	**IUCN[i]**
Black-bellied Plover	*Pluvialis squatarola*	Breeder: rare Migrant: rare (coast) to fairly common (coast in fall)	—	—	—	—	MC	—	—	—
American golden-plover	*P. dominica*	Breeder: common	—	—	—	A	HC	—	R	—
Semipalmated plover	*Charadrius semipalmatus*	Breeder: uncommon (barrier islands) and fairly common (inland) Visitor: rare	—	—	—	—	—	—	—	—
Killdeer	*C. vociferus*	Visitor: casual	—	—	—	A	MC	—	—	—
Eurasian dotterel	*C. morinellus*	Visitor: casual	—	—	—	—	—	—	—	—
Upland sandpiper	*Bartramia longicauda*	Breeder: fairly common (inland)	—	—	—	A	—	—	—	—
Whimbrel	*Numenius phaeopus*	Breeder: rare (inland) Visitor: uncommon (coast)	—	C	S	A	HC	—	Y	—
Black-tailed godwit	*Limosa limosa*	Visitor: accidental	—	—	—	—	—	—	—	NT
Hudsonian godwit	*L. haemastica*	Visitor: casual	—	C[j]	S	A	HC	—	Y	—
Bar-tailed godwit	*L. lapponica*	Possible breeder: uncommon	—	C	S	A	GC	—	R	NT
Ruddy turnstone	*Arenaria interpres*	Breeder: fairly common (coast), uncommon (inland)	—	—	—	—	MC	—	—	—
Red knot	*Calidris canutus*	Migrant: rare	—	C	S	A	GC	—	R	NT
Ruff	*C. pugna*	Visitor: casual	—	—	—	—	—	—	—	—
Sharp-tailed sandpiper	*C. acuminata*	Migrant: casual (coast)	—	—	—	—	—	—	R	—
Stilt sandpiper	*C. himantopus*	Breeder: uncommon Migrant: uncommon (fall)	—	—	—	—	—	—	—	—
Red-necked stint	*C. ruficollis*	Visitor: casual (coast)	—	—	—	—	—	—	—	NT
Sanderling	*C. alba*	Breeder: rare Migrant: rare (coast in spring), uncommon (coast in fall)	—	—	—	A	MC	—	—	—
Dunlin	*Calidris alpina*	Breeder: uncommon (coast) Migrant: uncommon (coast in fall)	—	C	S	A	HC[k]	—	R	—
Baird's sandpiper	*C. bairdii*	Breeder: uncommon	—	—	—	—	—	—	—	—
Least sandpiper	*C. minutilla*	Visitor: rare	—	—	—	—	—	—	—	—
White-rumped sandpiper	*C. fuscicollis*	Breeder: rare Migrant: rare (spring), uncommon (fall)	—	—	—	—	—	—	—	—

Species Group: Shorebirds			Conservation Listings							
Common Name	**Scientific Name**	**Status and Abundance[a]**	**ESA[b]**	**USFWS BCC[c]**	**BLM[d]**	**ADFG[e]**	**US SCPP[f]**	**PIF[g]**	**AUD[h]**	**IUCN[i]**
Buff-breasted Sandpiper	*C. subruficollis*	Breeder: uncommon Migrant: uncommon	—	C	S	A	HC	—	R	NT
Pectoral sandpiper	*C. melanotos*	Breeder: abundant Migrant: abundant (coast in fall)	—	—	—	A	HC	—	R	—
Semipalmated sandpiper	*C. pusilla*	Breeder: abundant (coast), common (inland) Migrant: common (coast in fall)	—	—	—	A	HC	—	—	NT
Western sandpiper	*C. mauri*	Possible breeder: rare Migrant: uncommon on coast	—	—	—	A	MC	—	Y	—
Long-billed Dowitcher	*Limnodromus scolopaceus*	Breeder: uncommon Visitor: fairly common (summer) Migrant: common on coast	—	—	—	—	MC	—	—	—
Wilson's snipe	*Gallinago delicata*	Possible breeder and Visitor: rare	—	—	—	—	—	—	—	—
Spotted sandpiper	*Actitis macularius*	Breeder: uncommon (inland)	—	—	—	A	—	—	—	—
Wandering tattler	*Tringa incana*	Breeder: uncommon (inland)	—	—	—	—	—	—	Y	—
Lesser yellowlegs	*T. flavipes*	Visitor: casual	—	C[l]	—	A	HC	—	R	—
Wilson's phalarope	*Phalaropus tricolor*	Visitor: accidental	—	—	—	—	—	—	—	—
Red-necked Phalarope	*P. lobatus*	Breeder: common Migrant: common to abundant (coast)	—	—	—	—	MC	—	—	—
Red phalarope	*P. fulicarius*	Breeder: fairly common (coast east to Jago Delta), uncommon (rest of coastal plain) Migrant: uncommon (coast in fall)	—	—	—	—	MC	—	—	—

Species Group: Larids			Conservation Listings							
Common Name	Scientific Name	Status and Abundance[a]	ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Pomarine jaeger	*Stercorarius pomarinus*	Breeder: occasionally common (coast) Visitor: common (summer) Migrant: common (spring)	—	—	—	—	—	—	—	—
Parasitic jaeger	*S. parasiticus*	Breeder: uncommon Summer resident: common	—	—	—	—	—	—	—	—
Long-tailed Jaeger	*S. longicaudus*	Breeder: fairly common (inland), rare (coast) Summer resident: common	—	—	—	—	—	—	—	—
Black-legged kittiwake	*Rissa tridactyla*	Visitor: rare (coast mostly offshore)	—	—	—	—	—	—	R	VU
Ivory gull	*Pagophila eburnea*	Migrant: rare	—	—	—	—	—	—	R	NT
Sabine's gull	*Xema sabini*	Breeder: uncommon (coast) Migrant: uncommon (coast)	—	—	—	—	—	—	—	—
Bonaparte's gull	*Chroicocephalus philadelphia*	Visitor: casual	—	—	—	—	—	—	—	—
Ross's gull	*Rhodostethia rosea*	Migrant: rare (coast)	—	—	—	—	—	—	Y	—
Mew gull	*Larus canus*	Breeder and visitor: rare	—	—	—	—	—	—	—	—
Herring gull	*L. argentatus*	Visitor and migrant: rare	—	—	—	—	—	—	—	—
Thayer's gull	*L. thayeri*	Visitor: rare	—	—	—	—	—	—	—	—
Slaty-backed Gull	*L. schistisagus*	Visitor: casual (coast)	—	—	—	—	—	—	—	—
Glaucous-winged Gull	*L. glaucescens*	Visitor: casual (coast)	—	—	—	—	—	—	—	—
Glaucous gull	*L. hyperboreus*	Breeder: common (coast), uncommon (inland) Summer resident: abundant (coast)	—	—	—	—	—	—	—	—
Caspian tern	*Hydroprogne caspia*	Visitor: accidental	—	—	—	—	—	—	—	—
Arctic tern	*Sterna paradisaea*	Breeder: uncommon (coast), rare (inland) Summer resident: common	—	C	—	—	—	—	—	—

Species Group: Raptors and Owls			Conservation Listings							
Common Name	Scientific Name	Status and Abundance[a]	ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Osprey	*Pandion haliaetus*	Visitor: accidental	—	—	—	—	—	—	—	—
Bald eagle	*Haliaeetus leucocephalus*	Visitor: casual	—	—	—	—	—	—	—	—
Northern harrier	*Circus hudsonius*	Possible breeder: uncommon (inland) Summer resident: uncommon	—	—	—	A	—	—	—	—
Sharp-shinned hawk	*Accipiter striatus*	Visitor: casual	—	—	—	—	—	—	—	—
Northern goshawk	*A. gentilis*	Visitor: casual (inland)	—	—	—	—	—	—	—	—
Rough-legged hawk	*Buteo lagopus*	Breeder: uncommon (inland) Visitor: rare (coast)	—	—	—	—	—	—	—	—
Golden eagle	*Aquila chrysaetos*	Breeder: rare (inland) Visitor: fairly common	—	—	—	A	—	—	—	—
Snowy owl	*Bubo scandiacus*	Breeder: common (in high microtine rodent years) to rare	—	—	—	A	—	C	—	VU
Short-eared owl	*Asio flammeus*	Breeder: common (in high microtine rodent years) to uncommon	—	—	—	A	—	—	—	—
American kestrel	*Falco sparverius*	Visitor: casual	—	—	—	A	—	—	—	—
Merlin	*F. columbarius*	Possible breeder and visitor: rare	—	—	—	—	—	—	—	—
Gyrfalcon	*F. rusticolus*	Permanent resident and breeder: uncommon (inland) Visitor: rare on coast	—	—	—	A	—	—	—	—
Peregrine falcon	*F. peregrinus*	Breeder: rare Visitor: uncommon	—	—	—	—	—	—	—	—

Species Group: Landbirds			Conservation Listings							
Common Name	Scientific Name	Status and Abundance[a]	ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Willow ptarmigan	*Lagopus lagopus*	Permanent resident and breeder: uncommon (coast), common to abundant (inland)	—	—	—	—	—	—	—	—
Rock ptarmigan	*L. muta*	Permanent resident and breeder: common	—	—	—	—	—	—	—	—
Common nighthawk	*Chordeiles minor*	Visitor: casual	—	—	—	—	—	—	—	—
Rufous hummingbird	*Selasphorus rufus*	Visitor: accidental	—	—	—	A	—	C	R	NT
Belted kingfisher	*Megaceryle ayon*	Visitor: casual	—	—	—	A	—	—	—	—
Hammond’s flycatcher	*Empidonax hammondii*	Visitor: accidental	—	—	—	—	—	—	—	—
Eastern phoebe	*Sayornis phoebe*	Visitor: accidental	—	—	—	—	—	—	—	—
Say’s phoebe	*S. saya*	Visitor: rare	—	—	—	—	—	—	—	—
Eastern kingbird	*Tyrannus tyrannus*	Visitor: accidental	—	—	—	—	—	—	—	—
Northern shrike	*Lanius borealis*	Possible breeder and visitor: rare (inland)	—	—	—	—	—	—	—	—
Gray jay	*Perisoreus canadensis*	Visitor: casual	—	—	—	—	—	—	—	—
Common raven	*Corvus corax*	Permanent resident: uncommon Possible breeder: rare	—	—	—	—	—	—	—	—
Horned lark	*Eremophila alpestris*	Breeder: rare (inland) Visitor: rare (rest of coastal plain)	—	—	—	A	—	—	—	—
Tree swallow	*Tachycineta bicolor*	Visitor: casual	—	—	—	A	—	—	—	—
Violet-green Swallow	*T. thalassina*	Visitor: casual	—	—	—	—	—	—	R	—
Bank swallow	*Riparia riparia*	Visitor: casual	—	—	—	A	—	—	R	—
Cliff swallow	*Petrochelidon pyrrhonota*	Possible breeder and visitor: rare	—	—	—	—	—	—	—	—
Barn swallow	*Hirundo rustica*	Visitor: casual	—	—	—	A	—	—	—	—
American dipper	*Cinclus mexicanus*	Permanent resident and breeder: uncommon (inland)	—	—	—	—	—	—	—	—
Bluethroat	*Luscinia svecica*	Breeder: rare (inland)	—	—	—	—	—	—	—	—
Northern wheatear	*Oenanthe oenanthe*	Visitor: rare	—	—	—	—	—	—	—	—
Gray-cheeked thrush	*Catharus minimus*	Visitor: rare	—	—	—	—	—	—	—	—
Hermit thrush	*C. guttatus*	Visitor: accidental	—	—	—	—	—	—	—	—
American robin	*Turdus migratorius*	Breeder: uncommon (inland) Visitor: rare (coast)	—	—	—	—	—	—	—	—
Varied thrush	*Ixoreus naevius*	Visitor: casual	—	—	—	A	—	—	—	—

Species Group: Landbirds			Conservation Listings							
Common Name	Scientific Name	Status and Abundance[a]	ESA[b]	USFWS BCC[c]	BLM[d]	ADFG[e]	US SCPP[f]	PIF[g]	AUD[h]	IUCN[i]
Cedar waxwing	*Bombycilla cedrorum*	Visitor: accidental	—	—	—	—	—	—	—	—
Eastern yellow wagtail	*Motacilla tschutschensis*	Breeder: fairly common	—	—	—	—	—	—	—	—
American pipit	*Anthus rubescens*	Breeder: rare Migrant: uncommon (fall)	—	—	—	A	—	—	—	—
Common redpoll	*Acanthis flammea*	Breeder: common	—	—	—	A	—	—	—	—
Hoary redpoll	*A. hornemanni*	Breeder: common	—	—	—	—	—	—	—	—
Pine siskin	*Spinus pinus*	Visitor: casual	—	—	—	A	—	—	—	—
Lapland longspur	*Caarius lapponicus*	Breeder: abundant	—	—	—	—	—	—	—	—
Smith’s longspur	*C. pictus*	Visitor: rare	—	C	S	A	—	—	—	—
Snow bunting	*Plectrophenax nivalis*	Breeder: common (coast)	—	—	—	A	—	—	—	—
Northern waterthrush	*Parkesia noveboracensis*	Visitor: casual	—	—	—	—	—	—	—	—
Orange-crowned warbler	*Oreothlypis celata*	Visitor: casual	—	—	—	A	—	—	R	—
Yellow warbler	*Setophaga petechia*	Breeder: rare (inland) Visitor: rare (coast)	—	—	—	A	—	—	—	—
Yellow-rumped warbler	*S. coronata*	Visitor: casual	—	—	—	—	—	—	—	—
Wilson’s warbler	*Cardellina pusilla*	Visitor: rare	—	—	—	A	—	—	—	—
American tree sparrow	*Spizelloides arborea*	Breeder: common (inland): Visitor: rare (coast)	—	—	—	—	—	—	—	—
Chipping sparrow	*Spizella passerina*	Visitor: casual	—	—	—	A	—	—	—	—
Clay-colored sparrow	*S. pallida*	Visitor: accidental	—	—	—	—	—	—	—	—
Savannah sparrow	*Passerculus sandwichensis*	Breeder: common	—	—	—	A	—	—	—	—
Fox sparrow	*Passerella iliaca*	Breeder: rare (inland) Visitor: rare (coast)	—	—	—	A	—	—	—	—
White-throated sparrow	*Zonotrichia albicollis*	Visitor: casual	—	—	—	—	—	—	—	—
White-crowned sparrow	*Z. leucophrys*	Breeder: uncommon (inland) Visitor: rare (coast)	—	—	—	A	—	—	—	—
Dark-eyed junco	*Junco hyemalis*	Visitor: rare	—	—	—	—	—	—	—	—
Red-winged blackbird	*Agelaius phoeniceus*	Visitor: casual	—	—	—	A	—	—	—	—
Rusty blackbird	*Euphagus carolinus*	Visitor: casual	—	—	—	A	—	—	—	VU
Brown-headed cowbird	*Molothrus ater*	Visitor: casual	—	—	—	—	—	—	—	—

Species Group: Seabirds			Conservation Listings							
Common Name	**Scientific Name**	**Status and Abundance[a]**	**ESA[b]**	**USFWS BCC[c]**	**BLM[d]**	**ADFG[e]**	**US SCPP[f]**	**PIF[g]**	**AUD[h]**	**IUCN[i]**
Thick-billed murre	*Uria lomvia*	Migrant: rare (coast)	—	—	—	—	—	—	—	—
Kittlitz's murrelet[m]	*Brachyramphus brevirostris*	Visitor: rare (offshore)	—	—	S	A	—	—	R	NT
Black guillemot	*Cepphus grylle*	Breeder: rare (coast) Summer resident: uncommon (coast)	—	—	—	—	—	—	—	—
Least auklet	*Aethia pusilla*	Visitor: casual (coast)	—	—	—	—	—	—	—	—
Horned puffin	*Fratercula corniculata*	Visitor: rare (coast)	—	—	—	—	—	—	R	—
Tufted puffin	*F. cirrhata*	Visitor: casual (coast)	—	—	—	—	—	—	R	—
Northern fulmar	*Fulmarus glacialis*	Visitor: rare (offshore)	—	—	—	—	—	—	—	—
Short-tailed shearwater	*Ardenna tenuirostris*	Visitor: rare (coast mostly offshore)	—	—	—	—	—	—	—	—

[a]Status and abundance from the bird occurrence information for the Arctic Refuge Coastal Plain presented in USFWS (2015, in Appendix F) and Pearce et al. (2018).
[b]Endangered Species Act listings for Alaska (USFWS and NMFS 2014). T = Threatened.
[c] USFWS Birds of Conservation Concern (USFWS 2008). C = Bird of Conservation Concern from USFWS.
[d] BLM Special Status Species List (BLM 2019). S = Sensitive Species..
[e] ADFG Alaska Wildlife Action Plan list of Species of Greatest Conservation Need (ADFG 2015). A = At-risk Species.
[f] Shorebirds of Conservation Concern (U.S. Shorebird Conservation Plan Partnership 2016). GC = Greatest concern; HC = High concern; MC = Moderate concern.
[g] Partners in Flight Landbird Conservation Plan Species of Continental Concern (Rosenberg et al. 2016). C = Birds of Continental Concern.
[h] Audubon Watchlist Species (Warnock 2017a and 2017b). R = Red-list species; Y = Yellow-list species.
[i] IUCN Red List of Threatened Species (IUCN 2018). EN = Endangered; VU = Vulnerable; NT = Near Threatened.
[j]Listed as a species of conservation concern for Bird Conservation Regions 2 and 5 only.
[k]Listed at the regional not national level.
[l]Listed as a species of conservation concern for Bird Conservation Regions 4 and 5 only.
[m]Source: Kuletz and Labunski 2017.

Table J-14
Birds on the Arctic Refuge Coastal Plain Listed as Canadian Wildlife Species At Risk

Species Group	Common Name	*Scientific Name*	Status
Waterbirds	Horned grebe	*Podiceps auritus* (western population)	S
Shorebirds	Red knot	*Calidris canutus* ssp. *roselaari*	T
	Buff-breasted sandpiper	*Tryngites subruficollis*	S
	red-necked phalarope	*Phalaropus lobatus*	S
Larids	Ivory gull	*Pagophila eburnea*	E
	Ross's gull	*Rhodostethia rosea*	T
Raptors and Owls	Short-eared owl	*Asio flammeus*	S
	Peregrine falcon*	*Falco peregrinus* ssp. *anatum/tundrius*	S
Landbirds	Common nighthawk	*Chordeiles minor*	T
	Bank swallow	*Riparia riparia*	T
	Barn swallow	*Hirundo rustica*	T
	Rusty blackbird	*Euphagus carolinus*	S

Source: COSEWIC 2018
S = Special Concern; T = Threatened; E = Endangered
*The *anatum/tundrius* subspecies of peregrine falcon was designated as "not at risk" by COSEWIC in 2017; however, it still retains special concern status under the Species At Risk Act (SARA)

Table J-15
Conservation Listings of Additional Bird Species Occurring Along Vessel Transit Route Between Dutch Harbor and the Program Area

Species Group: Waterbirds		Conservation Listings					
Common Name	**Scientific Name**	**ESA[a]**	**USFWS BCC[b]**	**BLM[c]**	**ADFG[d]**	**AUD[e]**	**IUCN[f]**
Emperor goose	*Anser canagicus*	—	—	—	A	Y	NT
Snow goose	*A. caerulescens*	—	—	—	—	—	—
Brant	*Branta bernicla*	—	—	—	—	Y	—
Cackling goose (Aleutian, Taverner's, minima)	*B. hutchinsii*	—	—	—	—	Y	—
Steller's eider	*Polysticta stelleri*	T	—	S	A	R	VU
Spectacled eider	*Somateria fischeri*	T	—	S	A	R	NT
King eider	*S. spectabilis*	—	—	—	—	Y	—
Common eider	*S. mollissima*	—	—	—	—	—	NT
Harlequin duck	*Histrionicus histrionicus*	—	—	—	—	—	—
Surf scoter	*Melanitta perspicillata*	—	—	—	—	—	—
White-winged scoter	*M. fusca*	—	—	—	—	—	—
Black scoter	*M. americana*	—	—	—	A	R	NT
Long-tailed duck	*Clangula hyemalis*	—	—	—	—	—	VU
Common goldeneye	*Bucephala clangula*	—	—	—	—	—	—
Barrow's goldeneye	*B. islandica*	—	—	—	—	—	—
Common merganser	*Mergus merganser*	—	—	—	—	—	—
Red-breasted merganser	*M. serrator*	—	—	—	—	—	—
Horned grebe	*Podiceps auritus*	—	—	—	—	—	VU
Red-throated loon	*Gavia stellata*	—	C	S	A	—	—
Arctic loon	*G. arctica*	—	—	—	—	—	—
Pacific loon	*G. pacifica*	—	—	—	—	—	—
Common loon	*G. immer*	—	—	—	—	—	—
Yellow-billed Loon	*G. adamsii*	—	C	S	A	R	NT

Species Group: Shorebirds		Conservation Listings					
Common Name	**Scientific Name**	**ESA[a]**	**USFWS BCC[b]**	**BLM[c]**	**ADFG[d]**	**AUD[e]**	**IUCN[f]**
Red-necked phalarope	*Phalaropus lobatus*	—	—	—	—	—	—
Red phalarope	*P. fulicarius*	—	—	—	—	—	—
Black oystercatcher	*Haematopus bachmani*	—	C	—	A	—	—
Semipalmated plover	*Charadrius semipalmatus*	—	—	—	—	—	—
Ruddy turnstone	*Arenaria interpres*	—	—	—	—	—	—
Rock sandpiper	*Calidris ptilocnemis*	—	—	S	—	Y	—
Least sandpiper	*C. minutilla*	—	—	—	—	—	—
Pectoral sandpiper	*C. melanotos*	—	—	—	A	R	—
Wandering tattler	*Tringa incana*	—	—	—	—	Y	—

Species Group: Larids		Conservation Listings					
Common Name	**Scientific Name**	**ESA[a]**	**USFWS BCC[b]**	**BLM[c]**	**ADFG[d]**	**AUD[e]**	**IUCN[f]**
Pomarine jaeger	*Stercorarius pomarinus*	—	—	—	—	—	—
Parasitic jaeger	*S. parasiticus*	—	—	—	—	—	—
Long-tailed Jaeger	*S. longicaudus*	—	—	—	—	—	—
Black-legged kittiwake	*Rissa tridactyla*	—	—	—	—	R	VU
Red-legged kittiwake	*R. 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	*L. delawarensis*	—	—	—	—	—	—
Herring gull	*L. argentatus*	—	—	—	A	—	—
Iceland gull	*L. glaucoides*	—	—	—	—	—	—
Slaty-backed gull	*L. schistisagus*	—	—	—	—	—	—
Glaucous-winged gull	*L. glaucescens*	—	—	—	—	—	—
Glaucous gull	*L. hyperboreus*	—	—	—	—	—	—
Aleutian tern	*Onychoprion aleuticus*	—	C	S	A	R	VU
Caspian tern	*Hydroprogne caspia*	—	C	—	—	—	—
Arctic tern	*Sterna paradisaea*	—	C	—	A	—	—

Species Group: Seabirds		Conservation Listings					
Common Name	**Scientific Name**	**ESA[a]**	**USFWS BCC[b]**	**BLM[c]**	**ADFG[d]**	**AUD[e]**	**IUCN[f]**
Dovekie	*Alle alle*	—	—	—	—	—	—
Common murre	*Uria aalge*	—	—	—	—	—	—
Thick-billed murre	*U. lomvia*	—	—	—	—	—	—
Black guillemot	*Cepphus grylle*	—	—	—	—	—	—
Pigeon guillemot	*C. columba*	—	—	—	—	—	—
Marbled murrelet	*Brachyramphus marmoratus*	—	C	S	A	R	EN
Kittlitz's murrelet	*B. brevirostris*	—	C	S	A	R	NT
Ancient murrelet	*Synthliboramphus antiquus*	—	—	—	A	—	—
Cassin's auklet	*Ptychoramphus aleuticus*	—	—	—	A	—	NT
Parakeet auklet	*Aethia psittacula*	—	—	—	—	—	—
Least auklet	*A. pusilla*	—	—	—	—	—	—
Whiskered auklet	*A. pygmaea*	—	C	—	—	Y	—
Crested auklet	*A. cristatella*	—	—	—	—	—	—
Rhinoceros auklet	*Cerorhinca monocerata*	—	—	—	—	—	—
Horned puffin	*Fratercula corniculata*	—	—	—	—	R	—
Tufted puffin	*F. cirrhata*	—	—	—	—	R	—
Laysan albatross	*Phoebastria immutabilis*	—	C	—	A	—	NT
Black-footed albatross	*P. nigripes*	—	C	—	A	—	NT
Short-tailed albatross	*P. albatrus*	E	—	—	A	R	VU
Northern fulmar	*Fulmarus glacialis*	—	—	—	—	—	—
Short-tailed shearwater	*Ardenna tenuirostris*	—	—	—	—	—	—
Sooty shearwater	*A. grisea*	—	—	—	—	—	NT
Fork-tailed storm-petrel	*Oceanodroma furcata*	—	—	—	—	—	—
Leach's storm-petrel	*O. leucorhoa*	—	—	—	—	—	VU
Double-crested cormorant	*Phalacrocorax auritus*	—	—	—	—	Y	—
Red-faced cormorant	*P. urile*	—	C	—	A	R	—
Pelagic cormorant	*P. pelagicus*	—	C	—	A	—	—

[a]Endangered Species Act listings for Alaska (USFWS and NMFS 2014); E = Endangered; T = Threatened
[b] USFWS Birds of Conservation Concern (USFWS 2008). C = Bird of Conservation Concern from USFWS
[c] BLM Special Status Species List (BLM 2019). S = Sensitive Species
[d] ADFG Alaska Wildlife Action Plan list of Species of Greatest Conservation Need (ADFG 2015). A = At-Risk Species
[e] Audubon Watchlist Species (Warnock 2017a and 2017b). R = Red-list species; Y = Yellow-list species
[f] IUCN Red List of Threatened Species (IUCN 2018). EN = Endangered; VU = Vulnerable; NT = Near Threatened

J.3 TERRESTRIAL MAMMALS

Table J-16
Terrestrial Mammal Species Known or Suspected to Occur in the Arctic National Wildlife Refuge (adapted from Appendix F in USFWS 2015)

English Name[a]	Scientific Name[a]	Present in Program Area
Cinereus shrew	*Sorex cinereus*	No
Pygmy shrew	*S. hoyi*	No
Dusky shrew	*S. monticolus*	No
Tundra shrew	*S. tundrensis*	Yes
Barren ground shrew	*S. ugyunak*	Yes
Holarctic least shrew	*S. minutissimus*	Yes
Collared lemming	*Dicrostonyx groenlandicus*	Yes
Brown lemming	*Lemmus trimucronatus*	Yes
Long-tailed vole	*Microtus longicaudus*	No
Singing vole	*M. miurus*	Yes
Root (tundra) vole	*M. oeconomus*	Yes
Meadow vole	*M. pennsylvanicus*	No
Taiga vole	*M. xanthognathus*	No
Northern red-backed vole	*Myodes rutilus*	No
Common muskrat	*Ondatra zibethicus*	No
Northern bog lemming	*Synaptomys borealis*	No
Alaska marmot	*Marmota broweri*	No
Arctic ground squirrel	*Urocitellus parryii*	Yes
Red squirrel	*Tamiasciurus hudsonicus*	No
North American porcupine	*Erethizon dorsatum*	No
American beaver	*Castor canadensis*	No; range is expanding northward
Snowshoe hare	*Lepus americanus*	Rare; range is expanding northward
Wolverine	*Gulo gulo*	Yes
North American river otter	*Lontra canadensis*	Rare
American marten	*Martes americana*	No
Ermine	*Mustela erminea*	Yes
Least weasel	*M. nivalis*	Yes
American mink	*Neovison vison*	No
Canada lynx	*Lynx canadensis*	Rare
Wolf	*Canis lupus*	Yes
Coyote	*C. latrans*	Rare
Arctic fox	*Vulpes lagopus*	Yes
Red Fox	*V. vulpes*	Yes
American black bear	*Ursus americanus*	No
Brown (grizzly) bear	*U. arctos*	Yes
Moose	*Alces americanus*	Yes
Caribou	*Rangifer tarandus*	Yes
Dall's sheep	*Ovis dalli*	No; nearby in mountains to south
Muskox	*Ovibos moschatus*	Yes

[a]Sources: MacDonald and Cook (2009), with taxonomic and nomenclatural updates from Bradley et al. (2014)

Table J-17
Acres in Different Levels of Use (Percent of Years Caribou Present) by Parturient Porcupine Caribou During Calving, by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

PCH Calving Table

Alternative	Lease Type	Percent of Years Present	Oil Potential: High	Medium	Low	Total
B	No sale/no surface occupancy	<20	105,300	14,900	900	121,100
		20–30	3,700	14,600	3,100	21,400
		30–40	0	11,100	500	11,600
		>40	0	51,700	83,800	135,500
	Timing limitations	<20	0	100	0	100
		20–30	0	300	500	800
		30–40	0	8,400	8,900	17,300
		>40	0	241,200	323,700	564,900
	Standard terms and conditions only	<20	263,800	69,000	1,900	334,700
		20–30	19,300	76,400	31,000	126,700
		30–40	0	114,900	10,400	125,300
		>40	0	26,100	1,800	27,900
C	No sale/no surface occupancy	<20	148,200	15,100	900	164,200
		20–30	10,800	21,500	3,600	35,900
		30–40	0	25,500	1,200	26,700
		>40	0	236,700	394,500	631,200
	Timing limitations	<20	43,000	34,000	1,900	78,900
		20–30	6,400	50,600	31,000	88,000
		30–40	0	47,500	18,600	66,100
		>40	0	68,600	14,800	83,400
	Standard Terms and Conditions Only	<20	177,900	34,800	0	212,700
		20–30	5,800	19,100	0	24,900
		30–40	0	61,400	0	61,400
		>40	0	13,700	0	13,700
D1	No sale/no surface occupancy	<20	205,200	44,200	2,800	252,200
		20–30	22,600	57,100	27,600	107,300
		30–40	0	68,400	16,800	85,200
		>40	0	305,600	408,400	714,000
	Controlled surface use	<20	32,400	26,500	0	58,900
		20–30	0	21,600	7,100	28,700
		30–40	0	27,900	3,000	30,900
		>40	0	4,500	900	5,400
	Standard terms and conditions only	<20	131,500	13,400	0	144,900
		20–30	400	12,500	0	12,900
		30–40	0	38,000	0	38,000
		>40	0	8,900	0	8,900
D2	No sale/no surface occupancy	<20	205,200	44,500	2,800	252,500
		20–30	22,600	60,300	34,600	117,500
		30–40	0	81,200	19,800	101,000
		>40	0	312,800	409,300	722,100
	Controlled surface use	<20	32,400	26,100	0	58,500
		20–30	0	18,500	0	18,500
		30–0	0	24,700	0	24,700
		>40	0	3,400	0	3,400
	Timing limitations	<20	131,500	13,400	0	144,900
		20–30	400	12,500	0	12,900
		30–40	0	28,400	0	28,400
		>40	0	2,800	0	2,800

Source: BLM GIS 2018

Table J-18
Acres within Different Levels of Use (percent of years caribou present) by Porcupine Caribou during Post-calving, by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

PCH Post-calving Table						
Acres (x1000)		Percent of Years Present	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
B	No sale/no surface occupancy	<20	83,400	4,900	700	89,000
		20–30	11,700	19,000	400	31,100
		30–40	11,700	38,500	5,700	55,900
		>40	2,200	30,000	81,500	113,700
	Timing limitations	<20	111,900	53,800	0	165,700
		20–30	77,300	84,700	1,800	163,800
		30–40	69,800	106,300	35,400	211,500
		>40	24,100	41,600	7,900	73,600
	Standard terms and conditions only	<20	0	29,000	4,800	33,800
		20–30	0	61,100	14,100	75,200
		30–40	0	86,800	16,100	102,900
		>40	0	73,200	298,100	371,300
C	No sale/no surface occupancy	<20	103,500	35,800	5,500	144,800
		20–30	26,400	56,200	14,500	97,100
		30–40	27,000	122,700	16,100	165,800
		>40	2,200	84,100	364,100	450,400
	Timing limitations	<20	91,900	43,400	0	135,300
		20–30	62,700	72,100	0	134,800
		30–40	29,200	13,400	0	42,600
		>40	0	100	0	100
	Standard terms and conditions only	<20	0	8,400	0	8,400
		20–30	0	36,400	1,800	38,200
		30–40	25,300	95,400	41,100	161,800
		>40	24,100	60,500	23,400	108,000
D1	No sale/no surface occupancy	<20	124,500	69,400	5,500	199,400
		20–30	46,300	114,000	16,400	176,700
		30–40	52,300	179,900	48,900	281,100
		>40	4,800	112,000	384,700	501,500
	Controlled surface use	<20	70,900	18,200	0	89,100
		20–30	42,800	48,000	0	90,800
		30–40	18,200	6,600	0	24,800
		>40	0	0	0	0
	Standard terms and conditions only	<20%	0	0	0	0
		20–30%	0	2,700	0	2,700
		30–40%	10,900	45,100	8,300	64,300
		>40%	21,500	32,600	2,700	56,800
D2	No sale/no surface occupancy	<20%	124,500	82,600	5,500	212,600
		20–30%	46,300	116,500	16,300	179,100
		30–40%	52,300	185,600	57,200	295,100
		>40%	4,800	114,000	385,700	506,300
	Controlled surface use	<20%	0	0	0	0
		20–30%	0	2,700	0	2,700
		30–40%	10,900	39,400	0	50,300
		>40%	21,500	30,700	0	52,200
	Timing limitations	<20%	70,900	5,000	0	75,900
		20–30%	42,800	45,500	0	88,300
		30–40%	18,200	6,600	0	24,800
		>40%	0	0	0	0

Source: BLM GIS 2018

Table J-19
Estimated Number of Acres (1000s) of Central Arctic Caribou Herd Seasonal Range (Based on Kernel Density Estimate Contours) by Different Lease Restriction Categories, Alternatives, and Expected Caribou Density

CAH Acres of Seasonal Range Table

Percent of CAH		Season	Caribou Density[a]			
Alternative	Lease Type		High	Medium	Low	Total
B	No sale/no surface occupancy	Post-calving	0	42	53	95
		Mosquito	50	51	122	223
		Oestrid fly	116	58	140	314
		Late summer	0	14	214	228
	Timing limitations	Post-calving	0	0	0	0
		Mosquito	0	0	189	189
		Oestrid fly	0	87	465	552
		Late summer	0	0	291	291
	Standard terms and conditions only	Post-calving	0	62	172	234
		Mosquito	119	159	328	606
		Oestrid fly	413	102	89	604
		Late summer	0	70	422	492
C	No sale/no surface occupancy	Post-calving	0	52	74	126
		Mosquito	64	73	255	392
		Oestrid fly	161	109	574	844
		Late summer	0	24	501	525
	Timing limitations	Post-calving	0	1	50	51
		Mosquito	4	51	261	316
		Oestrid fly	154	121	42	317
		Late summer	0	0	272	272
	Standard terms and conditions only	Post-calving	0	51	101	152
		Mosquito	100	87	124	311
		Oestrid fly	214	17	78	309
		Late summer	0	60	155	215
D1	No sale/no surface occupancy	Post-calving	0	66	111	177
		Mosquito	89	103	497	689
		Oestrid fly	290	212	640	1142
		Late summer	0	44	698	742
	Controlled surface use	Post-calving	0	1	36	37
		Mosquito	3	39	82	124
		Oestrid fly	94	30	0	124
		Late summer	0	0	124	124
	Standard terms and conditions only	Post-calving	0	37	78	115
		Mosquito	75	70	60	205
		Oestrid fly	145	5	54	204
		Late summer	0	40	105	145
D2	No sale/no surface occupancy	Post-calving	0	66	111	177
		Mosquito	89	103	532	724
		Oestrid fly	293	227	656	1176
		Late summer	0	44	718	762
	Controlled surface use	Post-calving	0	1	36	37
		Mosquito	3	39	63	105
		Oestrid fly	92	13	0	105
		Late summer	0	0	105	105
	Timing limitations	Post-calving	0	37	78	115
		Mosquito	75	70	44	189
		Oestrid fly	145	5	39	189
		Late summer	0	40	105	145

Source: BLM GIS 2018
[a] High, medium, and low density areas based on 50 percent, 75 percent, and 95 percent kernel density contours respectively

Table J-20
Porcupine Caribou Calving and Post-Calving in the Program Area

Percent of Years that Calving Caribou Are Present	Area (Acres)	Percent of Coastal Plain
<20	455,900	30.7
20–30	148,900	10.0
30–40	154,100	10.4
>40	728,200	49.0

Percent of Years that Post-Calving Caribou are Present	Area (acres)	Percent of Coastal Plain
<20	288,400	19.4
20–30	270,000	18.2
30–40	370,300	24.9
>40	558,500	37.6

Source: BLM GIS 2018

Table J-21
Central Arctic Herd Female Caribou Annual Use of the Program Area During June-August[a]

Year	Number of Collared Animals	Percent of Animals Using Program Area	Average Percent of Locations in Program Area per Animal
2003[b]	23	52	6
2004	45	89	10
2005	30	57	6
2006	27	44	4
2007	1	100	14
2008	1	100	17
2009	13	100	23
2010	13	92	19
2011	11	82	15
2012	8	88	15
2013	8	75	12
2014	14	57	11
2015	15	47	5
2016	13	46	3
2017	13	39	5
2018	15	53	4

Source: ADF&G telemetry data.
[a] Collars active greater than 85 days and reporting locations greater than 75 days and locations within 30 days of first collaring were removed to reduce effects of collaring location on program area use.
[b] For example, in 2003, 23 female CAH caribou were collared June–August, 52 percent were in the program area at least once and the average percent of locations in the program area for those 23 animals was 6 percent.

J.4 MARINE MAMMALS

J.4.1 Standard Mitigation Measures for Polar Bears Under MMPA Incidental Take Regulations (ITRs)

The current Marine Mammal Protection Act (MMPA) Incidental Take Regulations (81 FR 52318; 50 CFR 18.128) for the Alaska Beaufort Sea describe mitigation, monitoring, and reporting requirements. Oil and gas industry operators are required to use them in the coastal region of the central Beaufort Sea that abuts, but does not include, the program area. The Beaufort Sea ITRs encompass a large portion of the range of the Southern Beaufort Sea (SBS) stock of polar bears, so it is expected that the new ITRs to be promulgated for the program area are likely to include the same or similar requirements. The general mitigation, monitoring, and reporting requirements for oil and gas industry operators are described below.

A) Mitigation measures for all holders of letters of authorization (LOAs)

- Implement policies and procedures to conduct activities in a manner that minimizes adverse impacts on polar bears, their habitat, and their availability for subsistence uses
- Use adaptive management practices, such as temporal and spatial activity restrictions in response to the presence polar bears or bears engaged in a biologically significant activity, to avoid interactions with, and minimize impacts on, the bears and their availability for subsistence uses
- Cooperate with the USFWS and other designated federal, state, and local agencies to monitor and mitigate the impacts of industry activities on polar bears
- Designate trained and qualified personnel to monitor for the presence of polar bears, to initiate mitigation measures, and to monitor, record, and report the effects of industry activities on polar bears
- Provide personnel with polar bear awareness training
- Have an approved polar bear safety, awareness, and interaction plan on file with the USFWS and on-site; it must include the following:
  - The type of activity and where and when the activity will occur (i.e., a plan of operation)
  - A food, waste, and other bear attractants management plan
  - Personnel training policies, procedures, and materials
  - Site-specific polar bear interaction risk evaluation and mitigation measures
  - Polar bear avoidance and encounter procedures
  - Polar bear observation and reporting procedures
- Contact affected subsistence communities and hunter organizations to discuss potential conflicts

B) Mitigation measures for onshore activities

- To limit disturbance around known polar bear dens:
  - Attempt to locate polar bear dens—Holders of an LOA seeking to carry out onshore activities in known or suspected polar bear denning habitat during the denning season (November–April) must try to locate occupied polar bear dens within and near areas of operation, using appropriate tools, such as infrared imagery or polar bear scent-trained dogs. All observed or suspected polar bear dens must be reported to the USFWS before beginning activities under the LOA.
  - Observe the exclusion zone around known polar bear dens—Operators must observe a 1-mile operational exclusion zone around all known polar bear dens during the denning season

(November–April) or until the female and cubs leave the areas. Should previously unknown occupied dens be discovered within 1 mile of activities, work must cease and the USFWS must be contacted for guidance. It will evaluate these instances on a case-by-case basis to determine the appropriate action. Potential actions range from cessation or modification of work to conducting additional monitoring. The holder of the authorization must comply with any additional measures specified.

  - Use the den habitat map developed by the USGS—This measure ensures that the locations of potential polar bear dens are considered when conducting activities in the coastal areas of the Beaufort Sea.
  - Polar bear den restrictions—Restrict the timing of activities to limit disturbance around dens.

C) Mitigation measures for operational and support vessels

- Operational and support vessels must be staffed with dedicated marine mammal observers to alert crew members of the presence of polar bears and to initiate mitigation responses.
- Vessel operators must maintain the maximum distance possible from concentrations of polar bears. No vessel operator should approach within a 0.5-mile radius of polar bears observed on land or ice.
- Vessel operators must avoid areas of active or anticipated polar bear subsistence hunting activity, as determined through community consultations.
- The USFWS may require trained marine mammal monitors on the site of the activity or onboard any vessel or vehicles to monitor the impacts of industry's activity on polar bears.

D) Mitigation measures for aircraft

- Operators of support aircraft should conduct their activities at the maximum distance possible from concentrations of polar bears.
- Aircraft will not be operated at an altitude lower than 1,500 feet within 0.5 miles of polar bears observed on ice or land. Helicopter operators may not hover or circle above such areas or within 0.5 miles of such areas. When weather conditions do not allow a 1,500-foot flying altitude, operators will take precautions to avoid flying directly over or within 0.5 miles of these areas.
- Plan all aircraft routes to minimize any potential conflict with known subsistence polar bear hunting activity.

E) Mitigation measures for sound-producing offshore activities

Any offshore activity expected to produce pulsed underwater sounds with received sound levels ≥160 dB re 1 μPa will be required to establish and monitor acoustically verified mitigation zones surrounding the sound source and to implement mitigation measures, as follows:

- Mitigation zones—A polar bear mitigation zone is required where the received pulsed sound level would be ≥190 dB re 1 μPa.
- Mitigation measures:
  - Ramp-up procedures—For all sound sources, including sound-source testing, the following sound ramp-up procedures must be used to allow polar bears to depart the mitigation zones:
    - Visually monitor the ≥190 dB re 1 μPa mitigation zones and adjacent waters for polar bears for at least 30 minutes before initiating ramp-up procedures. If no polar bears are detected,

ramp-up procedures may begin. Do not initiate ramp-up procedures when mitigation zones are not observable.

  - Power-down procedures—Immediately power down a sound source when one or more polar bears are observed or detected in the area delineated by the pulsed sound ≥190 dB re 1 μPa polar bear mitigation zone.
  - Shutdown procedures—If the power-down operation cannot reduce the received pulsed sound level to <190 dB re 1 μPa, the operator must immediately shut down the sound source.

F) Mitigation measures for the subsistence use of polar bears

Holders of LOAs must minimize adverse impacts on the availability of polar bears for subsistence uses.

- Community consultation—Applicants must consult with potentially affected communities and appropriate subsistence-user organizations to discuss potential conflicts with subsistence polar bear hunting caused by the location, timing, and methods of operations and support activities.
- Plan of cooperation (POC)—If conflicts arise, the applicant must address conflict avoidance issues through a POC, where the holder of an LOA will be required to develop and implement a USFWS-approved POC.

G) Monitoring requirements

- Develop and implement a site-specific, USFWS-approved marine mammal monitoring and mitigation plan to monitor and evaluate the effectiveness of mitigation measures and the effects of activities on polar bears and the subsistence use of this species.
- Provide trained, qualified, and USFWS-approved on-site observers to carry out monitoring and mitigation activities identified in the marine mammal monitoring and mitigation plan.
- For offshore activities, provide trained, qualified, and USFWS-approved observers on board all operational and support vessels to carry out monitoring and mitigation activities identified in the marine mammal monitoring and mitigation plan.
- Cooperate with the USFWS and other designated federal, state, and local agencies to monitor the impacts of industry activities on polar bears. Where information is insufficient to evaluate the potential effects of activities on polar bears, and the subsistence use of this species, holders of an LOA may be required to participate in joint monitoring or research efforts to address these information needs and ensure the least practicable impact on these resources.

H) Reporting requirements

Holders of an LOA must report the results of monitoring and mitigation activities to the USFWS.

- In-season monitoring reports:
  - Activity progress reports—Notify the USFWS at least 48 hours before beginning activities; provide the USFWS with weekly progress reports of any significant changes in activities or locations; and notify the USFWS within 48 hours after activities end.
  - Polar bear observation reports—Report all observations of polar bears and potential polar bear dens during any industry activity. Information in the observation report must include the following:
    - Date, time, and location of observation
    - Number of bears

- Sex and age
- Observer name and contact information\Weather, visibility, sea state, and sea-ice conditions at the time of observation
- Estimated closest distance of bears from personnel and facilities
- Industry activity at time of sighting
- Possible attractants present
- Bear behavior
- Description of the encounter
- Duration of the encounter
- Mitigation actions taken

- Notification of LOA incident report—Report all LOA incidents during any industry activity. Reports must include all information specified for an observation report, a complete detailed description of the incident, and any other actions taken.
- Final report—The results of monitoring and mitigation identified in the marine mammal monitoring and mitigation plan must be submitted to the USFWS for review within 90 days of the LOA expiration. Information in the final report must include the following:
  - Copies of all observation reports submitted under the LOA
  - A summary of the observation reports
  - A summary of monitoring and mitigation, including areas, total hours, total distances, and distribution
  - Analysis of factors affecting the visibility and detectability of polar bears during monitoring
  - Analysis of the effectiveness of mitigation measures
  - Analysis of the distribution, abundance, and behavior of polar bears observed
  - Estimates of take in relation to the specified activities

J.4.2 Estimated Number of Maternal Polar Bear Dens likely to occur Annually in the Coastal Plain Program Area (authored by Ryan Wilson, USFWS)

We developed a framework with which to estimate how many polar bear dens might be disturbed by the planned seismic activity during winter in the Coastal Plain. This first required an estimate of the potential number of dens in a given year in the Coastal Plain, derived from peer-reviewed studies. While there have been no formal analyses to estimate the number of polar bears that form maternal dens in the 1002 Area, a number of studies include parameters that can be used to develop such an estimate, as follows:

- Estimated population size (Bromaghin et al. 2015)
- Proportion of adult females in the population (Bromaghin et al. 2015)
- Breeding probability of adult females (Regehr et al. 2010)
- Proportion of dens that occur on land versus sea ice (Olson et al. 2017)
- Proportion of dens that occur on land in the Coastal Plain [program] area (Durner et al. 2010)

Bromaghin et al. (2015) estimated the size of the SBS subpopulation to be 907 polar bears in 2010 (90 percent confidence interval [CI]: 606 to 1212). Additionally, Bromaghin et al. (2015) provided information on the number of adult females that were captured each year from 2001 to 2010. These data indicated that, on average, the population was composed of 35.1 percent adult females (SD = 3.8). Using these data to determine the percent of adult females (PAF) in the population assumes that captured individuals comprised a representative sample of the population.

Regehr et al. (2010) provide estimates of the breeding probability for adult females in the SBS subpopulation. This includes two components: (1) the probability of a female without cubs breeding and producing a litter, and (2) a female that has a litter loses her cubs and rebreeds in a given year. Regehr et al. (2010) estimate these parameters to be 0.44 (Pbreed0; 90 percent CI: 0.33 to 0.56) and 0.10 (Pbreed1; 90 percent CI: 0.02 to 0.38), respectively.

Based on collar data from SBS bears from 2007 to 2013, Olson et al. (2017) found that 55.2 percent (16 of 29) of adult females denned on land versus sea ice (Pland = 0.55). The proportion of dens that occur in the Coastal Plain was derived from the U.S. Geological Survey published database of all known dens for bears in the SBS subpopulation from 1910 to 2010 (Durner et al. 2010). We restricted these data to dens from 2000 to 2010 that were detected by satellite radio collars. This ensured that den observations were not skewed toward areas with industrial activity or communities, where dens might be more readily observed. There were 39 dens on land, 9 of which were in the Coastal Plain; this resulted in an estimated 23.1 percent of land-based SBS polar bear dens in the Coastal Plain in any given year (PCoastal Plain = 0.23). This estimate assumes that the den data obtained from VHF and satellite radio collars are representative of the entire population and not just those in the area where bears are available to be captured and collared.

From this information, the number of dens in the Coastal Plain was derived from the following calculations:

First, we obtained the estimated number of adult females (NAF) in the population:

NAF = N2010 × PAF = 907 × 0.35 = 317.5

Then, we estimated the number of adult females that bred (Nbreed) in a given year:

Nbreed = (NAF × Pbreed00) + (NAF × Pbreed0 × Pbreed1) = (317.5 × 0.437) + (317.5 × 0.437 × 0.104) = 153.2

We next estimated the number of denning females that occur on land (Nland):

Nland = Nbreed × Pland = 153.2 × 0.552 = 84.5

Finally, we estimated the total number of land dens in the Coastal Plain in a given year (NCoastal Plain):

NCoastal Plain = Nland × PCoastal Plain = 84.5 × 0.231 = 19.5

We calculated the total number of polar bear dens in the Coastal Plain in a given year to be 19.5. As it is not possible to have a partial den, we rounded this number up to 20 dens as a conservative estimate of the total number of dens expected to occur in the Coastal Plain in any one year.

J.5 References

ACCS (Alaska Center for Conservation Science). 2016. Vegetation map for northern, western, and interior Alaska. Alaska Center for Conversation Science, University Alaska Anchorage. Internet website: http://accs.uaa.alaska.edu/vegetation-ecology/vegetation-map-northern-western-and%20interior-alaska/

_____. 2018. Rare Plant Data Portal. Alaska Center for Conservation Science, University of Alaska Anchorage, Anchorage. Internet website: http://aknhp.uaa.alaska.edu/apps/rareplants/

ADFG (Alaska Department of Fish and Game). 2015. Alaska Wildlife Action Plan. Juneau.

Boggs, K., L. Flagstad, T. Boucher, T. Kuo, D. Fehringer, S. Guyer, and M. Aisu. 2016. Vegetation map and classification: Northern, Western and Interior Alaska, Second Edition. Alaska Center for Conservation Science, University of Alaska, Anchorage.

Bradley, R. D., L. K. Ammerman, R. J. Baker, L. C. Bradley, J. A. Cook, R. C. Dowler, C. Jones, D. J. Schmidly, F. B. Stangl, Jr., R. A. Van Den Bussche, and B. Würsig. 2014. Revised Checklist of North American Mammals North of Mexico, 2014. Museum of Texas Tech University, Occasional Papers, No. 327.

Mammals North of Mexico. 2014. Museum of Texas Tech University, Occasional Papers, No. 327.

Bromaghin, J. F., T. L. McDonald, I. Stirling, A. E. Derocher, E. S. Richardson, E. V. Regehr, D. C. Douglas, G. M. Durner, T. C. 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.

BLM (Bureau of Land Management). 2018 (in prep). Alaska Special Status Plant and Animal Species List—2018. Anchorage, Alaska.

BLM GIS (Geographic Information System). 2018. GIS data used in the Coastal Plain Oil and Gas Leasing Program EIS alternatives, affected environment, and impact analysis. Alaska Bureau of Land Management.

Ducks Unlimited, Inc. 2013. North Slope Science Initiative Landcover Mapping Summary Report.

Durner, G. M., A. S. Fischbach, S. C. Amstrup, and D. C. Douglas. 2010. Catalogue of Polar Bear (*Ursus maritimus*) Maternal Den Locations in the Beaufort Sea and Neighboring Regions, Alaska, 1910–2010. US Geological Survey Data Series 568, Reston, Virginia.

IUCN (International Union for Conservation of Nature). 2018. IUCN Red List of threatened species. Version 2018-1. Internet website: http://www.iucnredlist.org/.

MacDonald, S. O., and J. A. Cook. 2009. *Recent Mammals of Alaska*. University of Alaska Press, Fairbanks.

Olson, J. W., K. D. Rode, D. Eggett, T. S. Smith, R. R. Wilson, G. M. Durner, A. Fischbach, T. C. Atwood, and D. C. Douglas. 2017. "Collar temperature sensor data reveal long-term patterns in southern Beaufort Sea polar bear den distribution on pack ice and land." *Marine Ecology Progress Series* 564: 211–224.

Regehr, E. V., C. M. Hunter, H. Caswell, S. C. Amstrup, I. Stirling. 2010. "Survival and breeding of polar bears in the southern Beaufort Sea in relation to sea ice." Journal of Animal Ecology. 79(1):117-27. Internet website: https://www.ncbi.nlm.nih.gov/pubmed/19754681.

Rosenberg, K. V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, C. J. Beardmore, P. J. Blancher, et al. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee.

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. Internet website: http://www.shorebirdplan.org.

USFWS (US Fish and Wildlife Service). 2008. Birds of Conservation Concern 2008. Arlington, Virginia: US Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management.

_____. 2015a. Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan. US Fish and Wildlife Service, Final Environmental Impact Statement, Vol. 1. Internet website: https://www.fws.gov/home/arctic-ccp/.

USFWS and NMFS (National Marine Fisheries Service). 2014. Endangered, Threatened, Proposed, Candidate, and Delisted Species in Alaska (Updated May 13, 2014). Internet website: https://www.fws.gov/alaska/fisheries/endangered/pdf/consultation_guide/4_species_list.pdf.

Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska vegetation classification. US Department of Agriculture, Forest Serv., Pacific Northwest Research Station, Portland, Oregon. General Technical Report PNW-GTR-286.

Warnock, N. 2017a. Audubon Alaska Watchlist: 2017 Red List of Declining Bird Populations. Audubon Alaska. Anchorage.

_____. 2017b. The Audubon Alaska Watchlist 2017: Yellow List—Vulnerable Species. Audubon Alaska. Anchorage.

Appendix K

Fish and Aquatic Species

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Appendix K. Fish and Aquatic Species

K.1 FRESHWATER FISH

Many of the resident freshwater fish discussed below have at least some ability to tolerate brief periods of saline waters (USFWS 2015). Additional freshwater species not listed here, such as slimy sculpin, lake trout, and arctic char, have been reported in other parts of the Arctic National Wildlife Refuge (Arctic Refuge), and may be present (but not yet confirmed) in waters of the program area (BLM 2012). **Table K-1** summarizes habitat use and life history information for common species in the program area.

Round whitefish is a relatively small, benthic invertebrate feeding whitefish found in clearwater rivers and lakes in northern latitudes of North America and northeast Asia. The vast majority of round whitefish are resident freshwater fish, but some may tolerate brief periods in brackish waters. In the program area, these fish are found only in the Canning River. They are relatively less migratory in behavior than other whitefish. They are a minor component of subsistence catch due to low density.

Arctic grayling live in lakes and streams throughout northern North America and Asia and are found abundantly throughout the Arctic Refuge Coastal Plain. They exhibit very limited salinity tolerance. Adults feed on aquatic and terrestrial invertebrates and are capable of extensive annual movements between overwintering sites and summer feeding habitats. Though they constitute a minor subsistence component, recreational fishing for arctic grayling is likely common for residents of Kaktovik.

Burbot is large freshwater cod that inhabits deep areas of rivers and lakes throughout the circumpolar north (Evenson 1990; USFWS 2015). In the program area, burbot are found in waters along the Canning River (Smith and Glesne 1983; USFWS 2015). Burbot feed on insect larvae and other invertebrates as juveniles but move to a fish diet around age 4.

Ninespine stickleback are found throughout northern waters of North America. In the Arctic Refuge it is found in lakes, rivers and streams and is tolerant of saline waters up to 20 parts per thousand (ppt). This small, relatively short-lived species is present in large numbers throughout its range. Ninespine stickleback feed on small crustaceans and insects. They themselves are a major prey item for many larger species of fish as well as birds. Ninespine stickleback overwinter in freshwater habitats in the program area.

K.2 ANADROMOUS FISH

There are at least nine species of anadromous fish in the program area. Most use this area and adjacent coastal waters seasonally for foraging or migration to other habitats. Pacific salmon are at the northern portion of their range in the project area, though their numbers appear to be increasing with warming trends in the region. Whitefish are common in the program area and are extremely important to subsistence communities. Dolly Varden are the only sport/subsistence fish that overwinters in the program area and its numbers are therefore limited by available in spawning and overwintering habitat. For brevity, some of the following species are discussed within the context of family groups with similar life histories.

Pacific salmon (*Oncorhynchus* spp.) are represented by three primary species that have been reported in coastal waters adjacent to the program area; pink salmon, chum salmon, and Chinook salmon. Chinook salmon have not been reported in streams in the area, but several reports of chum salmon have been noted in the Canning River (Smith and Glesne 1983; USFWS 2015). Pink salmon are found in the Staines and Canning River complex. Pink salmon feed on plankton, larval fishes, fish eggs, and aquatic invertebrates.

Juveniles of chum and Chinook salmon consume copepods and amphipods before switching to a diet of fish as sub-adults and adults whereupon they reach large sizes (Bradford et al. 2009; Horne-Brine et al. 2009; Salo 1991). All spawn in freshwater streams where the young emerge from gravel and disperse to the sea; almost immediately for chum and pink salmon and after a period of a year or more for Chinook salmon (Salo 1991; USFWS 2015). Depending on the species, each salmon spends between 1 and 5 years at sea before returning to freshwater to spawn and die.

Whitefish (***Coregonus* spp.**) are important subsistence fishes and, in addition to the mostly freshwater round whitefish, are represented by four anadromous species found either in Arctic Refuge Coastal Plain streams or in the adjacent coastal waters: humpback whitefish, least cisco, broad whitefish, and arctic cisco. Each species displays a different degree of freshwater and saline water reliance during their life. All are relatively long-lived (up to 20 years and older). Because waters of the program area do not support overwintering or spawning habitat sufficient for these species, they are found only in the adjacent coastal waters as they migrate or forage. Humpback whitefish are medium sized, benthic invertebrate-feeding fish that are found in rivers lakes and estuaries in Asia and North America. In the Arctic Refuge Coastal Plain, they are only rarely documented in adjacent nearshore waters as they forage during summer months. Though they are rarely targeted for subsistence, they are a common bycatch species. Least cisco are a relatively small, nearshore and pelagic-feeding whitefish that is found in Arctic and sub-Arctic environments of Asia and North America. They are common in estuaries, rivers and lakes in northern Alaska, but are only found in coastal waters in or adjacent to the Arctic Refuge Coastal Plain during summer months as they forage before returning to deeper overwintering and spawning waters to the west or east (Seigle 2003; USFWS 2015). Least cisco may undertake extensive spawning, overwintering, and foraging migrations annually. As with humpback whitefish, they are caught mostly incidentally during subsistence activities and are commonly a source of dog food. Broad whitefish are a relatively large, primarily benthic-feeding fish that is very important in subsistence activities in northern Alaska, including in coastal waters adjacent to the program area. The species may exhibit freshwater resident or anadromous behavior, but those found near the program area during summer are overwintering and spawning elsewhere. Arctic cisco are a relatively small, pelagic-feeding species found in nearly all arctic waters. In Alaska, the evidence suggests that arctic cisco originate and later spawn in waters of the Mackenzie River drainage (Zimmerman et al. 2013; USFWS 2015). Arctic cisco are found foraging in Beaufort Sea coastal waters and overwintering in brackish waters of large rivers such as the Colville River to the west and Mackenzie River to the east. This is a fully anadromous species not known to reside in freshwaters. They are a prized subsistence species known for high fat content and good taste (Moulton et al. 2010).

Rainbow Smelt is a small schooling fish that spawns in freshwater but can be found extensively in nearshore brackish and marine waters throughout the Arctic Coastal Plain (ACP). They feed on a varied diet of crustacea, plankton, and various other aquatic invertebrates, as well as fish eggs and small fish. They are relatively short-lived (6 years) but can be highly migratory. It is unknown how common these fish are in the program area but they are known to have spawning populations in the Colville, Sag, Kuk, and Mackenzie Rivers (Craig 1984).

Dolly Varden is a coldwater species found in the higher latitude waters of North America, as well as Russia, Japan, and Korea. They are found widely within the northern portion of the Arctic Refuge and in several rivers of the Arctic Refuge Coastal Plain and adjacent coastal waters and can display resident and anadromous forms. In the Program Area, spawning populations are documented in the Canning, Hulahula (Brown et al. 2014; USFWS 2015), and Aichilik (USFWS 2015). Isolated resident populations are found in springs and lakes in the Canning (McCart and Craig 1973; USFWS 2015), Sadlerochit (USFWS 2015), and

Jago (USFWS 2015) River drainages. Resident species are typically smaller and live shorter lives while anadromous forms are larger and longer-lived (Underwood et al. 1996; USFWS 2015). Anadromous forms typically migrate to brackish, nearshore waters of the Arctic Refuge Coastal Plain at ages 2–5 from their overwintering habitats in deep pools and spring-fed areas of the Arctic Refuge Coastal Plain rivers (Underwood et al. 1996; Fechhelm et al. 1997; USFWS 2015). They are a highly migratory species who feed on mysid shrimp and amphipods, exhibiting little piscivory. They are the primary species targeted in subsistence fisheries by Kaktovik residents on the Hulahula River and in coastal areas during summer.

K.3 Coastal Marine Fish

Although adult and juvenile stages of several species of marine fishes may use coastal and lagoon waters adjacent to the Program Area, this section focuses on the four most commonly observed species. Additional species likely to occur in marine waters are described in the National Petroleum Reserve-Alaska Integrated Activity Plan/Environmental Impact Statement (BLM 2012).

Arctic cod are distributed throughout the entirety of the northern polar basin and may be the most abundant and widely distributed fish in the Beaufort Sea. They are common and often abundant in nearshore coastal waters adjacent to the Arctic Refuge Coastal Plain. They inhabit cold, saline waters, but are tolerant of fluxes in temperature, salinity, and are found nearshore, offshore and even lower reaches of large rivers. They are typically a small to medium sized species. They are common in nearshore coastal waters in summer and fall before moving into full-scale marine waters during winter. Arctic cod prey on amphipods, copepods, and mysid shrimp and are themselves common prey for marine mammals, birds and fish (Craig et al. 1984; Frost and Lowry 1984; USFWS 2015). They are incidentally harvested during subsistence activities along the Beaufort Sea coast, including near Kaktovik.

Saffron cod are found throughout the North Pacific and in the Arctic Ocean. They are common and widely distributed in the Beaufort Sea and along the Arctic Refuge Coastal Plain. They are found from coastal lagoons to offshore marine waters and some lower reaches of large rivers. They range from medium to large in size and feed on mysid shrimp, amphipods, and decapods, with some piscivory upon reaching larger sizes (Ellis 1962; USFWS 2015).

Fourhorn sculpin are found throughout the circumpolar north including the Beaufort Sea coastline, and waters adjacent to the Arctic Refuge Coastal Plain where they are typically very abundant. They feed on mysids, amphipods, isopods, and small fish.

Arctic flounder are found in coastal marine waters of much of the Artic and sub-Arctic of North America and Siberia. They are commonly found in nearshore waters of the Beaufort Sea, including the waters adjacent to the Arctic Refuge Coastal Plain. They are a relatively medium sized species, which remain near to shorelines and lagoons but are sometimes found in lower river reaches (Bendock 1979; USFWS 2015). They feed on amphipods, mollusks, crustaceans, and small fish.

Table K-1
Life History Attributes for Fish Species that May Use the Program Area

Species	Lifespan (Years)	Age at Maturity (Years)	Spawning Behavior	Spawning in Program Area?	Habitat Use in Program Area	Feeding Behavior in Program Area	Subsistence Use in Arctic Coastal Plain
Arctic cisco	~20	7–8	Semiannual; fall	No	Migration and foraging coastal marine waters during summer; not likely to overwinter in program area	Pelagic invertebrates	Extensive
Arctic cod	6–7	2–3	Annual to semiannual; fall	Likely	Common in coastal marine waters for spawning and rearing	Amphipods, copepods, mysid shrimp	Limited
Arctic flounder	9–12	4–5	Annual to semiannual	Likely	Common during summer in marine waters; lower river deltas	Amphipods, mollusks, crustacea, and small fish	Limited
Arctic grayling	up to 18	4–8	Annual to semiannual; spring	Yes	Summer in some freshwater streams; limited use of marine waters; present in the program area throughout the year	Aquatic and terrestrial invertebrates	Limited
Broad whitefish	>20	5–8	Annual to semiannual: fall	No	Summer migration and foraging in freshwater and coastal marine waters	Benthic invertebrates	Extensive
Burbot	>20	6–7	Semiannual; winter	Probably	Present throughout year in the Canning River, but not elsewhere in program area	Insect larvae and other invertebrates as juveniles; fish diet as adults	Extensive
Chinook salmon	4–7	4–7	Once; summer/fall	No	Rare in coastal marine waters for migration and foraging	Copepods/amphipods (early) fish (later)	Limited
Chum salmon	3–6	3–6	Once; summer/fall	No	Foraging in coastal waters; migration in Canning and Staines Rivers	Copepods/amphipods (early) fish (later)	Limited

Species	Lifespan (Years)	Age at Maturity (Years)	Spawning Behavior	Spawning in Program Area?	Habitat Use in Program Area	Feeding Behavior in Program Area	Subsistence Use in Arctic Coastal Plain
Dolly varden	Resident = 7 Anadromous = 10	Resident = 2–4 Anadromous = 4–8	Semiannual; fall	Yes	Common during summer in freshwater streams and springs and coastal marine waters; spawning and overwintering in freshwater springs	Resident = Dipteran larvae and macroinvertebrates Anadromous = Mysids, amphipods, and fish	Extensive
Fourhorn sculpin	up to 14	3–9	Annual to semiannual	Likely	Common in summer and fall in coastal marine waters; lower river deltas	Mysid shrimp, amphipods, isopods, fish	Limited
Humpback whitefish	>20	5–11	Annual to semiannual: fall	No	Summer migration and foraging in freshwater and coastal marine waters	Benthic invertebrates	Extensive
Least cisco	>25	3–7	Annual to semiannual; fall	Unknown	Summer migration and foraging in freshwater and coastal marine waters	Pelagic invertebrates and small fish	Limited
Ninespine stickleback	up to 5	1–2	Annual; summer	Yes	Nearly ubiquitous species that is common in freshwater and some brackish/coastal waters during summer; overwinters in freshwater; may spawn in fresh or brackish waters	aquatic and terrestrial insects, and crustacea	None
Pink salmon	2	2	Once: summer/fall	No	Migration in Canning and Staines Rivers; coastal marine waters	Plankton, larval fishes, fish eggs, aquatic invertebrates	Limited
Round whitefish	>20	3–8	Annual to semiannual	Probably	Common in Canning River throughout the year, including summer migration and foraging activities; also found in some brackish waters but not in other freshwaters of planning area	Benthic invertebrates	Limited

Species	Lifespan (Years)	Age at Maturity (Years)	Spawning Behavior	Spawning in Program Area?	Habitat Use in Program Area	Feeding Behavior in Program Area	Subsistence Use in Arctic Coastal Plain
Rainbow smelt	~6	2–6	Once; summer/fall	Unknown	Found in coastal marine waters; lower river deltas in summer/fall	Copepods, fish eggs, algae as juveniles; decapods, mysid shrimp, copepod, amphipod, small fish and other invertebrates as adults	Limited
Saffron cod	10–12	2–3	Annual to semiannual: fall	Likely	Common in coastal marine waters for spawning and rearing	Amphipods, copepods, decapods, mysid shrimp, some fish	Limited

K.4 References

Bendock, T. N. 1979. Beaufort Sea Estuarine Fishery Study. Final Report. *In:* Environmental Assessment of the Alaskan Continental Shelf. No. 4, 670–729. Bureau of Land Management, National Oceanic and Atmospheric Administration.

BLM (Bureau of Land Management). 2012. National Petroleum Reserve–Alaska: final Integrated Activity Plan/Environmental Impact Statement. Vol. 1. Prepared in cooperation with: 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.

Bradford, M. J., A. V. Vinster, and P. A. Milligan. 2009. "Freshwater life history, habitat, and the production of Chinook salmon from the upper Yukon Basin." In Pacific Salmon: Ecology and Management of Western Alaska's Populations (C. C. Krueger and C. E. Zimmerman, editors). Bethesda, Maryland: American Fisheries Society Symposium 70, 19–38.

Brown, R. J., M. B. Loewen, and T. L. Tanner. 2014. "Overwintering locations, migrations, and fidelity of radio-tagged dolly varden in the Hulahula River, Arctic National Wildlife Refuge, 2007–09." *Arctic* 67: 149–158.

Craig, P. C., W. B. Griffiths, S. R. Johnson, and D. M. Schell. 1984. "Trophic dynamics in an Arctic lagoon." In *The Alaskan Beaufort Sea: Ecosystems and Envrionments* (P. W. Barnes, D. M. Schell, and E. Reimnitz, editors). Pp. 347–380. Orlando, Florida: Academic Press.

Dunton, K. H., T. Weingartner, and E. C. Carmack. 2006. "The nearshore western Beaufort Sea ecosystem: Circulation and importance of terrestrial carbon in arctic coastal food webs." *Progress in Oceanography* 71: 362–378.

Ellis, D. V. 1962. "Observations on the distribution and ecology of some Arctic fish." *Arctic* 15(3): 179–189.

Evenson, M. J. 1990. Movement, abundance, and length composition of burbot in rivers of interior Alaska during 1989. 90-3, Fishery Data Series Alaska Department of Fish and Game, Anchorage.

Fechhelm, R. G., J. D. Bryan, W. B. Griffiths, and L. R. Martin. 1997. "Summer growth patterns of northern dolly varden (*Salvelinus malma*) smolts from the Prudhoe Bay region of Alaska." *Canadian Journal of Fisheries and Aquatic Sciences* 54: 1103–1110.

Frost, K. J., and L. F. Lowry. 1984. "Trophic relationships of vertebrate consumers in the Alaskan Beaufort Sea." In *The Alaskan Beaufort Sea: Ecosystems and Envrionments* (D. M. Schell, P. W. Barnes, and E. Reimnitz, editors). Pp. 381–401. Orlando, Florida: Academic Press.

Horne-Brine, M. M., J. Bales, and L. DuBois. 2009. Salmon age and Sex Composition and Mean Lengths for the Yukon River Area, 2007. 09-26, Fishery Data Series. Alaska Department of Fish and Game, Anchorage.

McCart, P. J., and P. C. Craig. 1973. "Life history of two isolated population of Arctic char (*Salvelinus alpinus*) in spring-fed tributaries of the Canning River, Alaska." *Journal of the Fisheries Research Board of Canada* 30: 1215–1220.

Moulton, L. a. L., B. Seavey, and J. Pausanna. 2010. "History of an under-ice subsistence fishery for arctic cisco and least cisco in the Colville River, Alaska." *Arctic* 63(4): 381–390.

Salo, O. 1991. "Life history of chum salmon (*Oncorhynchus keta*)." In *Pacific Salmon Life Histories* (C. Groot and L. Margolis, editors). Pp. 231–310. Vancouver, British Columbia: UBC Press.

Seigle, J. C. 2003. "Determination of marine migratory behavior and its relationship to selected physical traits for least cisco (*Coregonus sardinella*) of the Western Arctic Coastal Plain, Alaska." MS Thesis, Oregon State University, Corvallis, Oregon.

Smith, M. W., and R. S. Glesne. 1983. Aquatic Studies on the North Slope of the Arctic National Wildlife Refuge, 1981 and 1982. 83-01, Fisheries Progress Report. Fairbanks, Alaska: U.S. Fish and Wildlife Service.

Underwood, T. J., M. J. Millard, and L. A. Thorpe. 1996. "Relative abundance, length frequency, age, and maturity of dolly varden in near-shore waters of the Arctic National Wildlife Refuge, Alaska." *Transactions of the American Fisheries Society* 125: 719–728.

USFWS (US Fish and Wildlife Service). 2015. Arctic National Wildlife Refuge Revised Comprehensive Plan: Final Environmental Impact Statement, Wilderness Review, Wild and Scenic River Review. Vol. 1. Fairbanks and Anchorage, Alaska: Arctic National Wildlife Refuge and Alaska Regional Office.

Zimmerman, C. E., A. M. Ramey, S. M. Turner, F. J. Mueter, S. M. Murphy, and J. L. Nielsen. 2013. "Genetics, recruitment, and migration patterns of Arctic cisco (*Coregonus autumnalis*) in the Colville River, Alaska, and Mackenzie River, Canada." *Polar Biology* 36(11): 1543–1555. doi: 10.1007/s00300-013-1372-y.

Appendix L
Cultural Resources

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Appendix L. Cultural Resources

Table L-1
Documented Alaska Heritage Resources Survey (AHRS) Sites in Program Area

AHRS #	Site Name	Period	Resource Description	National Register Status
BRL-00005	Uqsruqtalik	Historic	Camp, hunting, sod houses, cabins, ice cellars	NDE
BRL-00007	Naalagiagvik	Prehistoric, Historic, Protohistoric	Settlement, sod houses, burials	DOE-S
BRL-00009	—	Historic	Burials	DOE-P-S
BRL-00012	—	Historic	Residential, cabin, log, sod house	NDE
BRL-00017	Uqsruqtalik	Historic	Burials	NDE
BRL-00018	Kapiluuraq	Historic	Camp, fishing, sod house	NDE
BRL-00020	—	Historic	Residential, sod house	NDE
BRL-00022	Puukak	Historic	Camp, sod houses, cemetery	NDE
BRL-00023	(Doe) BAR-M (AHRS) Barter Island	Historic	Defense, DEW Line	DOE-S
BRL-00044	Gravel structures, Barter Island Airfield	Historic	Defense, DEW Line, transportation	DOE-S
BRL-00051	Barter Island seawall	Historic	Military, seawall, defense, DEW Line	DREJ-S
BRL-00052	Browers Camp	Historic, Modern	Camp, tent floors, drying racks, windbreaks	NDE
XDP-00001	Angun	Historic	Sod house ruins, foundations	NDE
XDP-00021	—	Historic	—	NDE
XDP-00022	—	Historic	—	NDE
XDP-00024	Atchalik	Historic	Sod house ruins, sod quarry, cache pots	NDE
XDP-00026	—	Historic	Burials	NDE
XDP-00027	—	Historic	Sod house ruins, sod quarry	NDE
XDP-00028	—	Historic	Burials, box coffins	NDE
XDP-00029	—	Historic	—	NDE
XDP-00030	—	Historic	—	NDE
XDP-00031	—	Prehistoric	Lithic scatter	NDE
XDP-00032	—	Prehistoric	—	NDE
XDP-00033	—	Historic	—	NDE
XDP-00034	—	Historic	—	NDE
XDP-00035	—	Prehistoric	—	NDE
XDP-00045	Beaufort Lagoon (AHRS) Demarcation Point	Historic	Defense, DEW Line	DOE-S

AHRS #	Site Name	Period	Resource Description	National Register Status
XDP-00046	Nuvagapak Jacobson and Wentworth's Traditional Land Use Inventory (TLUI) Site 32	—	—	NDE
XDP-00048	Nuvagapak reburial	Historic	Reburied human remains	NDE
XFI-00003	Anderson Point	Prehistoric	Settlement, bone and wood artifacts	NDE
XFI-00009	Brownlow Point, Agliguagruk	Historic	House ruins, burials	NDE
XFI-00011	Sanniqsaaluk	Historic	Cabin, ice cellar, camp	NDE
XFI-00013	—	Historic	Ice cellar	NDE
XFI-00014	—	Historic	Lookout tower	NDE
XFI-00015	—	Historic	Single dwelling, sod house	NDE
XFI-00016	—	Historic	Settlement, sod houses, sod quarry	NDE
XFI-00017	Kanigniivik	Historic	Burials	NDE
XFI-00018	—	Historic	Single dwelling, sod house, artifacts	NDE
XFI-00019	—	Historic	Single dwelling, sod house	NDE
XFI-00020	—	Historic	Single dwelling, sod house	NDE
XFI-00030	Flaxman Island-Brownlow Point Historic District	—	—	NRXCL
XFI-00033	Brownlow cemetery	Historic	Cemetery	NDE
XFI-00034	Brownlow southern grave	Historic	Isolated grave	NDE
XFI-00035	—	Prehistoric	Artifact scatter	NDE
XMM-00001	Camden Bay	Prehistoric	House pit, midden, organic artifacts	NDE
XMM-00004	—	Historic	Sod houses, cellar	NDE
XMM-00005	—	Historic	Sod house ruin	NDE
XMM-00006	—	Historic	Sod house ruin, ice cellar, tent frame remains	NDE
XMM-00007	—	Prehistoric	Tent ring	NDE
XMM-00008	—	Prehistoric	—	NDE
XMM-00009	—	Prehistoric	Tent ring, scattered stones of other features	NDE
XMM-00010	—	Prehistoric	—	NDE
XMM-00011	—	Prehistoric	—	NDE
XMM-00012	—	Prehistoric	Tent ring, hearth(?)	NDE
XMM-00013	—	Prehistoric	—	NDE
XMM-00014	—	Prehistoric	—	NDE
XMM-00015	—	Prehistoric	—	NDE
XMM-00016	—	Prehistoric	—	NDE
XMM-00017	—	Prehistoric	—	NDE

AHRS #	Site Name	Period	Resource Description	National Register Status
XMM-00018	—	Historic	Sod house ruins, log cabin, historic debris	NDE
XMM-00019	—	Historic	Sod house, quarry	NDE
XMM-00020	—	Prehistoric	—	NDE
XMM-00021	—	Historic	—	NDE
XMM-00022	—	Prehistoric	—	NDE
XMM-00023	—	Prehistoric	—	NDE
XMM-00024	—	Prehistoric	—	NDE
XMM-00025	—	Prehistoric	—	NDE
XMM-00026	—	Prehistoric	—	NDE
XMM-00027	—	Prehistoric	—	NDE
XMM-00028	—	Prehistoric	Tent ring, scattered stones of other features	NDE
XMM-00029	—	Historic	—	NDE
XMM-00030	—	Prehistoric	—	NDE
XMM-00031	—	Historic	—	NDE
XMM-00032	—	Historic	—	NDE
XMM-00033	—	Historic	—	NDE
XMM-00034	—	Prehistoric	—	NDE
XMM-00035	—	Prehistoric, Historic	—	NDE
XMM-00037	—	Prehistoric	—	NDE
XMM-00038	—	Prehistoric	Tent rings	NDE
XMM-00039	—	Historic	—	NDE
XMM-00040	—	Historic	—	NDE
XMM-00041	—	Historic	Fish camp, tent rings(?)	NDE
XMM-00042	—	Historic	Settlement, winter, reindeer herding	NDE
XMM-00043	—	Historic	Settlement, winter, reindeer herding	NDE
XMM-00044	—	Historic	—	NDE
XMM-00045	—	Historic	Cemetery	NDE
XMM-00046	—	Historic	-	NDE
XMM-00114	(Doe) Camden Bay (AHRS) POW-D	Historic	Building, structure, defense, DEW Line	DOE-S
XMM-00117	Sivugag	—	—	NDE

Source: ADNR OHA 2018
— = no information provided in AHRS database. Information provided in this table is verbatim from the AHRS database.
NDE—no determination of eligibility; DOE-S—determined eligible through SHPO; DOE-P-S—pending consultation between agency and SHPO; DREJ-S—determined not eligible by agency and SHPO concurs; NRXCL—closed for other reason; needs re-evaluation

Table L-2
Documented Traditional Land Use Inventory (TLUI) Sites in Program Area

TLUI #	Site Name	Resource Description
TLUIXMM039	Katakturuk	Viewing area
TLUIXMM036	Aanalaaq	House ruins, cabin, and graves
TLUIXMM033	Salliġutchich	Reindeer herding area
TLUIXMM032	Nuvugaq	House and ice cellar ruins
TLUIXMM032	Nuvugaq	Another reference name is Saluksa, used by Indians; ruins and trapping and duck hunting area
TLUIXMM028	1st Fish Hole	Fishing area
TLUIXMM027	Sivugaq	Landmark and resting place along trail
TLUIXMM005	Iqalugliuraq	House ruins and fishing area
TLUIXMM001	Niaquqtuġvik	None given
TLUIXFI027	Agliġuaġruk Cemetery	Cemetery
TLUIXFI017	Kunagrak	House ruin
TLUIXFI016	Ukpillam Paaŋa	House ruins and standing caches
TLUIXFI015	Salliġutchit	House ruins, fishing area, and hunting and camping area
TLUIXFI014	Patkotak	House ruin
TLUIXFI013	Sanniqsaaluk	House ruins and graves
TLUIXFI012	Aanalaaq	House ruins, cabin, and graves
TLUIXFI011	Kaŋiŋiivik	House ruins and graves
TLUIXFI010	Kayutak	House ruins
TLUIXFI009	Tigutaaq	House ruins and grave
TLUIXFI008	Agliġuaġruk	Trading post and graves
TLUIXDP010	Igluġruatchiat	House ruin and graves
TLUIXDP009	Imaiġeauraq	House ruins, ice cellar ruins, and graves
TLUIXDP008	Anŋun	House ruins and oil seep
TLUIXDP007	Atchalik	House ruins and fishing area
TLUIBRL023	Pipsuk	House ruins and grave
TLUIBRL020	Uqpiilam Paaŋa	House ruins and standing caches
TLUIBRL019	Naalagiaġvik	House ruins, graves, and standing caches
TLUIBRL018	Igluqpaaluk	House ruins and graves
TLUIBRL017	Kaktovik (3rd Location)	Relocated village location
TLUIBRL016	Kaktovik (2nd Location)	Relocated village location
TLUIBRL015	Kaktovik (1st Location)	Original village location
TLUIBRL013	Tapqauraq	House ruins, cabin, and graves
TLUIBRL012	Uqsruqtalik	House ruins, cabin, and graves
TLUIBRL011	Puukak	House ruins
TLUIBRL009	Kaŋiqłuk	House ruin
TLUIBRL(45)	Tigluum Inaat	House ruin and graves
TLUIBRL(44)	Kapiłġuurak	House ruin and ice cellar ruins
None Given	2 graves	Grave
None Given	Aanaalaaq	None given
None Given	Aanalaaq	House ruins, cabin, and graves
None Given	Atchalik	House ruin
None Given	Disturbed grave associated with Igluġruatchiaq	Grave
None Given	Grave	Grave
None Given	Grave 2015	Grave

TLUI #	Site Name	Resource Description
None Given	Ice Cellar (Sigluaq)	Ice cellar
None Given	Kapiłġuurak (2)	House ruin
None Given	MainLand	Caribou hunting and camping area
None Given	Nuvugapak	House ruins
None Given	Nuyaaġialuk	Hunting and camping area
None Given	Qaluġavik	Hunting, fishing, and gathering area
None Given	Uluġaq	Hunting, fishing, and gathering area
None Given	Uqpiilam Paaŋa	House ruins
None Given	Uqsruqtalik Graves	Grave

Source: IHLC 2019

L.1 REFERENCES

ADNR OHA (Alaska Department of Natural Resources Office of History and Archaeology). 2018. Alaska Heritage Resources Survey. Anchorage, Alaska.

IHLC (Iñupiat History, Language, and Cultural Division). 2019. Traditional Land Use Inventory Sites. Utqiaġvik, Alaska.

Appendix M
Subsistence Uses and Resources

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Appendix M. Subsistence Uses and Resources

M.1 Kaktovik

M.1.1 Harvest Data

Table M-1
Kaktovik Subsistence Harvest Estimates[5] by Resource Category, All Resources Study Years

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
1985	All Resources	100	93	91	83	100	—	61,663	1,163	328	100.0
	Salmon	2	0	0	0	2	0	0	0	0	0.0
	Non-Salmon Fish	100	86	81	45	93	6,866	11,403	215	61	18.5
	Large Land Mammals	100	79	71	71	100	288	35,331	667	188	57.3
	Small Land Mammals	60	52	52	31	24	427	160	3	1	0.3
	Marine Mammals	88	69	57	41	86	174	10,762	203	57	17.5
	Migratory Birds	83	76	71	48	57	964	3,388	64	18	5.5
	Upland Game Birds	86	74	69	45	43	867	607	11	3	1.0
	Vegetation	24	17	2	5	21	—	13	<1	<1	<0.1
1986	All Resources	100	89	87	83	100	—	84,060	1,501	433	100.0
	Non-Salmon Fish	96	75	72	66	87	4,416	6,951	124	36	8.3
	Large Land Mammals	98	68	62	57	98	198	24,908	445	128	29.6
	Small Land Mammals	47	45	40	19	30	183	39	1	<1	<0.1
	Marine Mammals	96	64	60	64	96	—	49,723	888	256	59.2
	Migratory Birds	—	—	—	—	—	273	1,673	30	9	2.0
	Upland Game Birds	87	62	62	47	55	1,012	708	13	4	0.8
	Eggs	2	2	2	0	2	4	1	<1	<1	<0.1
	Vegetation	49	21	21	11	40	—	58	1	<1	0.1
1992a	All Resources	96	89	89	83	92	—	170,939	2,713	886	100.0
	Salmon	26	9	9	11	19	50	105	2	1	0.1
	Non-Salmon Fish	94	83	81	70	68	18,415	22,847	363	118	13.4
	Large Land Mammals	96	70	57	62	83	212	28,705	456	149	16.8
	Small Land Mammals	47	43	38	21	19	213	162	3	1	0.1
	Marine Mammals	89	64	40	70	87	-	115,645	1,836	599	67.7
	Migratory Birds	83	62	51	47	70	970	2,702	43	14	1.6
	Upland Game Birds	85	60	57	47	49	769	539	9	3	0.3
	Eggs	23	15	13	15	15	56	8	<1	<1	<0.1
	Vegetation	77	72	70	23	40	—	227	4	1	0.1

Study Year	Resource	Percent of Households: Use	Percent of Households: Try to Harvest	Percent of Households: Harvest	Percent of Households: Give	Percent of Households: Receive	Estimated Harvest: Number[1]	Estimated Harvest: Total Pounds[2]	Estimated Harvest: Average HH Pounds	Estimated Harvest: Per Capita Pounds	Percent of Total Harvest
1992b[3]	All resources	—	—	—	—	—	—	180,970	—	—	100.0
	Salmon	—	—	—	—	—	20	123	—	—	0.1
	Non-salmon fish	—	66	—	—	—	19,641	32,941	—	—	18.2
	Large land mammals	—	—	—	—	—	195	24,763	—	—	13.7
	Small land mammals	—	—	—	—	—	51	13	—	—	<0.1
	Marine mammals	—	—	—	—	—	77	120,287	—	—	66.5
	Migratory birds	—	64	—	—	—	773	2,362	—	—	1.3
	Upland game birds	—	—	—	—	—	400	257	—	—	0.1
	Eggs	—	—	—	—	—	32	5	—	—	<0.1
	Vegetation	—	50	—	—	—	56	219	—	—	0.1
1994–95	All resources	—	—	—	—	—	—	126,893	—	—	100.0
	Salmon	—	—	—	—	—	1	6	—	—	<0.1
	Non-salmon fish	—	—	—	—	—	4,425	7,934	—	—	6.3
	Large land mammals	—	—	—	—	—	119	17,007	—	—	13.4
	Small land mammals	—	—	—	—	—	59	18	—	—	<0.1
	Marine mammals	—	—	—	—	—	46	100,725	—	—	79.4
	Migratory birds	—	—	—	—	—	411	1,102	—	—	0.9
	Upland game birds	—	—	—	—	—	119	119	—	—	0.1
2002–03	All resources	—	—	—	—	—	—	104,777	—	—	100.0
	Non-salmon fish	—	—	—	—	—	2,363	4,784	—	—	4.6
	Large land mammals	—	—	—	—	—	130	17,104	—	—	16.3
	Small land mammals	—	—	—	—	—	56	20	—	—	<0.1
	Marine mammals	—	—	—	—	—	30	80,877	—	—	77.2
	Migratory birds	—	—	—	—	—	536	1,585	—	—	1.5
	Upland game birds	—	—	—	—	—	370	370	—	—	0.4
	Eggs	—	—	—	—	—	30	5	—	—	<0.1
	Marine invertebrates	—	—	—	—	—	3	6	—	—	<0.1
	Vegetation	—	—	—	—	—	9	27	—	—	<0.1
2007	All resources	—	—	—	—	—	6,277	78,243	954	—	100.0
	Salmon	—	—	—	—	—	5	14	<1	—	<0.1
	Non-salmon fish	—	—	—	—	—	5,086	7,592	93	—	9.7
	Large land mammals	—	—	—	—	—	181	21,168	258	—	27.1
	Small land mammals	—	—	—	—	—	31	14	<1	—	<0.1
	Marine mammals	—	—	—	—	—	17	47,316	577	—	60.5
	Migratory birds	—	—	—	—	—	537	1,814	22	—	2.3
	Upland game birds	—	—	—	—	—	199	139	2	—	0.2
	Bird eggs	—	—	—	—	—	43	13	<1	—	<0.1
	Marine invertebrates	—	—	—	—	—	—	—	—	—	—
	Vegetation	—	—	—	—	—	179	173	2	—	0.2

Study Year	Resource	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
2008	All resources	—	—	—	—	—	6,735	101,398	1,237	—	100.0
	Salmon	—	—	—	—	—	11	34	<1	—	<0.1
	Non-salmon fish	—	—	—	—	—	5,364	12,000	146	—	11.8
	Large land mammals	—	—	—	—	—	230	26,123	319	—	25.8
	Small land mammals	—	—	—	—	—	47	2	<1	—	<0.1
	Marine mammals	—	—	—	—	—	23	60,731	741	—	59.9
	Migratory birds	—	—	—	—	—	698	2,274	28	—	2.2
	Upland game birds	—	—	—	—	—	155	155	2	—	0.2
	Bird eggs	—	—	—	—	—	170	44	1	—	<0.1
	Marine invertebrates	—	—	—	—	—	—	—	—	—	—
	Vegetation	—	—	—	—	—	36	36	<1	—	<0.1
2009	All resources	—	—	—	—	—	4,796	126,628	1,472	—	100.0
	Salmon	—	—	—	—	—	4	14	<1	—	<0.1
	Non-salmon fish	—	—	—	—	—	3,737	7,919	92	—	6.3
	Large land mammals	—	—	—	—	—	202	23,050	268	—	18.2
	Small land mammals	—	—	—	—	—	54	8	<1	—	0.0
	Marine mammals	—	—	—	—	—	22	93,638	1,089	—	73.9
	Migratory birds	—	—	—	—	—	397	1,632	19	—	1.3
	Upland game birds	—	—	—	—	—	287	287	3	—	0.2
	Bird eggs	—	—	—	—	—	0	0	0	—	0.0
	Marine invertebrates	—	—	—	—	—	—	—	—	—	—
	Vegetation	—	—	—	—	—	93	82	1	—	0.1
2010	All resources	—	—	—	—	—	1,870	79,231	990	—	100.0
	Salmon	—	—	—	—	—	4	16	<1	—	<0.1
	Non-salmon fish	—	—	—	—	—	1,195	762	10	—	1.0
	Large land mammals	—	—	—	—	—	143	16,105	201	—	20.3
	Small land mammals	—	—	—	—	—	19	3	<1	—	<0.1
	Marine mammals	—	—	—	—	—	12	61,474	768	—	77.6
	Migratory birds	—	—	—	—	—	151	596	7	—	0.8
	Upland game birds	—	—	—	—	—	266	266	3	—	0.3
	Bird eggs	—	—	—	—	—	0	0	0	—	0.0
	Marine invertebrates	—	—	—	—	—	—	—	—	—	—
	Vegetation	—	—	—	—	—	81	9	<1	—	<0.1
2010–11	All resources	100	96	94	84	100	13,138	202,958	2,388	707	100.0
	Salmon	19	7	6	9	14	59	288	3	1	0.1
	Non-salmon fish	96	83	76	69	84	10,799	27,198	320	95	13.4
	Large land mammals	94	56	47	51	93	511	68,458	805	239	33.7
	Small land mammals	29	23	17	13	16	150	302	4	1	0.1
	Marine mammals	99	91	89	69	97	59	103,108	1,213	359	50.8
	Migratory birds	73	51	40	40	67	788	2,547	30	9	1.3
	Upland game birds	60	43	37	29	40	710	710	8	3	0.4
	Bird eggs	1	1	1	1	0	7	5	0	0	0.0
	Marine invertebrates	1	0	0	0	1	0	0	0	0	0.0
	Vegetation	46	29	19	21	41	55	342	4	1	0.2

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
2011[4]	All resources	—	—	—	—	—	8,216	98,841	1,236	—	100.0
	Salmon	—	—	—	—	—	1	6	<1	—	<0.1
	Non-salmon fish	—	—	—	—	—	7,390	16,837	210	—	17.0
	Large land mammals	—	—	—	—	—	191	21,920	274	—	22.2
	Small land mammals	—	—	—	—	—	6	3	<1	—	<0.1
	Marine mammals	—	—	—	—	—	14	58,944	737	—	59.6
	Migratory birds	—	—	—	—	—	239	884	11	—	0.9
	Upland game birds	—	—	—	—	—	127	127	2	—	0.1
	Bird eggs	—	—	—	—	—	65	18	<1	—	<0.1
	Marine invertebrates	—	—	—	—	—	—	—	—	—	—
	Vegetation	—	—	—	—	—	183	102	1	—	0.1
2012	All resources	—	—	—	—	—	5,806	133,258	1,666	—	100.0
	Salmon	—	—	—	—	—	7	32	<1	—	<0.1
	Non-salmon fish	—	—	—	—	—	4,948	9,556	119	—	7.2
	Large land mammals	—	—	—	—	—	169	20,099	251	—	15.1
	Small land mammals	—	—	—	—	—	39	2	<1	—	<0.1
	Marine mammals	—	—	—	—	—	9	102,278	1,278	—	76.8
	Migratory birds	—	—	—	—	—	434	1,089	14	—	0.8
	Upland game birds	—	—	—	—	—	0	0	0	—	0.0
	Bird eggs	—	—	—	—	—	0	0	0	—	0.0
	Marine invertebrates	—	—	—	—	—	—	—	—	—	—
	Vegetation	—	—	—	—	—	202	202	3	—	0.2

Sources: 1985, 1986 (ADFG 2018); 1992a (Pedersen 1995a); 1992b (Fuller and George 1999); 1994–95 (Brower, Olemaun, and Hepa 2000); 2002–03 (Bacon et al. 2009); 2007–12 (Harcharek, Kayotuk, George, and Pederson 2018); 2010–11 (Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016).

Notes: Sources: 2000–01, 2001-02 Pedersen and Linn 2005

[1]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[3]Due to a low response rate during the NSB 1992b survey, these data should be viewed with caution. Household participation for the 1992b study year is based on Table A5 in Fuller and George (1999); participation in migratory bird harvests includes waterfowl and eggs; participation in vegetation harvests includes only berries; participation in non-salmon fish harvests is for fish in general.
[4]The survey in 2011 consisted of only an 8-month survey, covering May through December 2011; therefore, estimates from 2011 may not be directly comparable with other years that covered an entire year. The estimated harvest numbers for the 1994-95 and 2002-03 data were derived by summing individual species in each resource category. Also, for those study years, total pounds were derived from conversion rates found at ADFG (2018) and total usable pounds for bowhead whales were calculated based on the method presented in (SRB&A and ISER 1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George, Philo, Suydam, Carroll, and Albert, n.d.
[5] The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.
(Stephen R. Braund & Associates 2018)

Table M-2
Kaktovik Subsistence Harvest Estimates[1] by Resource Category, Non-Comprehensive Study Years

Study Year	Resource	Percent of Households					Estimated Harvest			
		Use	Try to Harvest	Harvest	Give	Receive	Number	Total Pounds	Average HH Pounds	Per Capita Pounds
2000–01	Non-salmon fish	61	43	38	36	52	3,137	5,970	35	11
2001–02	Non-salmon fish	76	55	47	33	47	5,036	9,748	55	19

[1]The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.

(Stephen R. Braund & Associates 2018)

Table M-3
Kaktovik Subsistence Harvest Estimates[8] by Selected Species, All Study Years

Study Year	Resource[1]	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
1981–82	Caribou	—	—	—	—	—	43	—	—	—	—
1982–83	Caribou	—	—	—	—	—	160	—	—	—	—
1983–84	Caribou	—	—	—	—	—	107	—	—	—	—
1985–86	Caribou	—	—	—	—	—	235	—	—	—	—
1985	Caribou	95	76	69	67	86	235	27,941	527	149	45.3
	Arctic char	100	86	81	41	69	3,075	8,611	162	46	14.0
	Ringed seal	69	50	45	26	45	151	6,360	120	34	10.3
	Dall sheep	79	29	21	21	74	47	4,622	87	25	7.5
	Bearded seal	62	43	33	29	57	21	3,776	71	20	6.1
	Geese	71	62	57	38	43	647	2,913	55	15	4.7
	Cisco	79	60	55	29	62	3,546	2,482	47	13	4.0
	Moose	45	7	7	5	38	4	1,893	36	10	3.1
	Muskox	43	5	2	2	43	1	748	14	4	1.2
	Polar bear	24	5	2	2	21	1	626	12	3	1.0
	Ptarmigan	86	74	69	45	43	867	607	11	3	1.0
1986	Bowhead whale	96	62	43	51	94	—	43,704	780	225	52.0
	Caribou	98	66	60	53	94	178	21,188	378	109	25.2
	Arctic char	94	70	70	62	77	1,768	4,951	88	25	5.9
	Bearded seal	75	34	26	23	64	17	2,936	52	15	3.5
	Ringed seal	72	40	38	28	60	44	1,851	33	10	2.2
	Dall sheep	75	15	9	9	68	17	1,710	31	9	2.0
	Cisco	85	53	53	45	79	2,402	1,682	30	9	2.0
	Muskox	68	4	4	4	66	2	1,413	25	7	1.7
	Geese	83	55	51	36	70	371	1,410	25	7	1.7
	Polar bear	15	6	4	4	13	2	1,182	21	6	1.4
1986–87	Caribou	—	—	—	—	—	201	—	—	—	—
1987–88	Caribou	—	—	55	—	—	185	22,229	383	104	—
1990[4]	Caribou	—	—	48	—	—	113	13,453	224	67	—
1991	Caribou	—	—	50	—	—	181	22,113	369	94	—

Study Year	Resource[1]	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
1992a	Bowhead whale	87	53	6	62	85	—	108,160	1,717	560	63.3
	Caribou	96	70	55	53	75	158	19,136	304	99	11.2
	Arctic char	92	81	79	66	45	5,523	15,463	245	80	9.0
	Bering cisco[8]	77	62	62	57	45	8,103	5,672	90	29	3.3
	Dall sheep	70	36	28	32	64	44	4,379	70	23	2.6
	Bearded seal	75	47	28	32	60	24	4,246	67	22	2.5
	Muskox	53	21	9	17	51	5	3,179	50	16	1.9
	Geese	79	60	47	40	62	601	2,135	34	11	1.2
	Moose	36	11	6	9	32	4	2,011	32	10	1.2
	Ringed seal	47	30	26	28	36	42	1,689	27	9	1.0
1992b[5]	Bowhead whale	—	59	—	—	—	3	108,463	—	—	59.9
	Arctic char	—	—	—	—	—	7,937	22,224	—	—	12.3
	Caribou	—	66	—	—	—	136	15,926	—	—	8.8
	Arctic cisco	—	—	—	—	—	—	7,143	—	—	3.9
	Dall sheep	—	—	—	—	—	53	5,249	—	—	2.9
	Walrus	—	23	—	—	—	5	3,737	—	—	2.1
	Musk ox	—	—	—	—	—	6	3,588	—	—	2.0
	Bearded seal	—	62	—	—	—	17	2,998	—	—	1.7
	Beluga	—	—	—	—	—	2	2,761	—	—	1.5
	Grayling	—	—	—	—	—	3,299	2,639	—	—	1.5
	Geese	—	—	—	—	—	563	2,034	—	—	1.1
1994–95	Bowhead whale	—	—	—	—	—	3	88,688	—	—	69.9
	Caribou	—	—	—	—	—	78	10,608	—	—	8.4
	Bearded seal	—	—	—	—	—	21	8,820	—	—	7.0
	Dolly varden	—	—	—	—	—	1,875	6,188	—	—	4.9
	Dall sheep	—	—	—	—	—	30	3,120	—	—	2.5
	Muskox	—	—	—	—	—	9	2,655	—	—	2.1
	Arctic cisco	—	—	—	—	—	2,358	1,651	—	—	1.3
2000–01	Dolly varden	—	—	35	—	—	1,739	4,869	27	9	—
	Arctic cisco	—	—	91	—	—	1,361	953	32	9	—
	Lake trout	—	—	4	—	—	37	148	2	1	—
2001–02	Dolly varden	—	—	44	—	—	2,649	7,418	41	14	—
	Arctic cisco	—	—	38	—	—	2,187	1,531	19	7	—
	Lake trout	—	—	6	—	—	200	800	10	3	—
2002–03	Bowhead whale	—	—	—	—	—	3	75,515	—	—	72.1
	Caribou	—	—	—	—	—	112	15,232	—	—	14.5
	Arctic char	—	—	—	—	—	1,162	3,834	—	—	3.7
	Bearded seal	—	—	—	—	—	8	3,360	—	—	3.2
	Dall sheep	—	—	—	—	—	18	1,872	—	—	1.8
	Ringed seal	—	—	—	—	—	17	1,258	—	—	1.2
2007	Bowhead whale	—	—	—	—	—	3	40,833	498	—	52.2
	Caribou	—	—	—	—	—	181	21,168	258	—	27.1
	Beluga whale	—	—	—	—	—	6	5,934	72	—	7.6
	Dolly varden	—	—	—	—	—	1,658	4,643	57	—	5.9
	Arctic cisco	—	—	—	—	—	3,198	2,239	27	—	2.9
2008	Bowhead whale	—	—	—	—	—	3	57,482	701	—	56.7
	Caribou	—	—	—	—	—	185	21,586	263	—	21.3
	Dolly varden	—	—	—	—	—	3,921	10,980	134	—	10.8
	Dall sheep	—	—	—	—	—	45	4,425	54	—	4.4
	Polar bear	—	—	—	—	—	3	1,662	20	—	1.6
	Bearded seal	—	—	—	—	—	6	1,117	14	—	1.1

Study Year	Resource[1]	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
2009	Bowhead whale	—	—	—	—	—	3	88,488	1029	—	69.9
	Caribou	—	—	—	—	—	170	19,872	231	—	15.7
	Dolly varden	—	—	—	—	—	2,449	6,857	80	—	5.4
	Bearded seal	—	—	—	—	—	15	2,915	34	—	2.3
	Dall sheep	—	—	—	—	—	29	2,886	34	—	2.3
	Beluga whale	—	—	—	—	—	2	1,450	17	—	1.1
	White-fronted geese	—	—	—	—	—	274	1,234	14	—	1.0
2010	Bowhead whale	—	—	—	—	—	3	53,167	665	—	67.1
	Caribou	—	—	—	—	—	115	13,458	168	—	17.0
	Beluga whale	—	—	—	—	—	8	8,075	101	—	10.2
	Dall sheep	—	—	—	—	—	16	1,612	20	—	2.0
	Black bear[6]	—	—	—	—	—	12	1,035	13	—	1.3
2010–11	Bowhead	97	90	89	60	94	3	78,662	925	274	38.8
	Caribou	94	53	46	51	93	429	58,305	686	203	28.7
	Dolly varden	94	79	76	64	77	6,333	20,898	246	73	10.3
	Beluga	76	30	26	30	74	15	10,318	121	36	5.1
	Bearded seal	57	28	17	24	54	24	10,165	120	35	5.0
	Dall sheep	76	14	14	0	73	78	8,089	95	28	4.0
	Broad whitefish	43	26	20	20	29	1,148	3,729	44	13	1.8
	Geese	70	49	40	37	60	701	2,272	27	8	1.1
	Moose	16	9	4	4	13	4	1,960	23	7	1.0
2011[7]	Bowhead whale	—	—	—	—	—	3	57,661	721	—	58.3
	Caribou	—	—	—	—	—	170	19,909	249	—	20.1
	Dolly varden	—	—	—	—	—	5,440	15,232	190	—	15.4
	Dall sheep	—	—	—	—	—	20	2,011	25	—	2.0
	Bering cisco[8]	—	—	—	—	—	1,093	1,093	14	—	1.1
	Bearded seal	—	—	—	—	—	5	1,016	13	—	1.0
2012	Bowhead whale	—	—	—	—	—	3	100,968	1,262	—	75.8
	Caribou	—	—	—	—	—	155	18,145	227	—	13.6
	Dolly varden	—	—	—	—	—	2,861	8,010	100	—	6.0
2015	Caribou	—	52	—	—	—	303	35,451	—	—	—

Sources: 1981–82, 1982–83 (Pedersen and Coffing 1984); 1983–84 (Coffing and Pedersen 1985); 1985–86, 1986–87, 1987–88 (Pedersen 1990); 1985, 1986, 1990, 1991, (ADFG 2018); 1992a (Pedersen 1995a); 1992b (Fuller and George 1999); 1994–95 (Brower et al. 2000); and 2000–01, 2001–02 (Pedersen and Linn 2005); 2002–03 (Bacon et al. 2009); 2007–12 (Harcharek et al. 2018); 2010–11 (Kofinas et al. 2016); 2015 (SRB&A 2017a).

Notes:
[1]Except in the case of ducks and geese, which are lumped into more general species categories, this table shows individual species, unless they are not available for a given study year.
[2]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[3]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[4]Per capita pounds may be underestimated.
[5]Data should be viewed with caution due to a low response rate. Household participation for the 1992b study year was based on Table A5 in Fuller and George (1999). Bearded seal participation rates include all species of seal.
[6]Probably misreported and should be brown bear (Akłaq).
[7]The survey in 2011 consisted of only an 8-month survey, covering May through December 2011; therefore, estimates from 2011 may not be directly comparable with other years that covered an entire year. For All Resources study years (1985, 1986, 1992a, 1992b, 1994–95, 2002–03), species are listed in descending order by percent of total harvest and are limited to species accounting for at least 1.0 percent of the total harvest; for single-resource study years, species are listed in descending order by total estimated pounds (or total number harvested, in the case of salmon study years) and limited to the five top species. Years lacking "% of total harvest" data were not comprehensive (i.e., all resources) study years).
[8]Reports of Bering cisco harvests in 1992 and 2011 may be incorrect, as Bering cisco are rare in the Kaktovik area. The data are likely referencing Arctic cisco. The estimated harvest numbers for the 1994–95 and 2002–03 data were derived by summing

individual species in each resource category. Also, for those study years, total pounds were derived from conversion rates found at (ADFG 2018) and total (usable) pounds for bowhead whales were calculated based on the method presented in SRB&A and ISER (1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George et al., n.d.
[8] The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.

(Stephen R. Braund & Associates 2018)

M.1.2 Seasonal Round

Table M-4
Kaktovik Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon	■	■	■	■	■	■	■	■	■	■	■	■
Marine non-salmon	■	■	■	■	■	■	■	■	■		■	■
Salmon							■	■	■			
Caribou	■	■	■	■	■	■	■	■	■	■	■	■
Moose	■	■	■	■			■	■	■	■	■	■
Bear					■		■	■	■	■	■	
Sheep	■		■	■				■	■	■	■	■
Muskox	■	■	■					■		■	■	■
Furbearers	■	■	■	■	■			■		■	■	■
Small land mammals			■	■	■	■		■	■		■	
Marine mammals	■	■	■	■	■	■	■	■	■	■	■	■
Upland birds			■	■	■	■	■	■		■	■	
Waterfowl				■	■	■	■	■	■	■		
Eggs				■	■	■	■	■	■	■		
Marine invertebrates								■				
Plants and Berries							■	■	■			
Total number of resources categories by month	**8**	**7**	**10**	**11**	**10**	**8**	**11**	**16**	**12**	**11**	**11**	**8**

Sources: 2002–03 (Bacon et al. 2009); 1994–95 (Brower et al. 2000); 2004 (EDAW Inc., Consulting, Research, Callaway, Associates, and Economics 2008); 1992 (Fuller and George 1999); (Kofinas et al. 2016); pre-1989 (Pedersen, Haynes, and Wolfe 1991); 2000–01 (Pedersen and Linn 2005); 1996–2006 (SRB&A 2010); 2007–2012 (Harcharek et al. 2018)

■ Subsistence activity

M.1.3 Travel Method

Table M-5
Kaktovik Travel Method to Subsistence Use Areas

Resources	Boat	Snowmachine	Foot	Car/Truck	ATV
Arctic cisco	5	1	3	2	4
Burbot	5	4	4	0	0
Arctic char/dolly varden and broad whitefish	5	4	2	1	3
Broad whitefish	5	3	2	2	4
Caribou	5	4	3	0	2
Moose	5	0	0	0	0
Wolf and wolverine	4	5	0	0	0
Bowhead whale	5	0	0	0	0
Seals	5	4	0	0	0
Walrus	5	0	0	0	0
Geese	4	5	3	0	3
Eider	4	5	3	0	2
Total number of resources targeted	**12**	**9**	**7**	**3**	**6**

Sources: 1996–2006 (SRB&A 2010)

Note: For each resource, darker shades indicate greater use of that travel method and lighter shades indicate lesser use of a travel method. The shades have been given a value of 0–5, 0 being the lightest and 5 the darkest.

M.1.4 Resource Importance

Table M-6
Material and Cultural Importance of Subsistence Resources, Kaktovik

Resource Level	Resource[1]	Cultural Importance: Percent of Households: Try to Harvest	Cultural Importance: Percent of Households: Receive	Material Importance: Percent of Total Harvest
Major resources[2]	Bearded seal	38	59	2.6
	Bering cisco[3]	62	45	2.2
	Bowhead whale[6]	62	89	56.6
	Caribou	66	93	21.6
	Dall sheep	24	70	2.9
	Dolly varden and arctic char	79	67	7.4
	Ptarmigan	60	47	0.4
	Wood	64	21	—
Moderate resources[4]	Arctic cisco	17	16	1.2
	Arctic fox	14	1	—
	Arctic grayling	11	13	0.2
	Belukha/beluga	12	38	2.6
	Blueberry	20	22	<.1
	Broad whitefish	8	25	0.3
	Canada geese	48	46	0.3
	Common eider	19	15	0.1
	Cranberry	21	33	0.1
	King eider	13	10	<.1
	Lake trout	13	24	0.3
	Least cisco	9	13	0.1
	Long-tailed duck (oldsquaw)	22	17	<.1

Resource Level	Resource[1]	Cultural Importance: Percent of Households: Try to Harvest	Cultural Importance: Percent of Households: Receive	Material Importance: Percent of Total Harvest
Moderate resources[4] *(continued)*	Moose	8	37	1.3
	Muskox	8	40	1.5
	Polar bear	4	12	0.8
	Ringed seal	38	36	1.5
	Saffron cod	16	1	<.1
	Salmonberry/cloudberry	21	33	0.1
	Snow geese	17	9	<.1
	Squirrel	28	16	0.1
	Walrus	8	31	0.6
	White-fronted geese	30	26	0.5
	Wolf	11	2	—
	Wolverine	13	2	—
Minor resources[5]	Bird eggs	6	6	<.1
	Brown bear	3	6	0.2
	Halibut	1	9	0.2
	Humpback whitefish	—	5	<.1
	Red fox	9	1	—
	Spotted seal	9	5	0.2

Sources: 1981–82, 1982-83 (Pedersen and Coffing 1984); 1983–84 (Coffing and Pedersen 1985); 1985–86, 1986–87, 1987–88 (Pedersen 1990); 1985, 1986, 1990, 1991, (ADFG 2018); 1992a (Pedersen 1995a); 1992b (Fuller and George 1999); 1994–95 (Brower et al. 2000); and 2000–01, 2001–02 (Pedersen and Linn 2005); 2002–03 (Bacon et al. 2009); 2007–12 (Harcharek et al. 2018); 2010–11 (Kofinas et al. 2016); 2015 (SRB&A 2017a)

Notes:
[1]Resources that contributed an average of less than 1 percent of harvest, less than 5 percent attempting harvests, and less than 5 percent receiving harvests are categorized as minor and are not shown.
[2]Major resources contribute >9 percent total harvest, have ≥50 percent of households attempting harvest, or have ≥50 percent of households receiving a resource.
[3]Reports of Bering cisco harvests in 1992 and 2011 may be incorrect, as Bering cisco are rare in the Kaktovik area. The data are likely referencing Arctic cisco.
[4]Moderate resources contribute 2 to 9 percent of total harvest, have 11 to 49 percent of households attempting harvest, or have 11 to 49 percent of households receiving a resource.
[5]Minor resources contribute <2 percent of total harvest, have ≤10 percent of households attempting harvest, or have ≤10 percent of households receiving a resource.
[6]Averages include unsuccessful bowhead whale harvest years.

M.2 NUIQSUT

M.2.1 Harvest Data

Table M-7
Nuiqsut Subsistence Harvest Estimates[5] by Resource Category, All Resources Study Years

Study Year	Resource	Percent of Households: Use	Percent of Households: Try to Harvest	Percent of Households: Harvest	Percent of Households: Give	Percent of Households: Receive	Estimated Harvest: Number[1]	Estimated Harvest: Total Pounds[2]	Estimated Harvest: Average HH Pounds	Estimated Harvest: Per Capita Pounds	Percent of Total Harvest
1985	All resources	100	98	98	95	100	—	160,035	2,106	399	100.0
	Salmon	60	43	40	23	23	441	1,366	18	3	0.9
	Non-salmon fish	100	93	93	83	75	67,712	69,243	911	173	43.3
	Large land mammals	98	90	90	80	70	536	67,621	890	169	42.3
	Small land mammals	65	63	58	23	13	688	245	3	1	0.2
	Marine mammals	100	48	23	30	100	59	13,355	176	33	8.3
	Migratory birds	90	90	85	60	55	1,733	6,626	87	17	4.1
	Upland game birds	88	88	88	58	13	1,957	1,370	18	3	0.9
	Bird eggs	25	25	23	8	10	262	40	1	<1	<0.1
	Vegetation	38	50	18	10	20	—	169	2	<1	0.1
1992[3]	All resources	—	—	—	—	—	—	150,195	—	—	100.0
	Salmon	—	—	—	—	—	6	65	—	—	0.0
	Non-salmon fish	—	74	—	—	—	36,701	51,890	—	—	34.5
	Large land mammals	—	—	—	—	—	299	41,386	—	—	27.6
	Small land mammals	—	—	—	—	—	46	1	—	—	0.0
	Marine mammals	—	—	—	—	—	49	52,865	—	—	35.2
	Migratory birds	—	—	—	—	—	1,105	3,655	—	—	2.4
	Upland game birds	—	—	—	—	—	378	265	—	—	0.2
	Eggs	—	—	—	—	—	25	4	—	—	<0.1
	Vegetation	—	32	—	—	—	—	66	—	—	<0.1
1993	All resources	100	94	90	92	98	—	267,818	2,943	742	100.0
	Salmon	71	45	36	39	47	272	1,009	11	3	0.4
	Non-salmon fish	97	79	79	87	90	71,626	89,481	983	248	33.4
	Large land mammals	98	76	74	82	92	691	87,306	959	242	32.6
	Small land mammals	53	45	42	27	18	599	84	1	<1	<0.1
	Marine mammals	97	58	37	79	97	113	85,216	936	236	31.8
	Migratory birds	87	74	73	63	65	2,238	3,540	39	10	1.3
	Upland game birds	60	45	45	42	26	973	681	7	2	0.3
	Eggs	40	21	19	15	23	346	104	1	<1	<0.1
	Vegetation	79	71	71	27	40	—	396	4	1	0.1
1994–95[4]	All resources	—	—	—	—	—	—	83,228	—	—	100.0
	Salmon	—	—	—	—	—	10	31	—	—	<0.1
	Non-salmon fish	—	—	—	—	—	15,190	46,569	—	—	56.0
	Large land mammals	—	—	—	—	—	263	32,686	—	—	39.3
	Small land mammals	—	—	—	—	—	42	0	—	—	0.0
	Marine mammals	—	—	—	—	—	25	1,504	—	—	1.8
	Migratory birds	—	—	—	—	—	569	2,289	—	—	2.8
	Upland game birds	—	—	—	—	—	58	58	—	—	0.1
	Vegetation	—	—	—	—	—	14	91	—	—	0.1

Study Year	Resource	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
1995–96	All resources	—	—	—	—	—	—	183,576	—	—	100.0
	Salmon	—	—	—	—	—	42	131	—	—	0.1
	Non-salmon fish	—	—	—	—	—	10,612	16,822	—	—	9.2
	Large land mammals	—	—	—	—	—	364	43,554	—	—	23.7
	Small land mammals	—	—	—	—	—	27	0	—	—	0.0
	Marine mammals	—	—	—	—	—	178	120,811	—	—	65.8
	Migratory birds	—	—	—	—	—	683	2,166	—	—	1.2
	Upland birds	—	—	—	—	—	19	13	—	—	<0.1
	Vegetation	—	—	—	—	—	12	78	—	—	<0.1
2000–01	All resources	—	—	—	—	—	—	183,246	—	—	100.0
	Salmon	—	—	—	—	—	10	75	—	—	<0.1
	Non-salmon fish	—	—	—	—	—	26,545	27,933	—	—	15.2
	Large land mammals	—	—	—	—	—	504	62,171	—	—	33.9
	Small land mammals	—	—	—	—	—	108	2	—	—	<0.1
	Marine mammals	—	—	—	—	—	31	87,929	—	—	48.0
	Migratory birds	—	—	—	—	—	1,192	5,108	—	—	2.8
	Upland birds	—	—	—	—	—	23	16	—	—	<0.1
	Vegetation	—	—	—	—	—	2	13	—	—	<0.1
2014	All resources	100	95	90	91	97	—	371,992	3,444	896	100.0
	Salmon	64	41	40	31	35	—	3,889	36	9	1.0
	Non-salmon fish	93	78	71	72	71	—	85,106	788	205	22.9
	Large land mammals	91	66	64	67	72	—	108,359	1,003	261	29.1
	Small land mammals	17	16	10	2	7	—	0	0	0	0.0
	Marine mammals	95	55	40	71	95	—	169,367	1,568	408	45.5
	Migratory birds	79	71	66	52	38	—	4,742	44	11	1.3
	Upland birds	16	12	12	9	5	—	78	1	<1	<0.1
	Vegetation	67	55	53	21	38	—	414	4	1	0.1

Sources: 1985 (ADFG 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994–95 (Brower and Hepa 1998); 1995–96, 2000-01 (Bacon et al. 2009); 2014 (Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016).

Notes:
[1]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[2]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[3]The estimated pounds of moose harvested in 1992 is likely too high (Fuller and George 1999).
[4]The 1994–95 study year underrepresents the harvest of Arctic cisco and humpback whitefish (Brower and Hepa 1998). Nuiqsut did not successfully harvest a bowhead whale in 1994–95.
[5]The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.

The estimated harvest numbers for the 1994–95, 1995–96, and 2000–01 data were derived by summing individual species in each resource category. Also for those study years, total pounds were derived from conversion rates found at ADFG (2018), and total usable pounds for bowhead whales were calculated based on the method presented in SRB&A and ISER (1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George et al. n.d.

(Stephen R. Braund & Associates 2018)

Table M-8
Nuiqsut Subsistence Harvest Estimates[6] by Selected Species, All Study Years

Study Year	Resource[1]	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
1985	Caribou	98	90	90	80	60	513	60,021	790	150	37.5
	Cisco	98	75	73	65	60	46,478	29,354	386	73	18.3
	Broad whitefish	95	80	78	70	40	7,900	26,861	353	67	16.8
	Bowhead whale	100	23	5	8	100	0	7,458	98	19	4.7
	Moose	40	40	18	20	25	13	6,650	88	17	4.2
	White-fronted geese	90	90	85	55	48	1,340	6,028	79	15	3.8
	Arctic grayling	78	65	63	48	35	4,055	3,650	48	9	2.3
	Humpback whitefish	48	45	38	33	13	4,345	3,476	46	9	2.2
	Arctic char	75	63	60	33	35	1,060	2,969	39	7	1.9
	Burbot	75	60	60	43	33	669	2,675	35	7	1.7
	Bearded seal	48	25	15	15	35	15	2,675	35	7	1.7
	Ringed seal	53	25	18	23	40	40	1,676	22	4	1.0
1992	Bowhead whale	—	—	—	—	—	2	48,715	—	—	32.4
	Caribou	—	81	—	—	—	278	32,551	—	—	21.7
	Arctic cisco	—	—	—	—	—	22,391	22,391	—	—	14.9
	Broad whitefish	—	—	—	—	—	6,248	15,621	—	—	10.4
	Moose[4]	—	—	—	—	—	18	8,835	—	—	5.9
	Humpback whitefish	—	—	—	—	—	1,802	4,504	—	—	3.0
	Arctic char	—	—	—	—	—	1,544	4,324	—	—	2.9
	Bearded seal	—	—	—	—	—	16	2,760	—	—	1.8
	Arctic grayling	—	—	—	—	—	3,114	2,491	—	—	1.7
	Canada geese	—	—	—	—	—	319	1,437	—	—	1.0
1993	Caribou	98	74	74	79	79	672	82,169	903	228	30.7
	Bowhead whale	97	37	5	76	97	3	76,906	845	213	28.7
	Broad whitefish	90	66	66	65	66	12,193	41,455	456	115	15.5
	Arctic cisco	89	69	68	81	60	45,237	31,666	348	88	11.8
	Ringed seal	65	42	31	40	55	98	7,277	80	20	2.7
	Burbot	79	63	57	53	55	1,416	5,949	65	16	2.2
	Moose	69	47	10	29	63	9	4,403	48	12	1.6
	Arctic grayling	79	69	65	44	27	4,515	4,063	45	11	1.5
	Least cisco	63	52	47	36	27	6,553	3,277	36	9	1.2
1994–95[5]	Broad whitefish	—	—	—	—	—	3,237	37,417	—	—	45.0
	Caribou	—	—	—	—	—	258	30,186	—	—	36.3
	Arctic cisco	—	—	—	—	—	9,842	6,889	—	—	8.3
	Moose	—	—	—	—	—	5	2,500	—	—	3.0
	Geese unidentified	—	—	—	—	—	474	2,133	—	—	2.6
	Ringed seal	—	—	—	—	—	24	1,008	—	—	1.2
1995–96	Bowhead whale	—	—	—	—	—	4	110,715	—	—	60.3
	Caribou	—	—	—	—	—	362	42,354	—	—	23.1
	Broad whitefish	—	—	—	—	—	2,863	9,735	—	—	5.3
	Ringed seal	—	—	—	—	—	155	6,527	—	—	3.6
	Arctic cisco	—	—	—	—	—	5,030	3,521	—	—	1.9
	Bearded seal	—	—	—	—	—	17	2,974	—	—	1.6
	Least cisco	—	—	—	—	—	1,804	1,804	—	—	1.0
1999–00	Caribou	—	—	—	—	—	413	—	—	112	—

Study Year	Resource[1]	Percent of Households: Use	Try to Harvest	Harvest	Give	Receive	Estimated Harvest: Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	Percent of Total Harvest
2000–01	Bowhead whale	—	—	—	—	—	4	86220	—	—	47.1
	Caribou	—	—	—	—	—	496	57,985	—	—	31.6
	Arctic cisco	—	—	—	—	—	18,222	12,755	—	—	7.0
	Broad whitefish	—	—	—	—	—	2,968	10,092	—	—	5.5
	White-fronted geese	—	—	—	—	—	787	3,543	—	—	1.9
	Moose	—	—	—	—	—	6	3,000	—	—	1.6
2002–03	Caribou	95	47	45	49	80	397	—	—	118	—
2003–04	Caribou	97	74	70	81	81	564	—	—	157	—
2004–05	Caribou	99	62	61	81	96	546	—	—	147	—
2005–06	Caribou	100	60	59	97	96	363	—	—	102	—
2006–07	Caribou	97	77	74	66	69	475	—	—	143	—
2010	Caribou	94	86	76	—	—	562	65,754	707	—	—
2011	Caribou	92	70	56	49	58	437	51,129	544	134	—
2012	Caribou	99	68	62	65	79	501	58,617	598	147	—
2013	Caribou	95	79	63	62	75	586	68,534	692	166	—
2014	Bowhead	93	29	21	57	91	5	148,087	1,371	357	39.8
	Caribou	90	66	64	67	59	774	105,193	974	253	28.3
	Broad whitefish	72	60	59	52	40	11,439	36,605	339	88	9.8
	Arctic cisco	83	52	48	59	53	46,277	32,394	300	78	8.7
	Bearded seal	67	38	22	40	62	13,846	13,846	128	33	3.7
	Least cisco	33	28	28	19	7	13,332	9,333	86	22	2.5
	Ringed seal	52	40	35	38	33	108	6,156	57	15	1.7
2015	Caribou	96	84	78	74	72	628	73,527	728	180	—

Sources: 1985 (ADFG 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994–95 (Brower and Hepa 1998); 1995–96, 2000–01 (Bacon et al. 2009); 1999–00, 2002–2007 (Braem et al. 2011); 2010, 2011, 2012, 2013 (SRB&A 2012, 2013, 2014, 2015); 2014 (Brown et al. 2016); 2015 (SRB&A 2017b)

Notes:
[1]This table shows individual species unless they are not available for a given study year.
[2]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[3]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[4]The estimated pounds of moose harvested in 1992 is likely too high (Fuller and George 1999).
[5]The 1994–95 study year underrepresents the harvest of Arctic cisco and humpback whitefish (Brower and Hepa 1998); Nuiqsut did not successfully harvest a bowhead whale in 1994–95.
[6]The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.
Most of Nuiqsut's caribou harvests come from the Teshekpuk Herd and Central Arctic Herd; few Porcupine Caribou Herd caribou migrate into Nuiqsut's core harvesting area.
For All Resources study years (1985, 1992, 1993, 1994-95, 1995–96, 2000–01), species are listed in descending order by percent of total harvest and are limited to species accounting for at least 1.0 percent of the total harvest; for single-resource study years, species are listed in descending order by total estimated pounds (or total number harvested, in the case of salmon study years) and are limited to the five top species. Years lacking percent of total harvest data were not comprehensive study years for all resources. The estimated harvest numbers for the 1992, 1994–95, 1995–96 and 2000–01 data were derived by summing individual species in each resource category. Also, for those study years, total pounds were derived from conversion rates found at ADFG (2018). Total usable pounds for bowhead whales were calculated based on the method presented in SRB&A and ISER (1993). These estimates do not account for whale girth and should be considered approximate; more exact methods for estimating total whale weights are available in George et al. n.d. for the 2002–03, 2003–04, 2004–05, 2005–06, 2006–07, and 2010–11 study years, total pounds were derived from conversion rates from Braemet al. 2011.

(Stephen R. Braund & Associates 2018)

M.2.2 Seasonal Round

Table M-9
Nuiqsut Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freshwater non-salmon	Moderate	Limited	Moderate	Moderate	Limited	Limited	Moderate	High	High	High	High	Limited
Marine non-salmon									High	High		
Salmon							High	Moderate				
Caribou	Limited	Limited	Limited	Limited	Limited	Moderate	High	High	Moderate	Moderate	Limited	Limited
Moose	Limited						Limited	High	High	Moderate	Limited	Limited
Bear	Moderate	Moderate	Moderate	Limited	Limited	Limited	Limited	Limited	High	Moderate	Moderate	Moderate
Muskox								High	High	High		
Furbearers	High	High	High	High	Moderate	Limited	Limited	Limited	Limited	Limited	Moderate	High
Small land mammals					Limited	Limited	High	High	Limited			
Marine mammals			Moderate	High	Limited	Limited	Moderate	High	High	Limited	Limited	Limited
Upland birds	Moderate	Moderate	High	High	Moderate	Limited		Limited	Limited	Moderate	Moderate	Moderate
Waterfowl				Limited	High	High	Moderate	Moderate	Moderate	Moderate	Limited	Limited
Eggs						High						
Plants and berries					Limited	Limited	High	High				
Total number of resource categories by month	**6**	**5**	**6**	**7**	**9**	**10**	**10**	**12**	**11**	**10**	**8**	**8**

Sources: 1995–96, 2000–01 (Bacon et al. 2009); 2002–07 (Braem et al. 2011); 1994–95 (Brower and Hepa 1998); Pre-1979 (Brown 1979); 2014 (Brown et al. 2016); 2004 (EDAW Inc. et al. 2008); 1992 (Fuller and George 1999); 2001–2012 (Galginaitis 2014); 1988 (Hoffman, Libbey, and Spearman 1988); 1979 (Libbey, Spearman, and Hoffman 1979); 1995–2006 (SRB&A 2010); 2008–15 (SRB&A 2017b)

Limited activity and/or harvests; Moderate activity and/or harvests; High activity and/or harvests

M.2.3 Travel Method

Table M-10
Nuiqsut Travel Method to Subsistence Use Areas

Resources	Boat	Snowmachine	Foot	Car/Truck	ATV	Plane
Arctic cisco and burbot	3	5	2	4	0	0
Arctic char and dolly varden and broad whitefish	5	4	3	0	0	0
Caribou	5	4	0	2	4	0
Moose	5	0	4	0	0	0
Wolf and wolverine	4	5	0	0	0	4
Bowhead whale	5	0	0	0	0	0
Seals	5	4	0	0	0	0
Geese	4	5	3	1	2	0
Eider	5	4	0	0	0	0
Total number of resources targeted	**9**	**7**	**4**	**3**	**2**	**1**

Sources: 1995–2006 (SRB&A 2010), 2008–15 (SRB&A 2017b)

Notes: For each resource, darker shades indicate greater use of that travel method; lighter shades indicate lesser use of a travel method. The shades have been given a value of 0–5, 0 being the lightest and 5 the darkest. Caribou based on SRB&A 2017; all others based on SRB&A 2010a.

M.2.4 Resource Importance

Table M-11
Material and Cultural Importance of Subsistence Resources, Nuiqsut

Resource Level	Resource	Cultural Importance: Percent of Households Trying to Harvest	Cultural Importance: Percent of Households Receiving	Material Importance: Percent of Total Harvest
Major resources[2]	Arctic cisco	61	57	8.8
	Arctic grayling	50	24	1.0
	Bearded seal	32	50	1.6
	Bowhead whale[5]	30	96	30.4
	Broad whitefish	69	49	15.5
	Burbot	51	35	1.0
	Caribou	73	75	29.9
	Cloudberry	55	29	0.0
	White fronted geese	62	36	1.4
	Wood	50	3.2	0.0
Moderate resources[3]	Arctic char	38	22	0.9
	Arctic fox	14	1	0.0
	Beluga	2	24	0.0
	Bird eggs	16	12	0.0
	Blueberries	29	16	0.0
	Brant	17	9	0.1
	Brown bear	14	18	0.2
	Canada geese	42	24	0.4
	Chum salmon	23	11	0.6
	Ground squirrel	45	8	0.1
	Humpback whitefish	26	9	1.0
	King eider	24	19	0.0
	Least cisco	40	17	1.1
	Long-tailed duck	8	13	0.0
	Moose	40	41	2.5

Resource Level	Resource	Cultural Importance: Percent of Households: Trying to Harvest	Cultural Importance: Percent of Households: Receiving	Material Importance: Percent of Total Harvest
Moderate resources[3] *(continued)*	Pink salmon	28	17	0.4
	Polar bear	7	29	0.2
	Ptarmigan	48	15	0.2
	Rainbow smelt	13	22	0.1
	Red fox	22	2	0.0
	Ringed seal	36	43	1.6
	Snow geese	19	7	0.0
	Spotted seal	13	5	0.1
	Walrus	7	43	0.2
	Wolf	18	6	0.0
	Wolverine	22	5	0.0
Minor resources[4]	Arctic cod	7	7	0.0
	Chinook salmon	2	9	0.0
	Coho salmon	3	5	0.0
	Common eider duck	7	3	0.1
	Cranberries	9	5	0.0
	Crowberries	7	2	0.0
	Dall sheep	-	9	0.0
	Dolly varden	10	3	0.4
	Lake trout	3	8	0.0
	Muskox	—	8	0.3
	Northern pike	7	7	0.0
	Northern pintail	5	1.6	0.0
	Round whitefish	5	1	0.1
	Saffron cod	7	—	0.0
	Sheefish	—	6	0.0
	Sockeye salmon	3	6	0.0
	Sourdock	5	7	0.0
	Weasel	5	—	0.0

Sources: 1985 (ADFG 2018); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994–95 (Brower and Hepa 1998); 1995–96, 2000–01 (Bacon et al. 2009); 1999–2000, 2002–07 (Braem et al. 2011); 2010, 2011, 2012, 2013 (SRB&A 2012, 2013, 2014, 2015); 2014 (Brown et al. 2016); 2015 (SRB&A 2017)

Notes:
[1]Resources that contributed an average of less than 1 percent of harvest, less than 5 percent attempting harvests, and less than 5 percent receiving harvests are categorized as minor and are not be shown.
[2]Major resources contribute >9 percent total harvest, have ≥50 percent of households attempting harvest, or have ≥50 percent of households receiving resource.
[3]Moderate resources contribute 2 to 9 percent of total harvest, have 11 to 49 percent of households attempting harvest, or have 11 to 49 percent of households receiving resource.
[4]Minor resources contribute <2 percent of total harvest, have ≤10 percent of households attempting harvest, or have ≤10 percent of households receiving resource.
[5]Averages include unsuccessful bowhead whale harvest years.

M.3 ARCTIC VILLAGE

M.3.1 Harvest Data

Table M-12
Arctic Village Subsistence Harvest Estimates[1] by Resource Category, Non-Comprehensive Study Years

Study Year	Resource	Percent of Households					Estimated Harvest			
		Use	Try to Harvest	Harvest	Give	Receive	Number	Total Pounds	Average HH Pounds	Per Capita Pounds
2000	Migratory Birds	87	46	52	37	39	437	820	16	6
2001	Non-salmon fish	63	—	63	24	28	4,754	9,923	102	34
2002	Non-salmon fish	80	—	42	21	42	7,676	18,416	181	67

Sources: 2000 (Andersen and Jennings 2001); 2001–02, 2002–03 (Adamset al. 2005)
[1] The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.

(Stephen R. Braund & Associates 2018)

Table M-13
Arctic Village Subsistence Harvest Estimates[4] by Selected Species, All Study Years

Study Year	Resource[1]	Percent of Households: Use	Percent of Households: Try to Harvest	Percent of Households: Harvest	Percent of Households: Give	Percent of Households: Receive	Estimated Harvest: Number[2]	Estimated Harvest: Total Pounds[3]	Estimated Harvest: Average HH Pounds	Estimated Harvest: Per Capita Pounds	Percent of Total Harvest
2000	Scoter	—	—	—	—	—	187	370	7	3	—
	Scaup	—	—	—	—	—	71	118	2	1	—
	Long-tailed duck (oldsquaw)	—	—	—	—	—	67	100	2	1	—
	Mallard	—	—	—	—	—	49	95	2	1	—
	White-fronted geese	—	—	—	—	—	10	43	1	<1	—
2001	Broad whitefish	12	—	12	8	5	990	3,958	39	14	—
	Humpback whitefish	17	—	17	10	7	1,685	3,538	38	12	—
	Grayling	47	—	47	13	20	1,257	1,257	13	4	—
	Northern pike	18	—	18	7	5	187	562	6	2	—
	Lake trout	9	—	9	2	0	212	212	4	1	—
2002	Humpback whitefish	28	—	10	4	20	3,987	8,373	84	30	—
	Broad whitefish	40	—	16	10	26	1,673	6,691	65	24	—
	Northern pike	20	—	18	11	2	598	1,793	18	7	—
	Grayling	32	—	29	8	5	857	857	9	3	—
	Unknown whitefish	2	—	1	0	1	188	328	3	1	—

Sources: 2000 (Andersen and Jennings 2001); 2001–02, 2002–03 (Adams et al. 2005)
Notes: For single-resource study years, species are listed in descending order by total estimated pounds and limited to the five top species. Years lacking percent of total harvest data were not comprehensive study years for all resources.

Notes:
[1]This table shows individual species unless they are not available for a given study year.
[2]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[3]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[4] The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.

(Stephen R. Braund & Associates 2018)

M.3.2 Seasonal Round

Table M-14
Arctic Village Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish												
Caribou												
Moose												
Sheep												
Furbearers												
Small land mammals												
Waterfowl												
Vegetation (wood)												
Total number of resource categories by month	**5**	**5**	**6**	**3**	**4**	**3**	**3**	**6**	**6**	**5**	**7**	**6**

Sources: 1970–82 (Caulfield 1983); 2000 (Andersen and Jennings 2001)

Low to medium levels of activity; High levels of activity

M.3.3 Resource Importance

Data to calculate resources of importance for Arctic Village are not available. This is because there have been no comprehensive household harvest surveys conducted for that community; however, based on existing literature and statements from community members during scoping and elsewhere, the assumption is that caribou is a resource of primary subsistence, economic, cultural, and spiritual importance for the community of Arctic Village.

M.4 VENETIE

M.4.1 Harvest Data

Table M-15
Venetie Subsistence Harvest Estimates[1] by Resource Category, All Resources Study Years

Study Year	Resource	Percent of Households					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number*	Total Pounds**	Average HH Pounds	Per Capita Pounds	
2009	All resources	99	86	81	—	—	13,344	74,602	794	274	100.0
	Salmon	76	37	26	—	—	2,742	20,775	221	76	27.8
	Non-salmon fish	81	67	63	—	—	6,348	6,745	72	25	9.0
	Large land mammals	94	63	33	—	—	159	36,977	393	136	49.6
	Small land mammals	56	44	43	—	—	1,632	3,126	33	12	4.2
	Marine mammals	18	0	0	—	—	0	0	0	0	0.0
	Migratory birds	79	57	55	—	—	2,134	5,501	59	20	7.4
	Upland game birds	20	31	16	—	—	119	119	1	0	0.2
	Vegetation	67	46	43	—	—	210	1,360	15	5	1.8

Source: 2009 (Kofinas et al. 2016)
[1] The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.

(Stephen R. Braund & Associates 2018)

Table M-16
Venetie Subsistence Harvest Estimates by Resource Category, Non-Comprehensive Study Years

Study Year	Resource	Percent of Households					Estimated Harvest			
		Use	Try to Harvest	Harvest	Give	Receive	Number	Total Pounds	Average HH Pounds	Per Capita Pounds
2000	Migratory birds	—	—	68	—	—	2,077	3,306	94	25

Source: 2000 (Andersen and Jennings 2001)

(Stephen R. Braund & Associates 2018)

Table M-17
Venetie Subsistence Harvest Estimates[4] by Selected Species, All Study Years

Study Year	Resource[1]	Percent of Households: Use	Percent of Households: Try to Harvest	Percent of Households: Harvest	Percent of Households: Give	Percent of Households: Receive	Estimated Harvest: Number[2]	Estimated Harvest: Total Pounds[3]	Estimated Harvest: Average HH Pounds	Estimated Harvest: Per Capita Pounds	Percent of Total Harvest
2000	Unknown scoter	—	—	—	—	—	1,354	1,354	39	10	—
	White-fronted geese	—	—	—	—	—	150	638	18	5	—
	Canada geese	—	—	—	—	—	153	609	17	5	—
	Long-tailed duck (oldsquaw)	—	—	—	—	—	217	326	9	2	—
	Mallard	—	—	—	—	—	65	122	3	1	—
2008–09	Moose	95	51	32	68	92	22	12,060	—	80	—
	Caribou	98	18	18	65	92	16	2,135	—	14	—
	Black bear	14	11	6	3	6	5	532	—	4	—
	Brown bear	5	8	2	0	2	1	150	—	1	—
	Lynx	3	3	3	2	0	1	—	—	—	—
2009	Moose	93	61	30	60	87	40	21,476	229	79	28.8
	Caribou	86	23	14	49	85	105	14,230	151	52	19.1
	Chum salmon	42	27	20	12	30	2,066	12,395	132	46	16.6
	Chinook salmon	69	27	16	26	62	675	8,374	89	31	11.2
	Arctic grayling	80	66	62	44	49	5,492	4,943	53	18	6.6
	Geese	68	45	37	36	56	969	3,142	33	12	4.2
	Whitefishes	41	13	8	12	40	853	1,791	19	7	2.4
	Beaver	26	15	14	14	15	65	1,298	14	5	1.7
	Snowshoe hare	43	36	35	21	16	574	1,148	12	4	1.5
	Black bear	19	17	8	6	12	10	886	9	3	1.2
2009–10	Moose	53	41	13	36	50	24	16,548	—	86	—
	Caribou	39	13	5	25	39	6	556	—	3	—
	Black bear	8	5	5	2	5	4	417	—	2	—
	Brown bear	3	2	2	2	2	1	196	—	1	—
	Lynx	3	3	3	2	2	86	—	—	—	—
2010–11	Moose	—	35	9	11	14	5	2,916	—	16	—
	Caribou	—	30	15	16	10	44	6,615	—	37	—
	Lynx	—	0	0	0	9	0	—	—	—	—
	Marten	—	0	0	0	4	0	—	—	—	—

Sources: 2000 (ADFG 2018); 2008–09, 2009–10 (Van Lanen, Stevens, Brown, Maracle, and Koster 2012); 2009 (Kofinas et al. 2016); 2010–11 (Stevens and Maracle n.d.)

Notes:
[1]This table shows individual species unless they are not available for a given study year.
[2]Estimated numbers represent individuals in all cases except vegetation, where they represent gallons.
[3]Estimated pounds include only edible pounds and therefore do not include estimates for resources, such as furbearers, that are not typically eaten by community residents.
[4]The table provides harvest estimates from each study year based on a sample of households. Harvest studies generally do not capture a census of all households; therefore, data may underestimate community harvests if the sample excludes one or more particularly active harvester households.
For all resources study years (2009), species are listed in descending order by percent of total harvest and are limited to species accounting for at least 1.0 percent of the total harvest; for single resource study years, species are listed in descending order by total estimated pounds and are limited to the five top species. Years lacking percent of total harvest data were not comprehensive study years for all resources.

(Stephen R. Braund & Associates 2018)

M.4.2 Seasonal Round

Table M-18
Venetie Annual Cycle of Subsistence Activities

Resources	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish												
Caribou												
Moose												
Bear												
Furbearers												
Small land mammals												
Waterfowl												
Berries												
Wood												
Total number of resource categories by month	**4**	**4**	**5**	**6**	**5**	**5**	**5**	**7**	**7**	**2**	**4**	**4**

Sources: 2000 (Andersen and Jennings 2001); 1970–82 (Caulfield 1983); Kofinas et al. 2016; 2008–09, 2009–10 (Van Lanen et al. 2012); 2010–11 (Stevens and Maracle n.d.)

Low to medium levels of activity; High levels of activity

M.4.3 Resource Importance

Table M-19
Material and Cultural Importance of Subsistence Resources, Venetie

Resource Level	Resource	Cultural Importance		Material Importance
		Percent of Households		Percent of Total Harvest
		Trying to Harvest	Receive	
Major resources	Arctic grayling	66	49	6.6
	Caribou	21	56	19.1
	Chinook salmon	27	62	11.2
	Chum salmon	27	30	16.6
	Geese	45	56	4.2
	Moose	47	61	28.8
Moderate resources	Bearded seal	0	15	—
	Beaver	15	15	1.7
	Black bear	11	8	1.2
	Blueberry	41	49	0.9
	Bowhead	0	15	-
	Low bush cranberry	35	30	0.8
	Muskrat	11	10	0.5
	Other birds	31	8	0.2
	Parka squirrel (ground)	10	12	0.2
	Ptarmigan	27	8	0.1
	Snowshoe hare	18	8	1.5
	Whitefishes	13	40	2.4
Minor resources	Beluga	0	6	—
	Brown bear	6	1	0.5
	Grouse	7	2	—

Sources: 2000 (ADFG 2018); 2008–09, 2009–10 (Van Lanen et al. 2012); 2009 (Kofinas et al. 2016); 2010–11 (Stevens and Maracle n.d.)

[1]Resources that contributed an average of less than 1 percent of harvest, less than 5 percent attempting harvests, and less than 5 percent receiving harvests are categorized as minor and are not be shown.
[2]Major resources contribute >9 percent total harvest, have ≥50 percent of households attempting harvest, or have ≥50 percent of households receiving resource.
[3]Moderate resources contribute 2 to 9 percent of total harvest, have 11 to 49 percent of households attempting harvest, or have 11 to 49 percent of households receiving resource.
[4]Minor resources contribute <2 percent of total harvest, have ≤10 percent of households attempting harvest, or have ≤10 percent of households receiving resource.

M.5 CARIBOU STUDY COMMUNITIES

Table M-20
Caribou Harvest Data for All Available Study Years, Caribou Study Communities

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Alatna	1997–98	73	46	36	36	46	21	2,730	248	109	—
	1998–99	100	90	60	50	60	11	1,430	143	53	—
	1999–00	100	57	0	0	100	0	—	0	0	—
	2001–02	27	0	0	0	27	0	—	0	0	—
	2002–03	100	67	67	50	83	34	4,420	368	123	—
	2011	100	83	67	67	100	28	3,705	412	118	39.3
	Average	***83***	***57***	***38***	***34***	***69***	***16***	***2,048***	***195***	***67***	***39.3***
Allakaket	1997–98	42	15	6	10	39	11	1,375	25	8	—
	1998–99	100	55	26	20	86	43	5,623	92	29	—
	1999–00	93	34	12	15	86	13	1,719	29	10	—
	2001–02	21	7	7	3	15	9	1,170	19	7	—
	2002–03	96	68	44	32	68	106	13,728	312	53	—
	2011	76	48	33	48	62	95	12,350	217	84	—
	Average	***72***	***38***	***21***	***21***	***59***	***46***	***5,994***	***116***	***32***	***—***
Arctic Village	***No Comparable Caribou Harvest Data***										
Anaktuvuk Pass	1990–91	—	—	55	—	—	592	69,964	985	223	—
	1991–92	—	—	51	—	—	545	66,712	940	245	—
	1992	—	74	—	—	—	600	70,222	889	260	82.6
	1993–94	—	—	43	—	—	574	67,713	846	219	—
	1994–95	—	—	—	—	—	322	43,792	—	—	83.2
	1996–97	—	—	—	—	—	210	28,587	—	—	90.0
	1998–99	—	—	—	—	—	500	68,000	—	—	89.5
	1999–00	—	—	—	—	—	329	44,744	—	—	75.2
	2006–07	92	61	53	47	63	696	81,490	1,000	299	—
	2011	95	63	53	52	73	616	77,706	914	251	79.2
	2002–03	—	—	—	—	—	436	59,310	—	—	91.5
	2001–02	—	—	—	—	—	271	36,910	—	—	75.6
	2000–01	—	—	—	—	—	732	99,579	—	—	89.1
	Average	***94***	***66***	***51***	***50***	***68***	***494***	***62,671***	***929***	***250***	***84.0***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Atqasuk	1996–97	—	—	—	—	—	398	—	—	—	—
	2003	93	66	61	66	66	—	—	—	—	—
	2004	100	79	79	69	74	—	—	—	—	—
	2005	96	70	59	74	63	—	—	—	—	—
	2006	95	67	60	76	57	—	—	—	—	—
	Average	***96***	***70***	***65***	***71***	***65***	***398***	—	***—***	***—***	***—***
Beaver	1985	—	3	0	0	0	0	—	0	0	0.0
	2010–11	—	—	—	—	—	5	650	—	—	—
	2011	0	0	0	0	0	0	—	0	0	0
	Average	***0***	***0***	***0***	***0***	***0***	***0***	—	***0***	***0***	***0***
Bettles	1981–82	—	—	15	—	5	14	1,788	72	28	10.6
	1983	—	—	10	—	—	5	644	25	8	4.4
	1984	—	—	6	—	—	3	451	12	5	4.4
	1997–98	14	29	0	14	14	0	—	0	0	—
	1998–99	60	40	40	60	20	25	3,276	364	107	—
	1999–00	67	44	44	33	33	21	2,773	173	52	—
	2002–03	58	8	0	12	58	0	—	0	0	—
	2011	63	25	25	25	50	6	780	98	65	37.1
	Average	***52***	***29***	***18***	***29***	***30***	***9***	***1,214***	***93***	***33***	***14.1***
Birch Creek	2008–09	25	0	0	25	25	0	—	0	0	—
	2009–10	40	7	0	33	40	0	—	0	0	—
	2010–11	—	0	0	0	8	0	—	0	0	—
	Average	***33***	***2***	***0***	***19***	***24***	***0***	—	***0***	***0***	***0.0***
Chalkyitsik	2008–09	0	0	0	0	0	0	—	0	0	0
	2009–10	0	0	0	0	0	0	—	0	0	0
	2010–11	0	0	0	0	0	0	—	0	0	0
	Average	***0***	***0***	***0***	***0***	***0***	***0***	—	***0***	***0***	***0***
Circle	2008–09	85	23	3	5	83	1	130	—	1.3	—
	2009–10	7	7	7	0	7	4	400	—	5.9	—
	2010–11	—	0	0	0	0	0	—	—	0	—
	Average	***46***	***10***	***3***	***2***	***30***	***2***	***177***	***—***	***2.4***	***—***
Coldfoot	***2011***	***75***	***50***	***25***	***50***	***50***	***2***	***325***	***65***	***33***	***85.3***
Eagle	***2004***	***61***	***61***	***14***	***15***	***52***	***19***	***1,957***	***28.8***	***15.2***	***15.7***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Evansville	1981–82	—	—	15	—	5	14	1,788	72	28	10.6
	1983	—	—	10	—	—	5	644	25	8	4.4
	1984	—	—	6	—	—	3	451	12	5	4.4
	1997	50	14	7	21	50	3	334	19	8	—
	1998	67	25	17	8	58	4	455	33	16	—
	1999	67	25	17	17	50	2	282	22	10	—
	2002–03	58	8	0	12	58	0	—	0	0	—
	2011	77			25	77	—	—	—	—	0.0
	Average	***64***	***18***	***10***	***17***	***50***	***4***	***565***	***26***	***11***	***4.9***
Fort Yukon	1986–87	73	13	9	10	64	156	15,587	74	25	2.5
	2008–09	12	2	1	13	3	3	355	—	1	—
	2009–10	20	10	9	8	18	35	3,518	—	8	—
	Average	***35***	***8***	***6***	***10***	***28***	***65***	***6,487***	***74***	***11***	***2.5***
Kaktovik	1981–82	—	—	—	—	—	43	—	—	—	—
	1982–83	—	—	—	—	—	160	—	—	—	—
	1983–84	—	—	—	—	—	107	—	—	—	—
	1985–86	—	—	—	—	—	235	—	—	—	—
	1985	95	76	69	67	86	235	27,941	527	149	45.3
	1986	98	66	60	53	94	178	21,188	378	109	25.2
	1986–87	—	—	—	—	—	201	—	—	—	—
	1987–88	—	—	55	—	—	185	22,229	383	104	—
	1990	—	—	48	—	—	113	13,453	224	67	—
	1991	—	—	50	—	—	181	22,113	369	94	—
	1992a	96	70	55	53	75	158	19,136	304	99	11.2
	1992b	—	66	—	—	—	136	15,926	—	—	8.8
	1994–95	—	—	—	—	—	78	10,608	—	—	8.4
	2002–03	—	—	—	—	—	112	15,232	—	—	14.5
	2010–11	94	53	46	51	93	429	58,305	686	203	28.7
	Average	***96***	***66***	***55***	***56***	***87***	***170***	***22,613***	***410***	***118***	***20.3***
Nuiqsut	1985	98	90	90	80	60	513	60,021	790	150	37.5
	1992	—	81	—	—	—	278	32,551	—	—	21.7
	1993	98	74	74	79	79	672	82,169	903	228	30.7
	1994–95	—	—	—	—	—	258	30,186	—	—	36.3
	1995–96	—	—	—	—	—	362	42,354	—	—	23.1
	1999–00	—	—	—	—	—	413	—	—	112	—
	2000–01	—	—	—	—	—	496	57,985	—	—	31.6
	2002–03	95	79	63	62	75	586	68,534	692	166	—
	2003–04	99	68	62	65	79	501	58,617	598	147	—

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Nuiqsut *(continued)*	2004–05	92	70	56	49	58	437	51,129	544	134	—
	2005–06	94	86	76	—	—	562	65,754	707	—	—
	2006–07	97	77	74	66	69	475	—	—	143	—
	2010	100	60	59	97	96	363	—	—	102	—
	2011	99	62	61	81	96	546	—	—	147	—
	2012	97	74	70	81	81	564	—	—	157	—
	2013	95	47	45	49	80	397	—	—	118	—
	2014	90	66	64	67	59	774	105,193	974	253	28.3
	2015	96	84	78	74	72	628	73,527	728	180	—
	Average	***96***	***73***	***67***	***71***	***75***	***490***	***60,668***	***742***	***157***	***29.9***
Point Lay	1987	94	72	72	63	73	157	18,418	428	153	17.2
	2012	93	64	60	71	76	356	48,380	705	186	31.3
	Average	***94***	***68***	***66***	***67***	***75***	***256***	***33,399***	***567***	***169***	***24.2***
Stevens Village	2009–10	5	0	0	5	5	0	—	—	0	—
	2008–09	—	0	0	0	10	0	—	—	0	—
	Average	***5***	***0***	***0***	***3***	***8***	***0***	***—***	***—***	***0***	***—***
Utqiaġvik	1987	—	—	26	—	—	1,595	186,669	199	62	30.1
	1988	—	—	27	—	—	1,533	179,314	191	59	29.2
	1989	—	—	39	—	—	1,656	193,744	207	64	22.2
	1992	—	46	—	—	—	1,993	233,206	—	—	17.1
	1995–96	—	—	—	—	—	2,155	293,094	—	—	24.5
	1996–97	—	—	—	—	—	1,158	157,420	—	—	13.3
	2000	—	—	—	—	—	3,359	456,851	—	—	29.3
	2001	—	—	—	—	—	1,820	247,520	—	—	22.9
	2002–03	92	61	55	80	78	5,641	659,997	—	123	—
	2003	—	—	—	—	—	2,092	284,444	—	—	22.8
	2003–04	87	52	45	73	69	3,548	415,116	—	82	—
	2004–05	85	51	48	62	64	4,338	507,546	—	94	—
	2005–06	90	50	47	81	78	4,535	530,595	—	103	—
	2006–07	92	65	59	65	70	5,380	629,460	—	111	—
	2014	70	38	33	38	52	4,323	587,897	371	111	30.6
	Average	***86***	***52***	***42***	***67***	***68***	***3008***	***370,858***	***242***	***90***	***24.2***
Venetie	2008–09	98	18	18	65	92	16	2,135	—	14	—
	2009	86	23	14	49	85	105	14,230	151	52	19.1
	2009–10	39	13	5	25	39	6	556	—	3	—
	2010–11	—	30	15	16	10	44	6,615	—	37	—
	Average	***74***	***21***	***13***	***39***	***56***	***43***	***5,884***	***151***	***26***	***19.1***

Community	Study Year	Percent of Households (HH)					Estimated Harvest				Percent of Total Harvest
		Using	Trying to Harvest	Harvesting	Giving	Receiving	Total Number	Total Pounds	Average HH Lbs	Per Capita Lbs	
Wainwright	1988	—	—	57	—	—	505	59,085	476.49	117	23.0
	1989	—	—	66	—	—	711	83,187	699.05	177.75	23.7
	2009	97	64	61	62	84	1,231	167,356	1,073	284	41.7
	Average	***97***	***64***	***61***	***62***	***84***	***816***	***103,209***	***749***	***193***	***29.5***
Wiseman	1991	—	—	—	—	—	10	1,260	—	—	28.2
	2011	80	80	60	60	20	4	520	104	40	13.6
	Average	***80***	***80***	***60***	***60***	***20***	***7***	***890***	***104***	***40***	***20.9***

Source: ADFG 2018

Table M-21
Total Annual Harvest Summary of Porcupine Caribou as Reported at Annual Harvest Meetings of the Porcupine Caribou Management Board, 2010/11 through 2015/16

Canadian User Group	PCH Harvest						
	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	6 Year Total
Inuvialuit (NWT)[1]	121	294	176	368	123	345	1,427
NWT Gwich'in[2]	1,197	939	615	1,936	451	2,558	7,696
Vuntut Gwichin[3]	265	511	403	473	114	148	1,914
Tr'ondek Hwech'in[4]	1	3	1	2	0	12	19
Nacho Nayak Dun[5]	0	0	0	3	0	5	8
Yukon licensed[6]	38	13	8	81	3	232	375
NWT licensed[7]	98	90	80	57	58	67	450
Total (all user groups)	1,720	1,850	1,283	2,920	749	3,367	11,889

Sources: Porcupine Caribou Management Board 2018

Note: The data provided above is a summary of data collected by each user group and submitted to the Porcupine Caribou Management Board annually. The methods of data collection and reporting vary by user group and reflect a combination of reported and estimated harvests.

[1]Including Inuvialuit in and around Aklavik, Inuvik, and Tuktoyaktuk. Estimated harvest.
[2]Including Gwich'in in and around Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic. Minimum count harvest.
[3]Including First Nation Members in and around Old Crow. Minimum count harvest.
[4]Including First Nation Members in and around Dawson City. Minimum count harvest.
[5]Including First Nation Members in and around Mayo. Minimum count harvest.
[6]Including licensed hunters in the Yukon Territory. Mandatory kill reporting, total count.
[7]Including licensed hunters in the Northwest Territory. Maximum number of caribou harvested based on license sales.

M.6 REFERENCES

Adams, F. Jeffrey, Theresa Lynn Tanner, and Mark A. Nelson. 2005. Harvest and Biological Characteristics of the Subsistence Fishery in Arctic Village, Alaska, 2001-2003. Alaska Fisheries Data Series. no 2005-18. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office. Fairbanks, Alaska. Internet website: http://www.r7.fws.gov/fisheries/fieldoffice/fairbanks/pdf/ds_2005-18.pdf.

ADFG (Alaska Department of Fish and Game). 2018. Community Subsistence Information System: Csis. Harvest by Community. Juneau, Alaska. Internet website: https://www.adfg.alaska.gov/sb/CSIS/index.cfm?ADFG=harvInfo.harvestCommSelComm.

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. Internet website: http://www.subsistence.adfg.state.ak.us/TechPap/Tp268.pdf.

Bacon, J., T. Hepa, H. Brower, Jr., M. Pederson, T. Olemaun, J. George, and B. Corrigan. 2009. Estimates of Subsistence Harvest for Villages on the North Slope of Alaska, 1994-2003. North Slope Borough, Department of Wildlife Management. Barrow, Alaska. Internet website: http://www.north-slope.org/assets/images/uploads/MASTER%20SHDP%2094-03%20REPORT%20FINAL%20and%20%20Errata%20info%20(Sept%202012).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. Internet website: http://library.state.ak.us/asp/edocs/2011/06/ocn739704678.pdf.

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, Department of Wildlife Management. Barrow, Alaska. Internet website: http://www.north-slope.org/assets/images/uploads/Subsistence%20Harvest%20Doc%20Report_Nuiqsut_94-95.pdf.

Brower, Harry K., Thomas P. Olemaun, and Taqulik Hepa. 2000. North Slope Borough Subsistence Harvest Documentation Project: Data for Kaktovik, Alaska for the Period December 1, 1994, to November 30, 1995. Department of Wildlife Management, North Slope Borough. Barrow, Alaska.

Brown, Caroline L., Nicole M. Braem, Elizabeth H. Mikow, Alida Trainor, Lisa J. Slayton, David M. Runfola, Hiroko Ikuta, et al. 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. Internet website: 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.

Caulfield, Richard A. 1983. Subsistence Land Use in Upper Yukon-Porcupine Communities, Alaska = Dinjii Nats'aa Nan Kak Adagwaandaii. Technical Paper No. 16. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Internet website: http://www.adfg.alaska.gov/techpap/tp016.pdf.

Coffing, Michael, and Sverre Pedersen. 1985. Caribou Hunting: Land Use Dimensions, Harvest Level and Selected Aspects of the Hunt During Regulatory Year 1983-84 in Kaktovik, Alaska. Technical paper No. 120. Alaska Dept. of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Internet websites: http://www.arlis.org/docs/vol1/A/17347115.pdf and http://www.subsistence.adfg.state.ak.us/TechPap/tp120.pdf.

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. Internet website: 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. Internet website: http://www.north-slope.org/assets/images/uploads/Master%20Report%20(Fuller-George%2099).pdf.

Galginaitis, Michael. 2014. Monitoring Cross Island Whaling Activities, Beaufort Sea, Alaska, 2008-2012 Final Report, Incorporating Animida and Canimida (2001-2007). OCS Study BOEM 2013-218. U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Internet website: http://www.arlis.org/docs/vol1/BOEM/CrossIsland/FinalReport2008-12/index.html.

George, J., M. Philo, R. Suydam, G. Carroll, and T. Albert. n.d. Chapter 3: “Body mass of bowhead whales (*Balaena mysticetu*s) of the Bering Chukchi Beaufort seals.” Formatted for *Journal Arctic*.

Harcharek, Qaiyaan, Carla Sims Kayotuk, J. Craig George, and M. Pederson. 2018. Qaaktuġvik, “Kaktovik” Subsistence Harvest Report (2007–2012). Technical Report. North Slope Borough, Subsistence Harvest Documentation Project. Department of Wildlife Management. Barrow, Alaska.

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.

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*, pp. 151-161. Anchorage: U.S. Department of the Interior, National Petroleum Reserve in Alaska.

Pedersen, S. 1995a. "Kaktovik." 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.

_____. 1995b. "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, Sverre. 1990. Caribou Hunting: Land Use Dimensions of Harvest Level, and Selected Aspects of the Hunt During Regulatory Year 1987-88 in Kaktovik, Alaska. Technical Paper 172. Division of Subsistence, Alaska Department of Fish and Game, Anchorage.

Pedersen, Sverre, and M. Coffing. 1984. Caribou Hunting: Land Use Dimensions and Recent Harvest Patterns in Kaktovik, Northeast Alaska. Technical Paper No. 92. Division of Subsistence, Alaska Department of Fish and Game, Anchorage.

Pedersen, Sverre, Terry L. Haynes, and R. J. Wolfe. 1991. Historic and Current Use of Musk Ox by North Slope Residents, with Specific Reference to Kaktovik, Alaska. Technical Paper No. 206. Division of Subsistence, Alaska Department of Fish and Game, Anchorage.

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.

Porcupine Caribou Management Board. 2010. Harvest Management Plan for the Porcupine Caribou Herd in Canada. First Nation of Nacho Nyak Dun, Gwich'in Tribal Council, Tr'ondek Hwech'in, Vuntut Gwich'in Government, Government of the Northwest Territories, Government of Yukon, and Government of Canada. March 2010. Internet website: Http://Www.Pcmb.Ca/Pdf/General/Plan/Harvest%20management%20plan%202010.Pdf.

_____. 2018. Total Annual Harvest Summary of Porcupine Caribou as Reported at Annual Harvest Meetings of the Porcupine Caribou Management Board, Six Years.

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

_____. 2012. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Three Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2013. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 4 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2014. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 5 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 2015. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 6 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska.

_____. 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.

_____. 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) 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. Internet website: http://www.north-slope.org/assets/images/uploads/Braund_North_Slope_Subsistence_Study_Barrow_1987,_1988,_1989_MMS_91-0086.pdf.

Stevens, Carrie, and Bryan Karonhiakta'tie Maracle. n.d. Subsistence Harvest of Land Mammals, Yukon Flats, Alaska: March 2010-February 2011. Council of Athabascan Tribal Governments.

Van Lanen, James M., Carrie Stevens, C. Brown, Bryan Karonhiakta'tie Maracle, and D. Koster. 2012. Subsistence and Mammal Harvests and Uses, Yukon Flats, Alaska: 2008-2010 Harvest Report and Ethnographic Update. Alaska Department of Fish and Game, Division of Subsistence. Anchorage.

Appendix N
Environmental Justice

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Appendix N. Environmental Justice

Table N-1
Low-Income Populations of Kaktovik, Nuiqsut, Arctic Village, and Venetie, Compared with the North Slope Borough (NSB) and the State of Alaska: 2016

Demographic/Income Characteristic	Kaktovik	Nuiqsut	Arctic Village	Venetie	NSB	State of Alaska
Total population*	262	446	192	181	9,606	747,894
Persons employed	62	130	37	39	5,393	353,954
Unemployment rate (percent)	18.4	19.8	35.1	29.1	10.0	7.8
Per capita income	$21,925	$24,312	$15,253	$12,695	$49,982	$34,191
Median household income	$53,750	$84,464	$25,000	$27,813	$72,027	$74,444
Median family income	$66,250	$74,750	$28,750	$24,583	$77,330	$87,365
Percent low-income**	3.8	6.4	46.7	53.2	11.2	10.1

Source: U.S. Census Bureau 2016

"ACS 2012-2016 5-Year, DP03" unless otherwise noted.
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_DP03&prodType=table

*Total population figures shown for the individual communities are 2017 Alaska Department of Commerce, Community, and Economic Development Certified Population figures (https://dcra-cdo-dcced.opendata.arcgis.com/); NSB and Alaska population census estimates for 2016.
** Defined as those persons living below the poverty threshold.

Table N-2
Minority Populations of Kaktovik, Nuiqsut, Arctic Village, and Venetie, Compared with the NSB and the State of Alaska: 2010

Demographic Characteristic		Kaktovik		Nuiqsut		Arctic Village		Venetie		NSB		State of Alaska	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Race	White	24	10.0	40	10.0	7	4.6	3	1.8	3,059	32.4	455,320	64.1
	Black	0	0.0	1	0.2	0	0.0	0	0.0	91	1.0	21,949	3.1
	American Indian/Alaska Native	212	88.7	350	87.1	135	88.8	152	91.6	5,046	53.5	102,556	14.4
	Asian	0	0.0	0	0.0	0	0.0	1	0.6	414	4.4	37,459	5.3
	Pacific Islander	0	0.0	0	0.0	0	0.0	0	0.0	103	1.1	7,219	1.0
	Other	0	0.0	0	0.0	0	0.0	0	0.0	7	0.1	1,111	0.2
	Two or more races	3	1.3	11	2.7	10	6.6	10	6.0	461	4.9	45,368	6.4
Ethnicity	Hispanic or Latino	0	0.0	0	0.0	0	0.0	3	1.8	249	2.6	39,249	5.5
	Non-Hispanic or Latino	239	100.0	402	100.0	152	100.0	163	98.2	9,181	97.4	670,982	94.5
Minority status	Total minority population	215	90.0	362	90.0	145	95.4	163	98.2	6,371	67.6	254,911	35.9
	Total non-minority population	24	10.0	40	10.0	7	4.6	3	1.8	3,059	32.4	455,320	64.1
Total Population		**239**	**100.0**	**402**	**100.0**	**152**	**100.0**	**166**	**100.0**	**9,430**	**100.0**	**710,231**	**100.0**

Source: U.S. Census Bureau 2010
American Fact Finder.https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_P2&prodType=table; 2010 Census Redistricting Data (Public Law 94-171) Summary File: Hispanic or Latino, and Not Hispanic or Latino by Race.

N.1 References

U.S. Census Bureau. 2010. American Fact Finder. Internet website: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_P2&prodType=table.

_____. 2016. American Community Survey 2012-2016 5-Year, DP03. Internet website: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_DP03&prodType=table.

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Appendix O

Economy

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Appendix O. Economy

Table O-1
Populations of the Potentially Affected Communities and Areas, 2010 to 2017

Area	2010	2011	2012	2013	2014	2015	2016	2017	Percent Change
Communities									
Anaktuvuk Pass	324	323	343	358	325	357	355	355	10
Atqasuk	233	243	234	248	230	243	221	224	-4
Utqiaġvik	4,212	4,314	4,434	4,504	4,481	4,548	4,468	4,474	6
Kaktovik	239	247	244	262	251	243	244	234	-2
Nuiqsut	402	426	427	452	446	450	470	482	20
Point Hope	674	668	667	683	654	680	672	677	0
Point Lay	189	183	196	215	190	211	213	232	23
Wainwright	556	570	564	541	554	554	557	570	3
Venetie	166	186	180	197	187	189	192	181	9
Arctic Village	152	167	177	175	194	180	180	192	26
North Slope Borough	9,430	9,575	9,710	9,864	9,732	9,887	9,801	9,849	4
Alaska	710,231	722,388	731,042	735,776	736,906	737,467	739,709	737,080	4

Source: Alaska Department of Labor and Workforce Development (ADOLWD) 2018a

Table O-2
Employment and Total Wages in Potentially Affected Communities and Areas

Area	Residents Employed		Employment Sector			Total Wages
	#	%	Private	Local	State	$ Millions
Kaktovik	125	71	41	84	0	4.96
Anaktuvuk Pass	150	68	35	115	0	4.08
Atqasuk	112	76	19	93	0	3.54
Nuiqsut	193	75	73	120	0	5.92
Point Hope	301	67	117	183	1	8.02
Point Lay	106	77	15	91	0	3.48
Wainwright	219	63	72	147	0	6.66
Utqiagvik	2,044	71	875	1,155	14	111.01
Arctic Village	87	78	14	70	3	1.30
Venetie	103	57	23	80	0	1.64
North Slope Borough	3,261	71	1,258	1,988	15	148.49
Alaska	304,556	60	236,086	44,613	23,857	13,094.18

Source: ADOLWD 2018b

Table O-3
Kaktovik Resident Employment by Industry and Worker Characteristics, 2016

Industry	Number of Workers	Percent of Total Employed	Female	Male	Age 45 and Over	Age 50 and Over
Natural Resources and Mining	1	0.8	0	1	0	0
Construction	15	12.0	0	15	5	4
Trade, Transportation and Utilities	3	2.4	0	3	1	1
Financial Activities	13	10.4	5	8	7	5
Professional and Business Services	3	2.4	1	2	3	1
Leisure and Hospitality	4	3.2	4	0	2	2
Local Government	84	67.2	47	37	34	26
Other	2	1.6	0	2	0	0

Source: ADOLWD 2018c

Table O-4
City of Kaktovik Fiscal Year 2018 Budget

Source of Revenues	Amount
Locally Generated Revenues	**$1,117,380**
Tax Revenues	$48,000
Service Charges	$22,210
Enterprise Revenues	$840,759
Rentals	$45,000
Leases	$126,411
Sales	$27,000
Other Local Revenues	$8,000
State of Alaska Revenues	**$69,066**
Other Outside Revenues	**$277,457**
Total Operating Revenues	**$1,463,904**

Uses of Funds (Expenditures)	Amount
Administration and Finance	$302,777
Council	$13,111
Pull Tabs	$644,517
Bingo	$162,028
Recreation	$34,014
ASRC Summer Youth Program	$10,000
Others	$297,457
Total Operating Expenditures	**$1,463,903**

Source: Alaska Department of Commerce, Community, and Economic Development (ADCCED 2018)

Table O-5
North Slope Borough Resident Employment by Industry, 2016

Industry	Number of Employees	Percent Employment
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**	**100.0**

Source: ADOLWD 2018b

O.1 REFERENCES

ADCCED (Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs). 2018. Financial Documents Delivery System. City of Kaktovik Fiscal Year 2018 Budget Document. Internet website: https://www.commerce.alaska.gov/dcra/DCRARepoExt/RepoPubs/FinDocs/KaktovikFY2018Budget.pdf.

ADOLWD (Alaska Department of Labor and Workforce Development, Research and Analysis Division). 2018a. Population estimates, Cities and Census Designated Places, 2010 to 2017. Internet website: http://live.laborstats.alaska.gov/pop/index.cfm.

_____. 2018b. Alaska Labor and Regional Information (ALARI), employment and total wages information. Internet website: http://live.laborstats.alaska.gov/alari/.

_____. 2018c. Alaska Labor and Regional Information (ALARI), Kaktovik resident employment by sector and worker characteristics. Internet website: http://live.laborstats.alaska.gov/alari/details.cfm?yr=2016&dst=04&r=4&b=19&p=147.

Appendix P

Essential Fish Habitat

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Appendix P. Essential Fish Habitat

P.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 (Magnuson-Stevens Act, Public Law 94-265), one of the added management measures of the Sustainable Fisheries Act is to describe, identify, and minimize adverse effects to essential fish habitat (EFH). Definitions and rules involving EFH are presented in 50 CFR Part 600. For this EIS, the applicable definitions and rules regarding EFH from the Magnuson-Stevens Act are as follows:

Essential fish habitat 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 National Marine Fisheries Service 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, 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.

P.2 Essential Fish Habitat in the Coastal Plain Program Area

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; NPFMC 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 five species for which EFH is currently designated in freshwater, estuarine, and/or marine waters in or near the Coastal Plain are pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*O. keta*), arctic cod (*Boregogadus saida*), saffron cod (*Eleginus gracilis*), and snow crab (*Chionoecetes opilio*).

P.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% 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). 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 Arctic Refuge 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 two salmon species that have been recorded in Coastal Plain streams have anadromous life histories that are described in general terms in **Table P-1**. More detailed life-history information can be found in Meckelenburg et al. (2002) and Quinn (2005).

In general, Pacific salmon have a difficult time establishing sustainable spawning populations in the Arctic because of marginal freshwater conditions, including low water temperatures (Craig 1989; Fechhelm and Griffiths 2001; Irvine et al. 2009). It is noteworthy that the two Pacific salmon species that appear to have established spawning populations on the North Slope of Alaska are those that spend very little time as

Table P-1
Life History Characteristics for Pink and Chum Salmon

Species	Spawning Habitat	Migration to Sea from Spawning Habitat	Time at Sea Before Maturity
Pink salmon	Freshwater or intertidal zone	Immediately	18 months
Chum salmon	Freshwater	Immediately	3 to 5 years

juveniles in freshwater before migrating to saltwater; this trait along with the greater tolerance of colder water by the two species may have allowed pink and chum salmon to successfully colonize Arctic streams (Craig and Haldorson 1986). It is unknown how many sustainable spawning populations (versus runs of strays) of pink and chum salmon occur on the North Slope of Alaska, but the two species are commonly recorded, though typically in low numbers, in the Beaufort Sea (Craig and Haldorson 1986; Fechhelm and Griffiths 2001).

The freshwater streams in which pink and chum salmon have been recorded on the Coastal Plain, and for which EFH has been designated, are listed in **Table P-2**. In all cases, only adult salmon have been recorded as present in these water bodies. The segments of the streams in which EFH for pink and chum salmon has been designated are illustrated on **Map 3-19** in **Appendix A**. The three streams in which these salmon species occur (Canning River, West Canning River, and Staines River) are all on the far western edge of the Coastal Plain).

Table P-2
River Systems in the Coastal Plain Program Area with Designated EFH Based on the Anadromous Waters Catalog

River System	Anadromous Waters Catalog Code	Salmon Species Recorded
Canning River	330-00-10210	pink (present), chum (present)
West Canning River	330-00-10220	pink (present)
Staines River	330-00-10230	pink (present)

Source: Johnson and Blossom (2017)

P.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 (sea bed) and pelagic (open water) habitats. Fish mature from 2 to 3 years of age, spawning occurs only once in a lifetime, and the maximum age spans a narrow range of 6 to 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 in and adjacent to the Coastal Plain is illustrated on **Map 3-19** in **Appendix A**.

P.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 to 3 years of age, after which they spawn once a year; adults live to be 10 to 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 m) shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel." (NPFMC 2009, p. 81).

P.2.4 Snow Crab

Snow crabs are found in sea bed habitats in Arctic nearshore waters where the substrate is composed predominantly of mud (NPFMC 2009). The distribution of snow crab in Arctic waters off Alaska has been updated with new information indicating the species occurs in nearshore waters of the Chukchi and Beaufort seas east to the Canadian border (Simpson et al. 2017; NMFS 2019). The current extent of EFH for snow crab in nearshore waters adjacent to the Coastal Plain has been described for eggs, late juveniles, and adults. The spatial extent of EFH for snow crab in waters adjacent to the Coastal Plain is illustrated on **Map P-1**.

P.3 PROPOSED ACTION

Federal legislation (PL 115-97) was passed in December 2017, lifting the prohibition on oil and gas development imposed by Section 1003 of ANILCA and requiring the BLM to implement an oil and gas leasing program on the Coastal Plain of the Arctic Refuge. To assess the effects of an oil and gas leasing program on the Coastal Plain, the BLM must evaluate the potential impacts of likely subsequent oil and gas development activities on biological resources through the NEPA process (this Leasing EIS). Post-leasing activities could include seismic exploration, ice road construction and drilling exploration, gravel road and pad development, transportation of building modules in nearshore waters, and the construction of pipelines to transport oil and gas in and from the Coastal Plain.

As part of the process of assessing impacts on biological resources, the BLM must also consider the potential impacts of post-leasing activities on designated EFH in the Coastal Plain program area. As part of any leases granted, the BLM will require adherence to oil and gas leasing stipulations and required operation procedures developed specifically for the Coastal Plain, and will also require special protections for specific habitats and resources (see Section P.5 below). Post-leasing, the BLM will provide an opportunity, subject to appropriate conditions developed through a future NEPA process, to construct necessary infrastructure, primarily expected to be pipelines and roads, to bring oil and gas resources from leases in the Coastal Plain to the Trans-Alaska Pipeline System.

P.4 Potential Adverse Effects on EFH

The potential adverse effects on EFH from post-leasing oil and gas exploration and development activities in the Coastal Plain program area would be the same as those described for other fish habitats in Chapter section 3.3.2, Fish and Aquatic Species. Impacts to offshore marine EFH would be negligible as only infrequent shipping traffic is likely to occur to support onshore development activities; however, a seawater treatment plant, if constructed in nearshore waters, has the potential to adversely affect marine EFH by covering seabed habitats and disrupting the movements of marine and anadromous fish.

Other potential effects on nearshore and estuarine EFH could involve disturbance to saline and brackish water and seabed habitats as a result of the delivery of building modules by barge, the construction of a barge dock, and the possible construction of a seawater treatment plant and piping in marine habitats. Potential effects on freshwater EFH from seismic and drilling exploration activities could include noise and vibration effects on fish eggs and juvenile and adult fish. Effects from ice road construction, gravel mining, and gravel road and pad construction could include direct habitat loss and/or alteration; changes in water quality (e.g., increased turbidity and sedimentation); changes in water volume (e.g., water withdrawals for ice roads); physical alterations in flow patterns and riverine/lacustrine geomorphology; point and non-point source pollution (e.g., sheet flow of contaminated road dust or contaminant spills); and barriers to fish movements.

The primary differences among the EIS action alternatives with respect to potential impacts on EFH are the variable setback distances from water bodies required for infrastructure development under each alternative (except as required by PL 115-97 for road and pipeline crossings,and noting that gravel mines could be permitted in setback areas). For example, the required setback distances for the construction of infrastructure from water bodies increase from Alternative B (the least restrictive) to Alternative C (moderate restrictions) and Alternatives D1 and D2 (the most restrictive).

Specific streams known to be important for anadromous fish, such as the Canning River, are also afforded increasing infrastructure setback distances along the continuum between Alternatives B, C, and D1/D2. Similarly, there are no setback distances from the coast for infrastructure development under Alternative B, but increasing setback distances from the coast are required under Alternatives C and D1/D2 (with exceptions for barge landings, barge docks, and pipelines). Alternatives D1 and D2 also includes setback distances from known springs (which are important for overwintering fish) and aufeis areas that would help protect fish habitats. Largely because of these setback distances, the greatest risk for impacts to EFH in the Coastal Plain program area would occur under Alternative B, with less risk for Alternative C, and the least risk for Alternatives D1 and D2.

P.5 Proposed Mitigation Measures

A set of specific lease stipulations and required operating procedures (ROPs) prepared for this EIS would mitigate the potential impacts on EFH from post-leasing oil and gas development activities. Proper implementation of these protective measures should ensure that impacts to EFH in the Coastal Plain program area are avoided or minimized. The following list of lease stipulations and ROPs summarizes the mitigation measures that apply to fish habitats; details for each measure can be found in **Table 2-2**, in Chapter 2, Alternatives. 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).

- **Lease Stipulation 1—Rivers and Streams:** (No Surface Occupancy) Permanent oil and gas facilities including gravel pads, roads, airstrips, and pipelines are prohibited in the streambed, and variable setback distances from stream banks are required for the construction of those facilities (except as required by PL 115-97 for essential road and pipeline crossings, and noting that gravel mines could be permitted in setback areas). Setback distances increase for specific streams and rivers and are smallest under Alternative B, intermediate for Alternative C, and largest under Alternative D.

- **Lease Stipulation 2—Canning River Delta and Lakes:** (No Surface Occupancy) Permanent oil and gas facilities including gravel pads, roads, airstrips, and pipelines are prohibited within 0.5 mile of any water body in the delta areas of the Canning and Tamyariak rivers (except as required by PL 115-97 for essential road and pipeline crossings, and noting that gravel mines could be permitted in setback areas). Applies only to Alternative D.
- **Lease Stipulation 3—Spring/Aufeis:** Before drilling, the operator is required to conduct studies to ensure drilling will not disrupt flow to or from perennial springs and that waste injection wells will not contaminate any perennial springs. For Alternatives D1 and D2, selected springs and aufeis areas would not be offered for lease sale or would be protected with infrastructure setback distances; setback distances are greater under Alternative D2.
- **Lease Stipulation 4—Nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic Refuge:** (No Surface Occupancy) Exploratory well drill pads, production well drill pads, or a Central Processing Facility for oil or gas would not be permitted in coastal waters, lagoons, or barrier islands within the boundaries of the Coastal Plain. On a case-by-case basis, barge landings, docks, spill response staging and storage areas, and pipelines may be permitted. All open water activities in these coastal areas will be coordinated and timed to avoid impacts to wildlife and fish populations.
- **Lease Stipulation 9—Coastal Area:** Before beginning exploration or development within 2 miles inland of the coast, the lessee/operator/contractor is required to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on coastal habitats and the use of those habitats by wildlife and people. For Alternatives C and D, additional No Surface Occupancy restrictions apply: exploratory well drill pads, production well drill pads, or a Central Processing Facility would not be permitted within 1 mile (Alternative C) or 2 miles (Alternative D) inland of the coast. On a case-by-case basis, barge landings, docks, spill response staging and storage areas, and pipelines may be permitted.
- **Required Operating Procedure 1—**Areas of operation would be left clean of all debris (which could eventually reside in low-lying streambeds and lake basins). All solid waste and garbage would be disposed of in accordance with applicable federal, State, and local laws and regulations.
- **Required Operating Procedure 2—**The lessee/operator/contractor would prepare and implement a comprehensive waste management plan for all phases of exploration, development, and production, including seismic activities.
- **Required Operating Procedure 3—**Refueling equipment within 100 feet of the active floodplain of any water body is prohibited (Alternatives B and C). The refueling buffer distance is increased to 500 feet under Alternative D.
- **Required Operating Procedure 7—**A lessee/operator/contractor proposing a permanent oil and gas development would be required to design and implement a monitoring study of contaminants in locally used subsistence foods.
- **Required Operating Procedure 8—**Withdrawal of unfrozen water from springs, rivers, and streams during winter (onset of freeze-up to break-up) is prohibited. The removal of ice aggregate from grounded areas 4 feet deep or less may be authorized from rivers on a site-specific basis.

- **Required Operating Procedure 9—**Withdrawal of unfrozen water from lakes and the removal of ice aggregate from grounded areas 4 feet deep or less during winter (onset of freeze-up to break-up) and withdrawal of water from lakes during the summer may be authorized on a site-specific basis, depending on water volume and depth, the fish community, and connectivity to other lakes or streams and adjacent bird nesting sites. For Alternative D, additional modeling and monitoring of lake recharge may be required to ensure natural hydrologic regime, water quality, and aquatic habitat for birds (and fish).
- **Required Operating Procedure 11—**Protects stream banks and freshwater sources, minimizes soil compaction and the breakage, abrasion, compaction, or displacement of vegetation. During winter tundra travel, ice road construction, and seismic work, detailed procedures would be followed to minimize damage to stream banks and freshwater sources, and minimize soil compaction and damage to of vegetation. Slightly more stringent measures would be implemented under Alternative D.
- **Required Operating Procedure 12—**Maintains spring breakup runoff patterns and fish passage, minimizes flooding from infrastructure, prevents streambed sedimentation and scour, and protects stream banks and water quality. Waterways would be crossed using a low-angle approach. Crossings that are reinforced with additional snow or ice (bridges) would be removed, breached, or slotted before spring breakup. Ramps and bridges would be substantially free of soil and debris.
- **Required Operating Procedure 13—**Avoids additional freeze-down of aquatic habitat harboring overwintering fish and their aquatic invertebrate prey. Travel along streambeds is prohibited unless it can be demonstrated that there would be no additional impacts from such travel on overwintering fish, aquatic invertebrates, and water quality. Rivers, streams, and lakes would be crossed at areas of grounded ice or with the approval of the BLM (when it has been demonstrated that no additional impacts would occur on fish or aquatic invertebrates).
- **Required Operating Procedure 14—**When conducting vibroseis-based surveys above potential fish overwintering areas, lessees/operators/contractors would follow the recommendations of Morris and Winters (2005) to minimize impacts on fish. Only a single set of vibroseis shots would be conducted, if possible; if multiple shot locations are required, these would be conducted with minimal delay; multiple days of vibroseis activity above the same overwintering area would be avoided, if possible.
- **Required Operating Procedure 16—**Exploratory drilling is prohibited in fish-bearing rivers and streams and other fish-bearing water bodies to maintain water quality and minimize alteration of riparian habitat. On a case-by-case basis, the BLM may consider exploratory drilling in floodplains of fish-bearing rivers and streams.
- **Required Operating Procedure 17—**To minimize surface impacts, construction of gravel roads would be prohibited for exploratory drilling. Use of a previously constructed road or pad may be permitted if it is environmentally preferred.
- **Required Operating Procedure 18—**All roads must be designed, constructed, maintained, and operated to create minimal environmental impacts and to avoid or minimize impacts on subsistence use and access to subsistence hunting and fishing areas.
- **Required Operating Procedure 19—**Water quality and the diversity of fish, aquatic invertebrates, and wildlife populations and habitats would be protected by restricting oilfield infrastructure within 500 feet of fish-bearing water bodies (unless further setbacks are stipulated under Lease Stipulations 1, 2, or 3); pipeline and road crossings would be permitted in accordance with PL 115-97. Temporary winter exploration and construction camps are prohibited on frozen lakes and river ice, but are allowed and encouraged on river sand and gravel bars.

- **Required Operating Procedure 20—**Causeways and docks are prohibited in river mouths and deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths and active stream channels on river deltas. All these infrastructure features would be designed to ensure free passage of marine and anadromous fish and to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics.
- **Required Operating Procedure 21—**A detailed set of measures would be implemented to ensure that oilfield facilities are designed and located to minimize the development footprint and impacts on other purposes of the Arctic Refuge.
- **Required Operating Procedure 22—**A detailed set of measures would be used to reduce the potential for ice-jam flooding, damage from aufeis, impacts on wetlands and floodplains, erosion, alteration of natural drainage patterns, and restrictions of fish passage. These measures include the preference for single-span bridges over culverts and the use of Best Management Practices developed by the U.S. Fish and Wildlife Service and U.S. Forest Service (McDonald & Associates 1994; USFS 2008) to facilitate fish passage at road crossings of streams.
- **Required Operating Procedure 24—**Gravel mine site design and reclamation would be done in accordance with a plan approved by the BLM to minimize the impact of mineral-materials mining on air, land, water, fish, and wildlife resources. Whenever possible, gravel mining would occur outside of active riverine floodplains.
- **Required Operating Procedure 35—**Before final abandonment, land used for oil and gas infrastructure—including well pads, production facilities, access roads, and airstrips—would be reclaimed to ensure eventual restoration of ecosystem function. The leaseholder would be required to develop and implement a BLM-approved abandonment and reclamation plan.
- **Required Operating Procedure 41—**On a case-by-case basis, the BLM, in consultation with the USFWS, may permit low-ground-pressure vehicles to travel off gravel pads and roads during summer (winter tundra travel is covered under ROP 11). Permission for such use would be granted only after the vehicles to be used can be shown to have minimal impacts on soils and vegetation.
- **Required Operating Procedure 43—**Prevents the introduction or spread of nonnative, invasive species in the Coastal Plain. All equipment and vehicles (including helicopters, planes, boats, and barges) intended for use either off or on roads must be certified to be free of nonnative invasive species before transiting into the Coastal Plain.
- **Required Operating Procedure 45—**Minimizes the loss of individuals and habitat for mammalian, avian, fish, and invertebrate species designated as sensitive by the BLM in Alaska. If a development is proposed in an area that provides potential habitat for BLM sensitive species, the proponent would conduct surveys at appropriate times of the year and in appropriate habitats to detect the presence of BLM sensitive species. The survey results would be submitted to the BLM with the application for development.

P.6 ESSENTIAL FISH HABITAT 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 Lease Stipulations 4 and 9, and ROP 20, which substantially restrict and/or mitigate oil and gas activities in those marine waters. The possible construction of a seawater treatment plant in nearshore waters, with the potential to inhibit the movement of marine and anadromous fish, would be mitigated specifically by ROP 20.

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 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 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 program area is assigned the EFH assessment determination: May affect, not likely to adversely affect.

P.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, Alaska.

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 US 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, Alaska.

Fechhelm, R. G., and W. B. Griffiths. 2001. Status of Pacific salmon in the Beaufort Sea, 2001. LGL Alaska Research Associates, Inc., Anchorage, Alaska.

Frost, K J. 1984. "Trophic relationships of vertebrate consumers in the Alaskan Beaufort Sea." Pp. 381–401 *in* P. W. Barnes, D. M. Schell, and E. Reimnitz, editors. *The Alaskan Beaufort Sea. Ecosystem and Environments*. Academic Press, London, United Kingdom.

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, Alaska. 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., M. P. Eagleton, and J. L. Hanson. 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.

Logerwell, E., M. Busby, C. Carothers, S. Cotton, J. Duffy-Anderson, E. Farley, P. Goddard, R. Heintz, B. Holladay, J. Horne, 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.

McDonald, G. N., & Associates. 1994. Stream Crossing Design Procedure for Fish Streams on the North Slope Coastal Plain. Prepared by G. N. McDonald & Associates for BP Exploration (Alaska) Inc., Anchorage, and Alaska Department of Environmental Conservation, Juneau.

Mecklenburg, C. W., T. A. Mecklenburg, and L. K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland.

Morris, W., and J. Winters. 2005. Fish Behavioral and Physical Responses to Vibroseis Noise, Prudhoe Bay, Alaska 2003. Alaska Department of Fish and Game Technical Report 05-02. March 2005.

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. 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, Alaska.

_____. 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, Alaska.

_____. 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, Alaska.

Quinn, T. P. 2005. "The behavior and ecology of Pacific salmon and trout." American Fisheries Society, Bethesda, Maryland, and University of Washington Press, Seattle, Washington.

Simpson, S. C., M. P. Eagleton, J. V. Olson, G. A. Harrington, and S. R. Kelly. 2017. Final Essential Fish Habitat (EFH) 5-Year Review, Summary Report: 2010 through 2015. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/AKR-15.

USFS (U.S. Forest Service). 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings. U.S. Department of Agriculture, Forest Service National Technology and Development Program. 7700—Transportation Management 0877 1801—SDTDC. San Dimas, California.

Appendix Q

Analysis of Incomplete and Unavailable Information

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Appendix Q. Analysis of Incomplete and Unavailable Information

In accordance with CEQ NEPA regulation 40 CFR 1502.22 (stated below), **Appendix Q** provides an analysis of incomplete and unavailable information identified in agency resource assessments developed for the Coastal Plain Oil and Gas Leasing Program and in agency and public comments submitted on the Draft Leasing EIS. Although the resource assessments and comments are replete with discussion on the strengths and weaknesses of available scientific data, BLM analysts were generally able in the Leasing EIS to complete thorough analyses of potential impacts from Coastal Plain oil and gas leasing and to draw informed conclusions from the information available. The following analysis comprehensively addresses each item of incomplete or unavailable information identified in resource-specific assessments developed by the USFWS and the BLM for the Coastal Plain Oil and Gas Leasing Program as a whole, and in the agency and public comments specific to the Draft Leasing EIS.

Q.1 BACKGROUND

Following passage of the Tax Cuts and Jobs Act of 2017 (PL 115-97) and prior to the BLM's issuance of a Notice of Intent to prepare the Leasing EIS, the USFWS, the BLM, and other federal and state agencies organized to evaluate the possible types of decisions that might need to be made to successfully implement an oil and gas program in the Coastal Plain. A resource expert from USFWS or the BLM led the development of each of eighteen resource- and use-specific "Rapid Response Resource Assessments" that identified: i) regulatory- or management-related decisions that may have to be made in order to implement the Coastal Plain Oil and Gas Program; ii) what scientific information is available to support that decision making; iii) possible knowledge gaps; and iv) recommended studies or actions to fill any knowledge gaps or improve the best available science. These assessments were compiled in a document prepared by the USFWS and the BLM entitled *Rapid Response Resource Assessments and select References for the 1002 Area of the Arctic National Wildlife Refuge in anticipation of an Oil and Gas Exploration, Leasing and Development Program per the Tax Act of 2017 Title II Sec 20001* (Feb. 16, 2018), and address the following resources and uses: acoustic environment; air quality; birds; caribou; coastal resources; contaminants; cultural resources; fish; oil spills; paleontological resources; polar bears; public health; snow and climate; subsistence use; terrestrial mammals other than caribou; vegetation, soils, permafrost and wetlands; visitor use; and water resources.

In its comments on the Draft Leasing EIS submitted on behalf of several environmental and conservation organizations, Trustees for Alaska stated that the Draft EIS failed to comply with NEPA because it purportedly failed to identify and evaluate, pursuant to 40 CFR 1502.22, baseline resource data that is missing or out of date. Their comments stated that before proceeding with the EIS, additional scientific information is required for most of the resources and uses addressed in the agencies' Rapid Response Resource Assessments in order to fully evaluate impacts of oil and gas activities in the Coastal Plain and to develop necessary stipulations or BMPs for leasing or subsequent oil and gas activities. Similarly, in its comments on the Draft Leasing EIS, Public Employees for Environmental Responsibility (PEER) referenced and attached the agencies' Rapid Response Resource Assessments. Other agency and public comments on the Draft Leasing EIS also noted potential knowledge gaps and recommended additional studies.

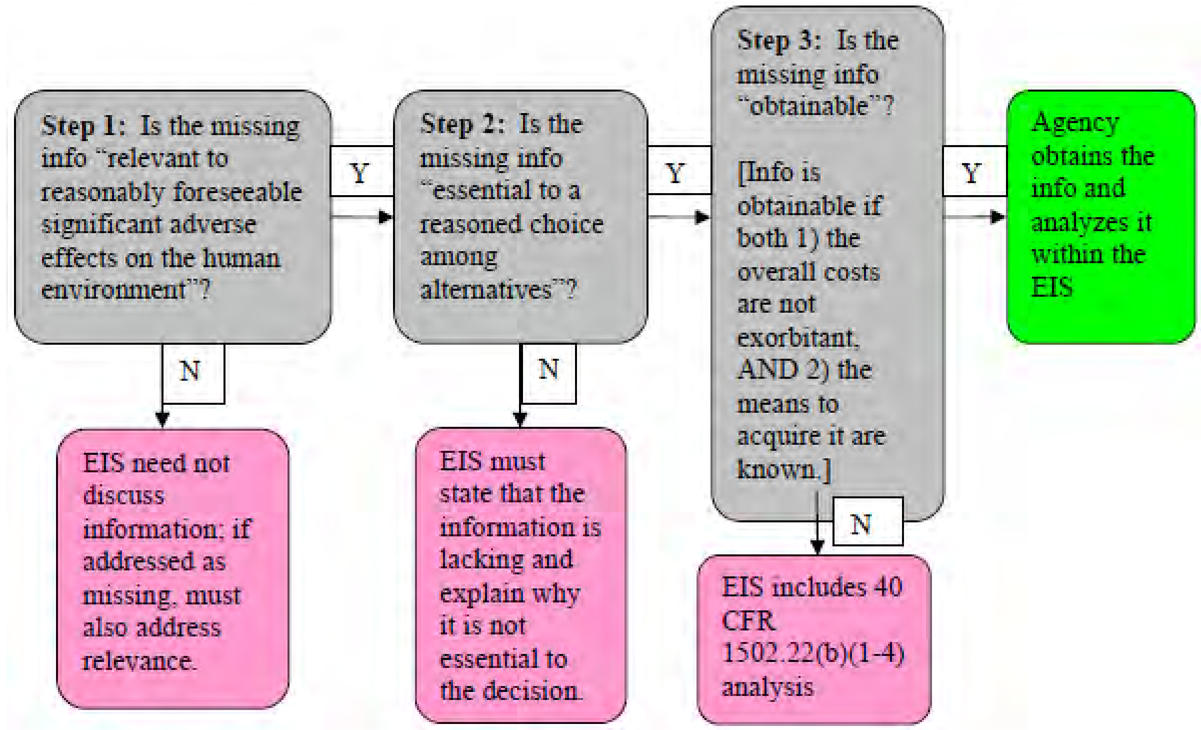
Q.2 METHODOLOGY

This appendix catalogues all potential knowledge gaps and recommended studies identified in the agencies' Rapid Response Resource Assessments and in agency and public comments submitted on the Draft Leasing EIS, providing a structured analysis of those potential knowledge gaps and recommended studies that tracks with the requirements of 40 CFR 1502.22. Each such item of "incomplete or unavailable information" then underwent a robust review process to ensure consistency with 40 CFR 1502.22, the relevant text of which reads:

> **1502.22 Incomplete or unavailable information.**
>
> When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.
>
> (a) If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.
>
> (b) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement: (1) A statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and (4) the agency's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, "reasonably foreseeable" includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason.

A potential knowledge gap or recommended study was considered *relevant* if it could be connected to reasonably foreseeable significant adverse impacts described in the Leasing EIS's resource and use-specific impact evaluations. All relevant potential knowledge gaps and recommended studies identified by agencies and in public comments were then evaluated to determine whether the information was *essential* to a reasoned choice among alternatives. To be essential, the information must provide a means for making a clear distinction between two or more alternatives. Lastly, if missing information was determined to be relevant and essential, the potential means of obtaining the information would be evaluated to determine whether the cost of obtaining the information would be *exorbitant*.

To promote thorough, consistent, and efficient review of the dozens of catalogued potential knowledge gaps and recommended studies, BLM analysts used a structured review approach (illustrated by the figure below). This approach, taken directly from the language of 40 CFR 1502.22, consists of three steps. Each step asks a "Yes" or "No" question, the answer to which determines whether the analysis of the potential knowledge gap and recommended study either progresses to the next step or requires no further review. Where analysts answered "Yes," they simply moved on to the next question. Where analysts answered "No," they recorded the reasoning behind the answer, thus concluding review of that potential knowledge gap and recommended study. The completed analysis for all catalogued statements was then reviewed by supervisory and staff specialists, who confirmed the analysis and determined that it satisfied 40 CFR 1502.22 (and DOI NEPA regulations at 43 CFR 46.125).



Q.3 RESULTS

Some catalogued potential knowledge gaps and recommended studies did not progress to Step 2 of the 1502.22 incomplete and unavailable information analysis, because they were determined to not be relevant to reasonably foreseeable significant adverse effects on the human environment described in the Leasing EIS. Also, no potential knowledge gaps and recommended studies progressed to Step 3 of the analysis, because BLM analysts determined that while many were broadly relevant to the important issues at hand, none were essential for a reasoned choice among alternatives. Step 3 would have required a determination as to "whether the cost of obtaining the missing information is exorbitant, or the means of doing so unknown."

As the statements were analyzed, some common themes became apparent with respect to the catalogued potential knowledge gaps and recommended studies. These included the following:

- **The availability of sufficient information to support sound scientific judgments and reasoned managerial decisions, even without the identified incomplete or unavailable information.** This concept recognizes that while there will always be some level of incomplete scientific information (especially regarding dynamic ecosystems), there is often enough information to formulate and support sound scientific judgments. Scientists frequently agree on larger issues and trends despite the lack of a particular item of information. Also, some information is simply not of a type that would alter scientific judgments or affect decision-making. Additionally, some information simply is not significant or relevant enough to be considered essential to a reasoned decision among alternatives.

- **The presumption that adverse effects would certainly occur under the specific circumstance to which the incomplete information applies.** For instance, it is already presumed that a large oil spill could cause significant adverse impacts on wildlife and other resources, through myriad direct and indirect effects; thus, it is not essential for the decision-maker, who is already made aware of the probability and severity of these potential impacts, to understand every particular mechanism through which these adverse impacts could occur. Additional information specific to how spilled oil may affect caribou foraging, for example, is not required for an understanding of the probability and severity of risks associated with each alternative.
- **The commonality of potential impacts amongst all action alternatives, which lessened the utility of incomplete information to the decision-maker.** For example, in the unlikely event of a large oil spill, it is well-understood that environmental impacts could be severe. The severity of potential impacts would be nearly identical under any action alternative; therefore, very specific types of information relevant to species, particular life history traits, or behavior do not help substantially in distinguishing among alternatives.
- **The existence of other environmental laws and regulations that would preclude significant adverse effects on particular resources.** For example, comprehensive regulatory standards under the Clean Air Act are sufficient to preclude air quality impacts from reaching a level of significance. Incomplete information regarding air quality issues is in this sense less useful to the decision-maker, who is assured that no matter which alternative he or she selects, significant adverse effects on air quality will likely be avoided.
- **The understanding that certain items of presently missing or incomplete information will be known (and utilized to avoid or minimize adverse impacts) at a later stage of the oil and gas program and associated environmental review.** An oil and gas program has various stages, including leasing (the current stage evaluated in the Leasing EIS), geophysical and drilling exploration, development and production, and reclamation. It is inherent in the implementation of an oil and gas program that information such as the specific locations or times of exploration or development activities are unknown at the lease sale stage. Instead, the BLM would thoroughly analyze exploration and development plans when a project proponent would actually submit a plan; thus, while certain information may be essential at a later stage in the implementation of an oil and gas program, such information may not be essential to a reasoned choice among alternatives at this lease sale stage.

The Yes/No responses for each potential knowledge gap or recommended study and the reasoning supporting each “No” response are provided below.

Q.4 1502.22 Analysis

Q.4.1 Climate and Meteorology

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Basic climatological data

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain: Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: There is no data gap; adequate climatological data are provided in the EIS.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Remote sensing information on snow depth

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Remote-sensing information on snow depth across the leasing area may be useful for developers and for agencies overseeing the development process, but such remote sensing information is not needed at this leasing stage, as it is assumed that developers will have to meet any applicable snow depth requirements during seasonal travel and development activities.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Snow density data

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Information on snow density across the leasing area may be useful for developers and for agencies overseeing the development process, but such information is not needed at this leasing stage, as it is assumed that developers will have to meet any applicable snow density or quality requirements during seasonal travel and development activities.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Snow water equivalent data

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Information on snow water equivalent across the leasing area may be useful for developers and for agencies overseeing the development process, but such information is not needed at this leasing stage, as it is assumed that developers will have to meet any applicable snow water equivalent requirements during seasonal travel and development activities.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Discussion of snow cover, depth and wind effects for facilitating tundra travel

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Discussion of snow cover, snow depth and wind effects on facilitating tundra travel is not necessary for NEPA-required decision-making with respect to the leasing stage. Conditions for tundra travel by developers are already imposed on existing and new developments ongoing on the North Slope, and the same conditions would apply to any Coastal Leasing program developments.

Agency/Commenter: Donald Walker, Letter 68

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Snow depth data

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Snow depth information across a given lease will be needed for developers and for agencies overseeing activities during the development process, but such information is not needed at this leasing stage, as it is assumed that developers will have to meet any applicable snow depth requirements during seasonal travel and development activities.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: How do climate trends affect water availability?

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: As described in the EIS, there are no readily apparent trends in annual precipitation amounts over the period of record on the North Slope, and this is true seasonally as well. Therefore, the warming climate trend in this region is not expected to affect water availability. Thus, this question does not relate to an actual data gap.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: In-situ and remote sensing snow data

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Snow depth information across a given lease will be needed for developers and for agencies overseeing activities during the development process. The measurement techniques described by the USFWS may be good candidates for the data collection when needed. However, such information is not needed at this point in the NEPA process, as it is assumed that developers will have to meet any applicable snow depth requirements during seasonal travel and development activities and will have to conduct appropriate monitoring during development.

Agency/Commenter: Faith Martineau, Alaska Dept. of Natural Resources, Letter 94102

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Quantification of methane leaks contribution to CO_2e emissions.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The last sentence in the cited paragraph of the DEIS clearly states that methane leaks would represent an incremental amount of approximately 5 percent of the CO_2e emissions for the low- and high-end production cases summarized in **Table 3-5** in **Chapter 3** of the EIS. Therefore, this is not a data gap.

Agency/Commenter: Richard Sumner, Letter 56477

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Need to quantify magnitude of current and future damage to resources of the Coastal Plain due to climate change and quantify mitigation opportunities for each alternative.

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain:

The comment does not address impacts of leasing and development; it addresses impacts of climate change. The comment presumes that climate change has damaged and will damage the Coastal Plain (presumably natural) resources, which is a value judgment that future conditions would be less desirable than current conditions assuming that climate continues to warm in the region. The BLM cannot measure any current climate change related damages in the Coastal Plain area, and any future damage is speculative and not quantifiable.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Agency/Commenter: Jessica Wentz, Sabin Center for Climate Change Law, Letter 75152

Applicable Resource or Use: Climate and Meteorology

Knowledge gap/recommended study: Need to quantify lifetime GHG emissions of the project.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: No development project is proposed at this time; however, the total lifetime emissions of GHGs for the leasing program are readily apparent in the Draft EIS, which provides an annual CO_2e emissions amount for a stated 70-year production life. Therefore, multiplying the annual emissions by 70 gives the total CO_2e over the assumed production life. In addition, a paragraph has been added to the Final EIS to show the estimated total lifetime (for 70-year production life) incremental CO_2 concentration in the global atmosphere, which is 0.02 ppm compared to the current global average concentration of approximately 410 ppm.

If NO, explain:

Q.4.2 Air Quality

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Air Quality

Knowledge gap/recommended study: A clear project description that details the RFD estimate along with additional high, medium or low projections to characterize the future potential development, is lacking. For each stage (exploration, construction/drilling, production), project descriptions need to include:

- Number, size, and highest probability location of wells
- Number of pads
- Estimates of air emissions
- Number and location of roads
- Specific and auxiliary equipment used
- Supplemental power used (fuel, storage)
- Control technologies used
- Construction activity and equipment used
- Geographic proximity of sensitive resources
- Topography
- Emission magnitude

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: No exploration or development project is proposed at this time. This type of information is not required and in many cases is simply unknown at this leasing stage. While a hypothetical development scenario was developed for the EIS, the location and timing of future development is unknown given the limited amount of exploration that has occurred in the program area. The BLM will thoroughly analyze exploration and development plans, which will include this type of information, when a project proponent submits a plan. Because the same number of wells and production levels are assumed for each action alternative, such information is not essential to a reasoned choice among alternatives at this lease stage.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Air Quality

Knowledge gap/recommended study: Current models must be expanded to include the 1002 area.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Air modeling is speculative and is not essential at the leasing stage. The assumption is that operators would have to comply with Clean Air Act requirements at the exploration and development stages, thereby limiting impacts on air quality. As described in the EIS, the BLM is undertaking the Cumulative Alaska North Slope Air Quality Regional Model to assess the cumulative effects of BLM-authorized oil and gas development throughout the North Slope, including the 1002 area (program area). The first modeling study is expected to be completed in 2020, well before development would begin in the program area. As such, currently planned modeling will include the program area in its modeling domain. In addition, as specific production designs and emission data are available from companies that want to develop the program area, cumulative modeling will address the emissions from this new area as well.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Air Quality

Knowledge gap/recommended study: Air quality modeling is the only way to evaluate how emissions sources will impact air quality aside from direct monitoring, which is only able to measure real-time pollution levels at the location of the monitoring device. The BLM must prepare a modeling analysis of the direct, indirect, and cumulative impacts on air quality that could occur under the various alternatives considered for the leasing DEIS. For each alternative, a comprehensive emissions inventory should be developed and used as input to an air quality dispersion modeling analysis in order to fully assess the impacts on air quality throughout the region from an oil and gas program in the Coastal Plain. The modeling analysis should be based on meteorological input data according to EPA's Guideline on Air Quality Models. See, e.g., Section 8.4 of EPA's Guideline on Air Quality Models at 40 CFR 51, Appendix W.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Air modeling is speculative and is not essential at the leasing stage. The assumption is that operators would have to comply with Clean Air Act requirements at the exploration and development stages, thereby limiting impacts on air quality. Unlike specific development projects, where location, timing, and scope of activities are understood, at this leasing stage such information is absent. These factors are key to performing useful air quality modeling. Given the absence of this information at the leasing stage, such quantitative modeling would not be helpful to a decision-maker in making a reasoned choice among alternatives, especially as the well counts and overall production levels were not anticipated to vary among the alternatives. Emissions inventories and air modeling is required by the BLM as part of site-specific NEPA analyses for development proposals and as part of the state permitting process for oil and gas production facilities.

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Air Quality

Knowledge gap/recommended study: Ambient air quality monitoring in the Arctic 1002 area and downwind (minimum of NAAQS, PM2.5, and Prevention of Significant Deterioration (PSD)) to address cumulative impacts and support accurate modeling is needed.

Kaktovik residents who use the 1002 area for subsistence and other stakeholders will benefit from a long-term NAAQS air quality monitoring station (and potentially HAPS, based on Nuiqsut requests for NPR-A development) within or downwind of the Arctic 1002 area to alleviate concerns regarding air quality impacts on the community from development.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Ambient air quality in the program area is not needed at this leasing stage, as the air quality of the area is known to be good due to the general lack of emissions-generating sources in the Coastal Plain. The BLM agrees that air monitoring, particularly of the Kaktovik area, is an important component of monitoring the effects of development on air quality over time. The BLM is currently developing a contract scope of work to establish a long-term air quality monitoring station in Kaktovik to support air analyses for future oil and gas development in the Coastal Plain and inform BLM decision-making.

Q.4.3 Acoustic Environment

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Acoustic Environment

Knowledge gap/recommended study: Baseline acoustic data for the 1002 Area are completely lacking, with the exception of short-term data collected in the extreme northwest corner of 1002 Area in support of the Point Thomson EIS. Baseline data provide a foundation for long-term monitoring that will be required to support impact mitigation and adaptive management.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Besides occasional aircraft and motorboat traffic, there is no existing commercial or industrial activity on federal lands in the Coastal Plain with a substantial noise signature. Additionally, subsistence use of off-road vehicles is generally limited to non-federal lands in and near Kaktovik. Accordingly, but for occasional subsistence use of snowmachines by Kaktovik residents in the winter, it is reasonably presumed that baseline noise levels throughout the Coastal Plain are similar to those found in other undeveloped natural areas. Additionally, baseline acoustic information is not needed at the leasing stage and can be obtained, if needed, when an application for a specific on-the-ground action is submitted. Until that time, the acoustic baseline will not be disturbed.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Acoustic Environment

Knowledge gap/recommended study: Although some general acoustic information is available, impact assessment and mitigation actions would benefit from specific acoustic information associated with specific development activities that are anticipated or proposed for the program area.

Is the Information/Study Relevant to Potentially Significant Effects? YES.

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes well understood key sources of noise associated with oil and gas development, to include aircraft, ground-based equipment (e.g., drill rigs), and gravel mining operations, as well as their associated noise levels and resulting impacts on relevant resources and uses (e.g., wildlife disturbance, subsistence use). Further site-specific noise analysis will occur when an application for a specific on-the-ground development is submitted, at which time acoustic characteristics of specific development-related noise sources will be better understood and more relevant.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Acoustic Environment

Knowledge gap/recommended study: Spatial noise propagation modeling that specifically applies to anticipated / proposed development activities and specific landscape characteristics and seasonal atmospheric conditions of the 1002 Area is lacking.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Because the hypothetical development scenario represents a level of development and not the actual locations of future project elements, no noise modeling was undertaken. Unlike specific development projects, where location, timing, and scope of activities are understood, at this leasing stage such information is absent. These factors, especially location, are key to performing useful noise propagation modeling. Site-specific noise analysis, which may include noise modeling depending on the scale and location of the proposal, will occur when an application for a specific on-the-ground development is submitted, at which time acoustic characteristics of specific development-related noise sources will be better understood and more relevant.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Acoustic Environment

Knowledge gap/recommended study: Although much general information is available, specific disturbance-response information is needed to quantitatively or qualitatively characterize relationships between noise metrics and response metrics for noise-sensitive resources including wildlife (especially caribou and polar bears), residents and subsistence users, and Arctic Refuge visitors in the Coastal Plain and in adjoining Wilderness. Disturbance of subsistence resources (particularly caribou) and subsistence activities by low-flying aircraft associated with oil and gas development has long been an issue of concern to North Slope residents. concern has increased over time as use of aircraft to support research and monitoring, recreation, oil and gas development, and other activities on the North Slope has increased during the past few decades.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS used the best data available on disturbance-response of human and wildlife receptors that utilize the Coastal Plain. Some of these data have been published in the time since the Rapid Resource Assessments were prepared, including noise-related impacts from aircraft on subsistence users and subsistence resources. These data are adequate at this leasing stage to assess the potential impacts from future project-related development that may be expected to occur under each action alternative given the areas of allowable leasing and the resources in those areas. This information is thus adequate to allow the BLM to make a reasoned choice among leasing alternatives.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Acoustic Environment

Knowledge gap/recommended study: To support impact mitigation and adaptive management, long-term acoustic monitoring should be established early during the phased progression of development activities. Baseline data and long-term monitoring are required for those specific geographic locations and specific time periods where and when anticipated / proposed development activities are expected to coincide with high resource sensitivity. Note that long-term monitoring also is lacking in the BLM-administered NPR-A and the nearby village of Nuiqsut despite public concerns over impacts of aircraft disturbance and development-related noise on village residents, subsistence resources, and subsistence activities. This lack of monitoring information has relevance to the 1002 Area, if BLM Best Management Practice F-1 (BLM 2013) is to be considered for application to future development activities in the 1002 Area..

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Long-term monitoring is not needed to assess the potential for significant effects at this leasing stage. The low levels of background noise are sufficiently understood at this time given that there is no existing commercial or industrial activity on federal lands in the Coastal Plain with a substantial noise signature. Noise analyses will occur at the project level once specific projects have been proposed. Baseline ambient noise information would be gathered at that time to more accurately reflect actual background conditions.

Q.4.4 Geology and Minerals

Agency/Commenter: Sharon Mathe, Letter 69361

Applicable Resource or Use: Geology and Minerals

Knowledge gap/recommended study: Study of underlying faults that could be potential sources of earthquakes triggered by drilling.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Injection of fluids associated with drilling can trigger earthquakes in locations with no previous historic seismicity or known active faults; however, most injection wells are not associated with induced seismicity. A combination of many factors is necessary for fluids injection to induce earthquakes large enough to be felt. In addition to the presence of faults of sufficient size, factors include: the injection rate and volume; stresses that are large enough to produce earthquakes; and the presence of pathways for the fluid pressure to travel from the injection point to faults (USGS 2019: Induced Earthquakes, Myths and Misconceptions. Accessed June 28, 2019 at https://earthquake.usgs.gov/research/induced/myths.php). Furthermore, the specific locations of future injection wells are not known; therefore, even if information regarding faults in the program area were obtained, the potential for induced seismicity to occur would still be unknown and would not be a distinguishing factor among the action alternatives.

Agency/Commenter: Donald Walker, Letter 68

Applicable Resource or Use: Geology and Minerals

Knowledge gap/recommended study: Detailed characterizations of the surficial geomorphology, microtopography, vegetation, snow, and ground ice, which would also serve as the basis for detecting long-term changes from 3D seismic exploration.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Current information regarding surficial geomorphology, microtopography, vegetation, snow, and ground ice in the program area is sufficient for identifying potential impacts of the proposed leasing action. The entire program area could be subject to a 3D seismic survey, regardless of alternative. While detailed information could provide a more defined baseline for evaluating the effects of 3D seismic exploration, it would not be relevant for distinguishing between the action alternatives.

Agency/Commenter: Donald Walker, Letter 68

Applicable Resource or Use: Geology and Minerals

Knowledge gap/recommended study: Data regarding the long-term environmental effects of 3D seismic surveys, which are necessary to understand the resistance and resilience of the various terrain and vegetation types to past and future 3D-seismic disturbance.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The entire program area could be subject to a 3D seismic survey, regardless of alternative; therefore, data regarding the long-term environmental effects of 3D seismic surveys would not be relevant for distinguishing between the alternatives. It is already understood that newer seismic surveys have fewer environmental impacts.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Geology and Minerals

Knowledge gap/recommended study: To predict and manage impacts from new seismic surveys in the program area, we need to know how impacts would be different from the seismic surveys conducted on the North Slope between 1984 and 2001. We particularly need information from current or recent exploration in hillier terrain similar to the program area.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The entire program area could be subject to a 3D seismic survey, regardless of alternative. While more information on the differences in impacts from newer seismic surveys compared to older seismic surveys would be useful, it is not necessary information for making a reasoned choice between the action alternatives. It is already understood that newer seismic surveys have fewer environmental impacts.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Geology and Minerals

Knowledge gap/recommended study: Information on the history and current status of the Alpine Field or another newer field, rather than the older Prudhoe Bay field, as it relates to development beyond the seismic exploration stage.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Appendix B already presents a description of reasonably foreseeable development in the Coastal Plain based on the activities typically associated with oil and gas operations on the North Slope of Alaska, including new fields west of Prudhoe Bay. This description forms the basis for analysis of impacts in the Leasing EIS and is sufficient for making a reasoned choice among the alternatives.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment

Applicable Resource or Use: Geology and Minerals

Knowledge gap/recommended study: Information on the timing and duration of sea ice to understand how it may affect seasonal access.

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: Two types of seasonal access are related to sea ice. Transportation via sea ice road requires sea ice to be present at sufficient thickness, and transport via barge or boat requires an absence of sea ice, i.e., open water. The reasonably foreseeable development scenario does not include use of sea ice roads and assumes an average of only two barge transports per year. Additional knowledge of the timing and duration of sea ice and its effects on seasonal access is not necessary for assessing reasonably significant adverse impacts on the human environment.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Q.4.5 Physiography

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Physiography

Knowledge gap/recommended study: Updated shoreline erosion/change rates.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Current information on shoreline erosion and change rates as described in the EIS is sufficient for identifying coastal erosion as a potential risk to oil and gas development infrastructure placed at or near the shoreline. The reasonably foreseeable development scenario identifies two facilities, a seawater treatment plant and a barge landing, that would be dependent on a coastal location. Rates of coastal erosion vary considerably with location, and specific locations of facilities are not known at the leasing stage; therefore, more precise data on shoreline erosion rates would not change the analysis of reasonably significant potential impacts. Lease Stipulations 4 and 9 include restrictions on facilities within coastal waters, lagoons, and barrier islands that vary by alternative; however, coastal erosion is not a factor in these stipulations and updated information would not help to distinguish between action alternatives.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Physiography

Knowledge gap/recommended study: Need more information on substrates, including ice content/permafrost, sediment composition, grain size, etc. to better understand coastal and barrier island geomorphology. This understanding is important relative to access from offshore ice or waters and to inform erosion modeling.

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: The Leasing EIS did not identify potentially significant adverse effects associated with access of the program area from offshore ice or waters. While coastal geomorphologic features would be a factor in the siting of future coastal facilities, such as a seawater treatment plant or barge landing, specific locations of facilities are not known at the leasing stage; therefore, additional information on substrates is not relevant for assessing reasonably significant adverse effects on the human environment described in the Leasing EIS.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Physiography

Knowledge gap/recommended study: GPS instrumented monuments across the coastal area would provide information on changes in elevation due to subsidence, which is suggested by existing areas of tundra killed by saltwater inundation that have not recovered.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Land subsidence has been identified in the Leasing EIS as a potential risk to oil and gas infrastructure. Specific locations of facilities are not known at the leasing stage; thus, while site-specific information on current subsidence along the coast would be important for the siting of future facilities, such information is not essential to a reasoned choice among the action alternatives at this leasing stage.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Physiography

Knowledge gap/recommended study: A better understanding of barrier islands is needed to understand how they will change in a warmer, ice-free environment.

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: The reasonably foreseeable development scenario does not include facilities on barrier islands and the specific locations of future oil and gas facilities on the coast are not known. While it is recognized that barrier islands provide important protections to coastal areas and could influence the siting of and assessment of potential risks to future coastal dependent oil and gas development facilities, this information is not relevant for distinguishing among the action alternatives.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Q.4.6 Soil Resources

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Soil Resources

Knowledge gap/recommended study: No detailed high-accuracy maps exist for soils, permafrost or wetlands.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such detailed site-specific information is not needed at the leasing stage. The Leasing EIS identifies on a large scale that the typical soil and permafrost conditions in the program area and are adequate for the leasing stage. The hypothetical development scenarios are considered in the analysis for individual resources. Site-specific analysis, including those associated with infrastructure in support of oil and gas development, can be provided when the BLM receives an application to permit such infrastructure.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Soil Resources

Knowledge gap/recommended study: More information is needed on the seasonal soil freeze/thaw and snowpack/melt cycles in the 1002 area to determine stipulations for opening and closing the tundra travel season

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such information is not needed at the leasing stage. The Leasing EIS will not result in the authorization of any on-the-ground activities. Accordingly, the environmental baseline will be preserved throughout the lease sale process. Any on-the-ground activities will require additional site-specific NEPA analysis. At that time, the BLM will determine which baseline studies regarding tundra travel may be necessary.

Agency/Commenter: Kevin Kane Letter

Applicable Resource or Use: Soil Resources

Knowledge gap/recommended study: Baseline data needs to be collected for soil density (compaction), monitoring needs to be established to measure soil compaction.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such information is not needed at the leasing stage. The Leasing EIS will not result in the authorization of any on-the-ground activities. Accordingly, the environmental baseline will be preserved throughout the lease sale process. Any on-the-ground activities will require additional site-specific NEPA analysis. At that time, the BLM will determine which baseline studies for tundra travel may be necessary.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Soil Resources

Knowledge gap/recommended study:

A. How long does the subsurface need to be frozen and at what temperature/depth? Currently DNR uses a rough standard where ground temps need to be approximately -5° at 30 cm depth. Typically, the BLM follows this standard.

B. How do active layer dynamics change based on soil type? Active layer can be monitored via weather stations but will also need to be measured with ground surveys. Soil surveys will need to be produced at a finer spatial resolution than is currently available in order to capture some of the variability in the 1002 area.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such information is not needed at the leasing stage. The Leasing EIS will not result in the authorization of any on-the-ground activities. Accordingly, the environmental baseline will be preserved throughout the lease sale process. Any on-the-ground activities will require additional site-specific NEPA analysis. At that time, the BLM will determine which baseline studies may be necessary.

Q.4.7 Water Resources

Agency/Commenter: USFWS, Letter 95601

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Effectiveness of BMPs, mitigation, restoration, and monitoring

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, potential impacts from oil and gas development activities, taking into account the effectiveness of BMPs, mitigation, restoration, and monitoring. Lease Stipulations and ROPs have also been identified to address these impacts, and how they differ among the various alternatives. Further site-specific water resources impact analysis will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS, Letter 95601

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Importance of springs, aufeis, and ice dam flooding in supporting habitat and river recharge

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, potential impacts from oil and gas development activities as well as existing information and past studies that have been completed to assess the discharge of springs and the extent of aufeis formations and persistence. Lease Stipulations and ROPs have also been identified to address these impacts and how they differ among the various alternatives. Further site-specific water resources impact analysis will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Inventory of sensitive resources, including springs, aufeis, and ice dam flooding in supporting habitat and river recharge

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, potential impacts from oil and gas development activities as well as existing information and past studies that have been completed to assess the discharge of springs and the extent of aufeis formations and persistence. Lease Stipulations and ROPs have also been identified to address these impacts and how they differ among the various alternatives. Further site-specific water resources impact analysis will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS, Letter 95601

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Identify high value/vulnerable lakes and seasonality of water quantity and quality

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, existing information on water quality of lakes and discharge measurements in rivers and springs as well as the potential impacts from oil and gas development activities. Lease Stipulations and ROPs have also been identified to address these impacts and how they differ among the various alternatives. Further site-specific water resources impact analysis will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Resource inventory/water quantity and quality of rivers and lakes

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, existing information on water quality of several lakes and discharge measurements of rivers and springs as well as the potential impacts from oil and gas development activities. Lease Stipulations and ROPs have also been identified to address these impacts and how they differ among the various alternatives. Further site-specific water resources impact analysis and gathering of baseline data will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: Kaarle Strailey, Letter 95670

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Baseline data for stream flows and water chemistry in streams

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, existing information on water quality and discharge measurements of rivers and springs. Further site-specific gathering of baseline data will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Groundwater Inventory

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, existing information on discharge measurements of rivers and springs as well as the potential impacts from oil and gas development activities. References were also cited that present a conceptual groundwater model, likely flow paths, coincidence of spring locations and geologic faults, and isotopic signatures. Lease Stipulations and ROPs have also been identified to address these impacts and how they differ among the various alternatives. Further site-specific water resources impact analysis and gathering of baseline data will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Seasonality of water quantity and quality

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, existing information on water quality measurements, discharge measurements of rivers and springs, and the potential impacts from oil and gas development activities. Lease Stipulations and ROPs have also been identified to address these impacts and how they differ among the various alternatives. Further site-specific gathering of baseline data will occur when an application for a specific on-the-ground development is submitted.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Coastal water quality and chemistry

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, the potential impacts on coastal areas from oil and gas development activities. Further site-specific gathering of baseline data will occur when an application for a specific on-the-ground development is submitted. USFWS indicates that this baseline data is currently being collected by the Beaufort Sea LTER.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Water Resources

Knowledge gap/recommended study: Coastal Bathymetry

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: The Leasing EIS identifies and adequately describes, at this leasing stage, the potential impacts on coastal areas from oil and gas development activities. Development of designs for barge landings or sea water treatment plants would require a detailed assessment of bathymetry, currents, and water quality. Further site-specific gathering of baseline data will occur when an application for a specific on-the-ground development is submitted.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Q.4.8 Contamination and Oil Spills

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Contamination and Oil Spills

Knowledge gap/recommended study: Baseline lack of contaminant concentrations in sensitive resources

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Baseline information has been collected on sensitive resources with limited exposure to contaminants in the program area since the 1980s through resource assessments. Continued data collection would be needed to support scientific judgements and reasoned managerial decisions at the development stage. All leasing alternatives have similar potential impacts from the introduction of contamination to sensitive species and such impacts cannot be distinguished between alternatives. At the time of a site-specific proposal, the operator will be required to submit additional baseline data and collect data during development and operation to track potential changes of contaminant concentrations in sensitive species.

Agency/Commenter: Brooke Brisson, Trustees for Alaska, Letter 98270

Applicable Resource or Use: Contamination and Oil Spills

Knowledge gap/recommended study: Marine impacts of potential oil spills on keystone Arctic species

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Barging is not discussed as a shipping method for crude oil. Barging activities would be limited as discussed in the Reasonably Foreseeable Development Scenario (**Appendix B**), barge activity is assumed for providing supplies and modules. If an oil spill were to occur in marine waters, it could cause significant adverse impacts to keystone Arctic species (i.e., Arctic cod). Barging of supplies and modules are common under all action alternatives and the incomplete information would not provide useful information to the decision-maker.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Contamination and Oil Spills

Knowledge gap/recommended study: Full disclosure, characterization, and tracking of hazardous materials, including potential proprietary mixtures, which may be disposed of in the 1002 area, including by injection.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: No hazardous materials will be disposed of in the 1002 area as part of the leasing stage. **Section 3.2.11** of the EIS references types of hazardous materials that can be produced from oil and gas activities and their effect on the environment. As chemicals used for oil and gas projects are similar and if spilled would cause significant adverse impacts to wildlife, water quality, vegetation, and wetlands. This is common under all action alternatives and the incomplete information would not provide useful information to the decision-maker. Evaluation of specific hazards to humans and the environment would be further assessed through the environmental review for proposed projects.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Contamination and Oil Spills

Knowledge gap/recommended study: Hydrological evaluation of underground aquifers and surface waters.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: There is a lack of data regarding underground aquifers and surface waters in the 1002 area. If a spill were to occur in surface waters it would cause comparable significant adverse effects on aquatic wildlife, water quality, and wetlands, regardless of the leasing alternative selected. At the time of site-specific proposal, the operator will be required to collect data regarding surface waters and underground aquifers to determine development offsets and injection depths. DEC and EPA regulate types of materials and depths allowed for disposal in injection wells. The additional information regarding groundwater aquifers would not be useful in choosing among alternatives; this is because all action alternatives must comply with DEC and EPA regulations regarding injection wells.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Contamination and Oil Spills

Knowledge gap/recommended study: Monitoring plans for contaminants of concern and sensitive resources. Provide baseline (pre-project) data.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at the leasing stage. Baseline information has been collected on sensitive resources with limited exposure to contaminants in the program area since the 1980s through resource assessments. Continued data collection would be needed to support scientific judgements and reasoned managerial decisions at the project stage. All action alternatives have similar potential impacts from the introduction of contamination to sensitive species and such impacts cannot be distinguished between alternatives. At the time of site-specific proposal, the operator will be required to submit additional baseline data and collect data during development and operation to track potential changes of contaminant concentrations in sensitive species.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Contamination and Oil Spills

Knowledge gap/recommended study: Groundwater monitoring, include location, depth, and monitoring interval of groundwater wells.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Adverse impacts on groundwater would be similar under all action alternatives. At the time of site-specific proposal, the operator will be required to collect data regarding surface waters and underground aquifers to determine development offsets and injection depths. DEC and EPA regulate types of materials and depths allowed for disposal in injection wells. The additional information regarding groundwater aquifers would not useful as all action alternatives must comply with DEC and EPA regulations regarding injection wells.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Contamination and Oil Spill

Knowledge gap/recommended study: Area-specific surveys of wildlife presence, numbers, reproductive success, and toxicity testing

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such site-specific information is not needed or helpful at the leasing stage. Wildlife studies have been conducted in the program area extensively since the 1980s. The Coastal Plain leasing alternatives encompass over 1 million acres. Once specific project locations are proposed, wildlife studies can be better suited to specific locations within the lease area. Issuance of 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. Further environmental review would be conducted based on an application for oil and gas activities.

Q.4.9 Vegetation and Wetlands

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Vegetation and wetlands

Knowledge gap/recommended study: High resolution detailed digital mapping of vegetation and wetland types

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such detailed information is not needed at the leasing stage. In the context of this leasing EIS the existing information is suitable to obtain a complete listing of the vegetation types in the area and determine which general areas may adversely impact individual types. Further high accuracy mapping will be required and obtained as necessary for individual proposed exploration and development projects.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Vegetation and wetlands

Knowledge gap/recommended study: Studies of impacts and recovery from seismic exploration within the 1002 area

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at the leasing stage. The information used in evaluating potential impacts from seismic exploration is adequate for the leasing stage. It was taken from long term studies in the NPR-A and a USFWS study conducted on the Arctic Refuge Coastal Plain. Also incorporated was information synthesized in a recent white paper published by UAF scientists. Rolling terrain dominated by tussock tundra predominates in the south east portion of the EIS leasing program area. For the purposes of the EIS analysis the conservative assumption was made that these areas would be the most at risk for surface disturbance based on results from existing studies in similar vegetation types. Conservatively extrapolating results from existing studies within similar vegetation types is appropriate for the scope of a leasing EIS.

Agency/Commenter: Donald Walker, Letter 68

Applicable Resource or Use: Vegetation and wetlands

Knowledge gap/recommended study: Studies of impacts and recovery from seismic exploration within the 1002 area

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at the leasing stage. The information used in evaluating potential impacts from seismic exploration is adequate for the leasing stage; it was taken from long term studies in the NPR-A and a USFWS study conducted on the Arctic Refuge Coastal Plain. Also incorporated was information synthesized in a recent white paper published by UAF scientists. Compilation of existing literature from similar ecosystems is adequate for evaluation and analysis for the leasing EIS and further study is not required.

Q.4.10 Fish and Aquatic Species

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Fish and Aquatic Species

Knowledge gap/recommended study: Detailed baseline fish presence/absence data relative to specific habitat types (e.g., Lakes, Streams, Nearshore) is limited for habitats that might be considered for exploratory seismic surveys or industrial water use.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such detailed information is not needed at the leasing stage. USFWS has collected the bulk of known fish species presence data to date in the program area, at least for flowing fresh water. Due to a lack of unfrozen water during winter months in the vast majority of streams in the program area (outside of various recognized perennial springs identified in **Chapter 3.3.2**, **Appendix A**, **Figure 3-12**), fish overwintering habitat is extremely limited in the program area. The bulk of fish-bearing lake habitat is located in the northwest portion of the program area. Few surveys have been conducted on these lakes.

The University of Texas and USGS are conducting fish surveys in 2018 and 2019 in portions of the nearshore environment of the program area as part of the LTER program. The limited nearshore data available so far indicate similar fish assemblages (and life history strategies) as for coastal waters further west in the ACP.

The alternatives analyzed in this lease sale EIS contain several lease stipulations and required operating procedures that will adequately protect existing (limited) liquid water resources and the biota of those resources in the program area. These stipulations and required operating procedures will place significant buffers around most flowing freshwater during most of the year, particularly during winter. Once an application for a specific on-the-ground action is submitted to resource agencies, more detailed studies of water resources and aquatic biota will be required as necessary for the NEPA process. Until that time, the fish and aquatic biota baseline conditions will not be disturbed.

Agency/Commenter: Natalie Dawson, Letter 81061

Applicable Resource or Use: Fish and Aquatic Species

Knowledge gap/recommended study: Detailed baseline presence/absence data for Ninespine Stickleback for exploratory seismic surveys or industrial water use.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such detailed information is not needed at the leasing stage. USFWS has collected the bulk of known fish species presence data to date in the program area, at least for flowing fresh water. Due to a lack of unfrozen water during winter months in the vast majority of streams in the program area (outside of various recognized perennial springs identified in **Chapter 3.3.2**, **Appendix A**, **Figure 3-12**), overwintering habitat is extremely limited in the program area. Ninespine stickleback are diverse in their life history strategies and are found in freshwater and brackish water environments. The bulk of ninespine stickleback lake habitat is located in the northwest portion of the program area where the bulk of deep lakes are present.

Additional habitat is likely available in the brackish lagoon areas inside barrier islands. Nearshore surveys are ongoing in the nearshore environment of the program area. The University of Texas and USGS are conducting fish surveys in 2018 and 2019 in portions of the nearshore environment of the program area. Once an application for a specific on-the-ground action is submitted to resource agencies, more detailed studies of water resources and aquatic biota will be required as necessary for the NEPA process. Until that time, the fish and aquatic biota baseline conditions will not be disturbed.

Agency/Commenter: Natalie Dawson, Letter 81061

Applicable Resource or Use: Fish and Aquatic Species

Knowledge gap/recommended study: What are consequences of aufeis harvest from perennial springs relative to maintaining downstream flows and providing adequate migration for fish?

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such detailed information is not needed at the leasing stage. The current lease sale and subsequent exploratory seismic efforts are unlikely to require use of aufeis in creation of ice roads or other project activities. Furthermore, lease stipulations and required operating procedures inhibit the use of ice and water in or near springs. Once an application for a specific on-the-ground action is submitted to resource agencies, more detailed studies of water resources, including the importance of aufeis to the hydrologic regime in program area streams will be required as necessary for the NEPA process. Until that time, the water resources and fish and aquatic biota baseline conditions will not be disturbed.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Fish and Aquatic Species

Knowledge gap/recommended study: What are consequences of aufeis harvest from perennial springs relative to maintaining downstream flows and providing adequate migration for fish?

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such detailed information is not needed at the leasing stage. The current lease sale and subsequent exploratory seismic efforts are unlikely to require use of aufeis in creation of ice roads or other project activities. Furthermore, lease stipulations and required operating procedures inhibit the use of ice and water in or near springs. Once an application for a specific on-the-ground action is submitted to resource agencies, more detailed studies of water resources, including the importance of aufeis to the hydrologic regime in program area streams will be required as necessary for the NEPA process. Until that time, the water resources and fish and aquatic biota baseline conditions will not be disturbed.

Agency/Commenter: Wendy Loya, USFWS, Letter 97942

Applicable Resource or Use: Fish and Aquatic Species

Knowledge gap/recommended study: Recommend adding a description of the seasonal use of nearshore marine waters and lagoons by fish.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such information is not needed at the leasing stage. Under the reasonably foreseeable development scenario in the Leasing EIS, there are no substantial uses anticipated for these environments; however, due to the lack of liquid surface freshwater sources for use in industrial activities, such as ice road development and camp water needs, it is possible that a salinity treatment plant will be required to support infrastructure. Once an application for a specific on-the-ground action is submitted to resource agencies, more detailed studies of nearshore marine waters and the aquatic organisms that live there will be required as necessary for the NEPA process. Until that time, the water resources and fish and aquatic biota baseline conditions in the nearshore brackish/marine waters of the program area will not be disturbed.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Fish and Aquatic Species

Knowledge gap/recommended study: Recommend analysis of nearshore impacts on fish and invertebrates from industrial coastal activities (e.g., shipping, salinity treatment)

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such information is not needed at the leasing stage. Under the reasonably foreseeable development scenario in the Leasing EIS, there are no substantial uses anticipated for these environments; however, due to the lack of liquid surface freshwater sources for use in industrial activities (e.g., ice road development, camp water needs), it is possible that a salinity treatment plant will be required to support future infrastructure. Once an application for a specific on-the-ground action is submitted to resource agencies, more detailed studies of nearshore marine waters and the aquatic organisms that live there will be required as necessary for the NEPA process. Until that time, the water resources and fish and aquatic biota baseline conditions in the nearshore brackish/marine waters of the program area will not be disturbed.

Q.4.11 Birds

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment); Deanna Noel, Defenders of Wildlife, Letter 75598; Name Withheld, Letter 83837; Name Withheld, Letter 42704; Veronica Estelle, Letter 94060; Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Birds

Knowledge gap/recommended study: Data on abundance and distribution of breeding and non-breeding birds, important habitat areas, phenology, and seasonal movements within the Refuge and beyond. Studies must be conducted over several years due to high annual variability. Studies must begin as soon as possible prior to seismic exploration.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at the leasing stage. Existing data are adequate for accurately describing the bird community and bird distributions and for distinguishing important seasonal habitats of birds for the purposes of this Leasing EIS. Site-specific surveys will be required prior to any future proposed development project. No population-level impacts are anticipated to occur as a direct result of normal oil and gas development activities.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment); James Warren, Letter 45446

Applicable Resource or Use: Birds

Knowledge gap/recommended study: More research must be done to determine the vulnerability and status of at-risk populations. Surveys should be prioritized based on conservation needs.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at the leasing stage. Site-specific surveys will be required prior to any future proposed development project and will ensure that impacts on at-risk species, such as TES, are minimized. ROP 32 will minimize impacts on threatened eiders, ROP 45 will minimize impacts on BLM-listed sensitive species, and Lease Notice 1 will ensure Section 7 consultations for any listed species.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment); Veronica Estelle, Letter 94060

Applicable Resource or Use: Birds and Terrestrial Mammals

Knowledge gap/recommended study: Population studies of predators. Studies must be conducted over several years due to high annual variability. Studies must begin as soon as possible.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Increases in predator populations are anticipated, as described by the EIS, and are well documented in similar development areas. ROPs 2 and 25 will minimize human-caused changes in predator populations. Alternatives will not differ with respect to effects of predator populations.

Agency/Commenter USFWS and BLM (Rapid Response Resource Assessment); Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Birds

Knowledge gap/recommended study: Disturbance and impacts studies, including habitat changes and contaminant effects analysis

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Direct and indirect impacts on habitats, including potential accidental contaminant releases are anticipated to occur, as described in the EIS. The ARCP is currently undeveloped and background contaminant levels are presumed to be low to undetectable. Adequate data are available regarding potential direct and indirect impacts on habitats, on potential effects of disturbance and displacement, and on contaminant effects for making a reasoned choice among alternatives.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Birds (and other resources)

Knowledge gap/recommended study: Future survey and study data should be available in a publicly accessible database.

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: Comment is a recommendation for future data storage and availability, is not relevant to assessment of the significance of impacts on birds.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Agency/Commenter: Eric Walsh, Government of Canada, Letter 74346

Applicable Resource or Use: Birds

Knowledge gap/recommended study: Risk assessment for barge shipping route spills

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The hypothetical RFD is applicable to the program area, and speculation beyond where marine vessel traffic would go is beyond the scope of this analysis; direct and indirect impacts cannot be analyzed on a site-specific basis within this EIS but are analyzed for the program area generally based off of the hypothetical development scenario. Alternatives do not differ with respect to impacts of barge traffic on the marine route.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment); Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Birds (also Hydrology)

Knowledge gap/recommended study: Studies of water balance

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Site-specific information on water withdrawals and water use are not available at this leasing stage. Impacts on waterbirds are anticipated to occur as a result of water withdrawals at specific locations and may affect the local abundance and distribution of some birds, particularly if recharge rates are low, as may be anticipated. All alternatives will have similar requirements for water usage and would differ only in specific locations of withdrawals, not in volume. ROP 9 will reduce impacts of water withdrawals on birds.

Q.4.12 Terrestrial Mammals

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: Increase number of radio collars deployed on caribou to increase knowledge of 1) the relationship between habitat conditions and demography; and 2) emigration rates to neighboring herds.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Radio collars have been deployed on PCH and CAH caribou since the late 1980s (Fancy et al. 1990), therefore there is a large amount of radio collar data currently available for analysis. The relationship between habitat and demography for these and other Arctic herds has been an active area of caribou research (e.g., Gerhardt 1995, Cameron et al. 2005, Griffith et al. 2002, Barboza et al. 2018, Russell and Gunn 2019). This line of research will continue but likely differences among alternatives involve potential calving displacement which has been studied by Griffith et al. (2002) and Russell and Gunn (2019). The potential impact of development on demographic parameters of the CAH was discussed in various studies (NRC 2003; Cameron et al. 2005; and Arthur and Del Vecchio 2009). A recent study of herd interchange and overlap among the four Arctic Alaska herds has been conducted (Prichard et al. 2019), it found that there is high herd fidelity for the Porcupine and Western Arctic herds and lower herd fidelity for the Teshekpuk and Central Arctic Herds.

Agency/Commenter: Name Withheld, Letter 48698

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: Assessment of impacts on caribou movements, natality, mortality, nutritional status from development.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The impacts of development on movements, natality, mortality, and nutritional status are difficult to predict, especially at the programmatic Leasing EIS stage where there is no specific project plan because how the caribou will react is not known with certainty and how changes in behavior will translate to demographic impacts is difficult to predict. The CAH has been exposed to oil development for about 40 years and has been heavily studied. Some lessons can be learned from CAH behavior but there are some differences between herds in how behavioral changes will impact demography. Both Griffith et al. (2002) and Russell and Gunn (2019) tried to predict the impacts of calving displacement on calf survival. Russell and Gunn (2019) used modeling to predict the effect of behavioral disturbance on herd size, but this required very specific assumptions of how much caribou would change their behavior (primarily time spent foraging) with development and those assumptions were not available from the literature. Additional impacts analysis and assessment can be conducted during the project-specific NEPA process if leasing does occur.

Agency/Commenter: Brook Brisson, Trustees for Alaska, Letter 98271

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: In addition, comparison of population patterns for the CAH and PCH would be enhanced by inclusion of quantitative population data in the DEIS. This is currently lacking. The BLM needs to provide these data for the CAH both for the pre-oil and gas exploration and development period, particularly prior to Prudhoe Bay exploration in 1968 and intense construction of the Trans-Alaska Pipeline between 1969-1977, as well as for the period following exploration and development. Along with data from both periods, any limitations of the data should be discussed. This will allow a more robust assessment of population trends and potential development impacts.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The EIS includes information on recent population sizes for the CAH and PCH. Skoog (1968) presented evidence of a separate CAH but thought it had disappeared by the 1950s. The CAH wasn't positively defined as a separate herd until the 1970s (Cameron and Whitten 1979). Early observations of caribou were limited by lack of radio collars or other methods to assess herd identity. The amount of reliable information increased starting in the 1980s with the use of radio collars, extensive research associated with the development of oil at Prudhoe Bay and Kuparuk and the use of photo censuses to count the herd. The potential impact of development on demographic parameters of the CAH was discussed in various studies (NRC 2003; Cameron et al. 2005; and Arthur and Del Vecchio 2009).

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: Identify and evaluate the relative importance of climate, predator abundance, forage quality, insect harassment, population density, and anthropogenic disturbance on calving site selection using a combination of long-term and newly collected data.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Specific aspects of this question have been studied for various caribou herds (e.g. Fancy et al. 1991; Wolfe 2000; Kelleyhouse 2001; Griffith et al. 2002; Wilson et al. 2012) but complete understanding of calving site selection is difficult to compile with changing annual conditions and inherently incomplete information. The calving locations used by the PCH have been documented and an assessment of the impacts of displacement has been conducted (Griffith et al. 2002; USFWS 2015a; Russell and Gunn 2019).

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: Use long-term and newly collected data to understand the influence of weather, forage conditions, insect harassment and population density on caribou movement and resource-selection patterns during the post-calving period.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Specific aspects of this question have been studied for various caribou herds (e.g. Roby 1978; Yokel et al. 2011; Wilson et al. 2012; Russell and Gunn 2019). The long-term radio collar dataset provides specific information on areas that are actually used. The specific movement patterns of the PCH during post-calving have been documented in the EIS and in other documents (USFWS 2015a; Russell and Gunn 2019).

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: A large database of telemetry data exists that could provide valuable baseline information on caribou movements. These data need to be formally analyzed to update the report "Sensitive Habitats of the Porcupine Caribou Herd" (Porcupine Caribou Technical Committee, 1993). This information is needed to identify sensitive areas that may require special management during development and production.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The report "Sensitive Habitats of the Porcupine Caribou Herd" is being updated by Canadian biologists and maps from this recent effort were included in the EIS. This information helped inform the alternatives and the impacts analysis.

Agency/Commenter: Rosa Brown, Vuntut Gwitchin Government, Letter 74326

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: The Draft EIS…fails to incorporate any traditional knowledge and also contains a biased and poor summary of western scientific research on impacts of oil and gas development on the Central Arctic Caribou herd.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Traditional knowledge has been shared with the BLM throughout development of the EIS, including during scoping, public meetings on the DEIS, government-to-government and ANCSA consultations, and through the Section 106 process. This information has been used to help inform development of the EIS and ensure a more robust analysis (see **Appendix C**). The major research findings from the CAH for assessing potential impacts on the PCH and differences among herds were described.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: Existing long-term monitoring programs should be continued to predict population trends and evaluate the roles of natural vs. anthropogenic factors. These data will be needed to evaluate causes of future changes in population size that are likely to occur during the development and production periods.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Alaska Department of Fish and Game, USFWS, and Canadian agencies all monitor the PCH and deploy radio collars on caribou in coordination with the International Porcupine Caribou Board. There is a requirement for a caribou study "the lessee would design and implement and report a study of caribou movement, unless an acceptable study specific to the PCH and CAH has been completed within the last 10 years and approved by the BLM Authorized Officer" (ROP 23). Additional monitoring could be required during any given project-specific NEPA process.

Agency/Commenter: Brook Brisson, Trustees for AK, Letter 98271

Applicable Resource or Use: Terrestrial Mammals (Caribou)

Knowledge gap/recommended study: It is the responsibility of the BLM to evaluate, using the best available scientific information, the potential costs for caribou population growth of being unable to access nutritious forage for one or a few years in a row due to development.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: A major potential impact from development is potential displacement of calving caribou from calving areas within the program area and the impact of this was assessed by Griffith et al. (2002) and

Russell and Gunn (2019) and included in the EIS. The specific impacts are not known, due to the lack of specific project descriptions, incomplete knowledge of how caribou will react, and the varying spatial distribution of vegetation types and plant quality. Additional impacts analysis and assessment can be conducted during the project-specific NEPA process if leasing does occur.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: We need a greater understanding of predator/prey and competitive relationships among red and arctic foxes, lemmings, and ground-nesting birds; how these are affected by lemming cycles; and how these complex relationships may be altered by a warming climate and anthropogenic disturbance.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: There is a substantial amount of literature on red and arctic foxes on the Arctic Coastal Plain and near oilfields (Pamperin et al. 2006, 2008, Lehner 2012, Savory et al. 2014, Stickney et al. 2014). Potential changes in fox populations and associated predation on small mammals and birds can be partially mitigated with waste management plans and other mitigation measures. All action alternatives are limited to 2000 acres of gravel, although the location of those 2000 acres may vary. The major effects on small mammals are likely to be direct loss of habitat from gravel placement, and localized direct and indirect effects from seismic exploration and ice roads. These impacts are unlikely to vary by alternatives. Impacts can be outlined with more specificity during the project-specific NEPA process if leasing does occur.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: We lack current data regarding the abundance and distribution of grizzly bears; the relative importance of the 1002 area as denning habitat is unknown; improved methods are needed to reduce availability of anthropogenic foods and the resulting negative interactions with human activities.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Bear data collected near the Prudhoe Bay and Kuparuk oilfields provide useful information on den site selection and on mitigation methods for limiting grizzly bear access to anthropogenic food sources (Shideler and Hechtel 2000; Pedersen 2019). Previous research has been conducted on grizzly bears in the program area (USFWS 2015). Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on grizzly bears are unlikely to substantially differ by alternative. Additional impacts analysis and assessment of grizzly bear denning habitat can be conducted during any given project-specific NEPA process if leasing does occur.

Is the Information/Study Relevant to Potentially Significant Effects?

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: Current data are needed regarding the distribution and abundance of wolves and wolverines; to document den site locations and habitat attributes; evaluate potential for disturbance or mortality related to interaction with human activities; and evaluate effects of increased access by subsistence hunters and trappers.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Wolves and wolverines both occur at low densities in the program area (USFWS 2015). Most subsistence harvest occurs during winter (USFWS 2015) which will limit the potential impact of road access for subsistence harvest of these species. Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on wolves and wolverines are unlikely to substantially differ by alternative. Additional impacts analysis and analysis of specific den locations or suitable denning habitat can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: More information is needed regarding how predation, weather, disease, and nutrition influence population dynamics of moose and muskoxen; the potential for reestablishment of muskoxen in the Refuge by expansion of neighboring populations; and the potential effects of human activities (positive: protection from predators; or negative: disturbance or displacement) on both species.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Both moose and muskoxen are currently rare in the program area, but there is a chance that both species may increase in the future. Both species are monitored by State and Federal agencies. Muskoxen were more numerous in the program area in recent years and future population increases are possible and moose are expanding their range north in response to climate change. Information on past distribution for muskoxen and habitat associations for moose is available and was used to inform potential impacts of alternatives. Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on moose and muskoxen are unlikely to substantially differ by alternative but the stipulations regarding riparian areas will be important. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: Abundance and density of muskoxen within the Arctic Refuge should be monitored to determine if muskoxen return to the Refuge from adjacent areas and if this is influenced by oil field infrastructure or changes in abundance and distribution of predators and other prey species.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Muskoxen are currently rare in the program area, but they were more numerous in the past and there is a chance that they may increase in the future. The Alaska Department of Fish and Game and USFWS have conducted monitoring and research on muskoxen population in northeastern Alaska. Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on muskoxen are unlikely to substantially differ by alternative but the stipulations regarding riparian areas will be important. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing occurs.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: Are lemming cycles changing? How does this affect survival and population dynamics of ground-nesting birds? Does this moderate or increase effects of human activities?

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The largest potential impacts on small mammals will be located near gravel roads and pads and include direct mortality from road construction and vehicle traffic and direct loss of habitat. Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on small mammals are unlikely to substantially differ by alternative. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: We have only limited knowledge of which mammal species are present in the Coastal Plain; information is particularly needed for little-known species and those whose ranges are restricted to arctic tundra.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: There are varying amounts of data available on use of the program area by terrestrial mammal species (USFWS 2015). Caribou, moose, and muskoxen are actively monitored. There is less data on large carnivores that occur at low densities, but habitat associations and general density patterns are known. The largest potential impacts on small mammals will be located near gravel roads and pads and include direct mortality from road construction and vehicle traffic and direct loss of habitat. Because all alternatives limit the gravel footprint to 2,000 acres, the impacts of leasing on small mammals are unlikely to substantially differ by alternative. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: Distribution, abundance, and habitat associations of arctic ground squirrels should be documented. Ground squirrels are a key species in the Arctic, in that they are an important prey for many predators and can influence vegetation communities by consuming vegetation and by fertilizing the tundra around their colonies; thus, changes in ground squirrel populations can have profound effects on local communities.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Arctic ground squirrels are widespread across the Arctic Coastal Plain in areas with suitable conditions for dens (USFWS 2015). The largest potential impacts on arctic ground squirrels will be located near gravel roads and pads and include direct mortality from road construction and vehicle traffic and direct loss of habitat; although potential changes in predator densities would also impact arctic ground squirrels. Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on arctic ground squirrels are unlikely to substantially different by alternative. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: The distribution and abundance of hares in the Coastal Plain should be documented, and species identity should be determined (snowshoe vs. Arctic hare). Hares are a key species of the boreal forest and are likely to increase their range northward as the climate warms. This will have far-reaching effects on both vegetation and other mammals and birds.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Alaska hare (*Lepus othus)* may have previously occupied parts of the North Slope (MacDonald and Cook 2009, Cason et al. 2016), but a recent reanalysis of records of Alaska hare only found one verified specimen from the North Slope collected in 1898 (Cason et al. 2016). The Arctic hare (*Lepus arcticus*) does not occur in Alaska (Best and Henry 1994, MacDonald and Cook 2009, USFWS 2015). The snowshoe hare (*Lepus americanus*) does occur in the program area and is expanding their range north due to climate change but are limited to areas with minimum shrub height of 1.24-1.36 m (Tape et al. 2015). Because all alternatives limit the gravel footprint to 2000 acres, the impacts of leasing on snowshoe hare are unlikely to substantially differ by alternative. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: Conduct long-term monitoring of relative abundance of terrestrial mammals, predator/prey relationships, habitat characteristics, and range expansion/movement. These data are needed to distinguish between natural and anthropogenic effects.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Significant amounts of research and monitoring have been conducted on large terrestrial mammals on the Arctic Coastal Plain and within the program area by the Alaska Department of Fish and Wildlife and federal agencies. Research conducted outside of the program area can provide information on predator/prey relationships and habitat associations. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Agency/Commenter: Tim Whitehouse, PEER, Letter 95601

Applicable Resource or Use: Terrestrial Mammals

Knowledge gap/recommended study: Population levels of microtines and other small rodents should be monitored to determine the timing and magnitude of population highs and lows and how these relate to other components in the ecosystem, especially population dynamics of mesocarnivores and their alternate prey (ground-nesting birds). Effects of climate change on the distribution and dynamics of small mammals should also be investigated.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The largest potential impacts on small mammals will be located near gravel roads and pads and include direct mortality from road construction and vehicle traffic and direct loss of habitat. Because all alternatives limit the gravel footprint to 2,000 acres, the impacts of leasing on small mammals are unlikely to substantially differ by alternative. Additional impacts analysis can be conducted during any given project-specific NEPA process if leasing does occur.

Q.4.13 Marine Mammals

Agency/Commenter: Harry K Brower Jr., North Slope Borough, Letter 95612

Applicable Resource or Use: Marine Mammals

Knowledge gap/recommended study: Literature review for additional whale species that could occur near the project area (harbor porpoise, killer whale, and narwhal).

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: These 3 species are considered to be extralimital or casual in the program area, so their occurrence there is extremely rare. Their respective core ranges do not include the program area, making impacts on the populations, or even individuals, of these 3 species highly unlikely. Any effects on these 3 whale species will not differ among alternatives. Furthermore, effects on these species would not differ from the potential effects described for more common species that are discussed in depth: short-term changes in the acoustic environment during screeding and barging operations; risk of collision during shipping; and risk of hazardous material spills in the marine environment. Regulations under the Marine Mammal Protection Act provide protection of these species.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Marine Mammals (Polar Bear)

Knowledge gap/recommended study: "Accurate and current" understanding of population dynamics, to inform take estimates and negligible impact determinations under the MMPA and jeopardy determinations under the ESA

Is the Gap/Study Relevant to Potentially Significant Effects? YES

If NO, explain: –

Is the Statement Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Updated population data is not needed at this leasing stage. It is assumed that oil and gas activities subsequent to leasing will have to comply with the MMPA and ESA, which would not allow authorization of activities that could significantly impact polar bears. A substantial amount of information has been published about the SBS stock of polar bears, and the available data on population size, trend, and demography are sufficient to inform the federal decision-maker about the declining trend in the SBS stock of polar bears related to declining sea-ice cover resulting from climate change. While some level of incomplete scientific information is to be expected (especially regarding changing ecosystem conditions and related responses by species populations), enough information is currently available to formulate and support sound scientific judgments. Until a new population estimate is obtained, the USFWS (2017a, 2017b) is using the best available data, which is the most recent population estimate and demographic analysis by Bromaghin et al. (2015), as cited in the DEIS and FEIS. A new population estimate is expected to be produced in the near future (USFWS 2017b), which then would be available for use in subsequent NEPA analyses of oil and gas activities that may be proposed in the program area. Continuing research, primarily by USGS and USFWS biologists, is expected to contribute more information for subsequent use in post-leasing NEPA analyses at a later stage of the oil and gas program.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Marine Mammals (Polar Bear)

Knowledge gap/recommended study: "Understanding the relationship between polar bears and environmental parameters" to help "explain current habitat use patterns" and to predict "how distribution and movements are likely to respond to predicted sea ice loss and other habitat changes" in the future, to inform take estimates and negligible impact determinations under the MMPA and assessment of destruction or adverse modification of critical habitat under the ESA

Is the Gap/Study Relevant to Potentially Significant Effects? YES

If NO, explain: –

Is the Statement Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at this leasing stage. It is assumed that oil and gas activities subsequent to leasing will have to comply with the MMPA and ESA, which would not allow authorization of activities that could significantly impact polar bears. Obtaining the desired information is consistent with the last element of the Conservation Management Strategy of the PBCMP (USFWS 2016: pp. 48–52) to conduct "strategic monitoring and research" to continually improve understanding of the factors affecting the species, for use in the species recovery process. Nevertheless, a large volume of information has been published on the habitat use patterns, distribution, and movements of the SBS stock of polar bears, including in the program area, and including changes being observed as the climate changes and sea ice declines. That published information provides a solid basis for predicting impacts and formed the basis for description of these population characteristics in the Affected Environment section of the EIS. Additional information has been added to the FEIS on the basis of comments received on the DEIS. While some level of incomplete scientific information is to be expected (especially regarding changing ecosystem conditions and related responses by species populations), enough information is currently available to formulate and support sound scientific judgments. Continuing research, primarily by USGS and USFWS biologists, is expected to contribute more information for subsequent use in post-leasing NEPA analyses at a later stage of the oil and gas program.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Marine Mammals (Polar Bear)

Knowledge gap/recommended study: "Understanding the potential spatial and temporal overlap between polar bears and oil and gas development and the factors influencing the likelihood and consequences of interactions between polar bears and those development activities," to inform take estimates and negligible impact determinations under the MMPA and jeopardy determinations under the ESA

Is the Gap/Study Relevant to Potentially Significant Effects? YES

If NO, explain: –

Is the Statement Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at this leasing stage. It is assumed that oil and gas activities subsequent to leasing will have to comply with the MMPA and ESA, which would not allow authorization of activities that could significantly impact polar bears. Obtaining the desired information is consistent with the last element of the Conservation Management Strategy of the PBCMP (USFWS 2016: pp. 48–52) to conduct "strategic monitoring and research" to continually improve understanding of the factors affecting the species, for use in the species recovery process. Nevertheless, the existing ITR/LOA process has provided a substantial body of information on polar bear interactions with oil and gas activities, gathered over more than 25 years, which was used in preparing the DEIS and which has been supplemented in the FEIS on the basis of comments on the DEIS. Comprehensive regulatory standards under the MMPA ITR/LOA process and ESA Section 7 consultation are expected to be sufficient to prevent significant program-related impacts on subsistence and cultural uses of polar bears. Incomplete information regarding subsistence and cultural use is, in this sense, less useful to the federal decision-maker, who is reasonably assured that no matter which alternative he or she selects, significant adverse effects on polar bears will likely be avoided. If the USFWS cannot support determinations of negligible take under the MMPA, as well as a no-jeopardy determination under the ESA, then the required ITRs for program-related activities will not be promulgated. Continuing research, primarily by USGS and USFWS biologists, is expected to contribute more information for subsequent use in post-leasing NEPA analyses at a later stage of the oil and gas program.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Marine Mammals (Polar Bear)

Knowledge gap/recommended study: Evaluate emerging technologies for integration into existing monitoring plans; Improve understanding of the environmental and biological characteristics of important polar bear habitats, particularly denning habitat; Expand and improve den detection, mapping, and monitoring activities; Identify movement and land use patterns of polar bears in the 1002 area, and projected changes due to sea ice loss; Identify potential for habitat use and behavioral patterns to be modified due to increased human activities.

Is the Gap/Study Relevant to Potentially Significant Effects? YES

If NO, explain: –

Is the Statement Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: This list of information needs is actually a five-part request, essentially consisting of a list of objectives for future USFWS (and USGS) research. Such additional information is not needed at this leasing stage. It is assumed that oil and gas activities subsequent to leasing will have to comply with the MMPA and ESA, which would not allow authorization of activities that could significantly impact polar bears. Obtaining the desired information is consistent with the last element of the Conservation Management Strategy of the PBCMP (USFWS 2016: pp. 48–52) to conduct "strategic monitoring and research" to continually improve understanding of the factors affecting the species, for use in the species recovery process. In preparing the DEIS, the technical analysts drew upon the existing body of knowledge about each one of these five elements, for which a substantial amount of published information is available. Additional information was added for the FEIS, where warranted, on the basis of comments on the DEIS. While some level of incomplete scientific information is to be expected (especially regarding changing ecosystem conditions and related responses by species populations), enough information is currently available to formulate and support sound scientific judgments. Continuing research, primarily by USGS and USFWS biologists, is expected to contribute more information for subsequent use in post-leasing NEPA analyses at a later stage of the oil and gas program.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Marine Mammals (Polar Bear)

Knowledge gap/recommended study: Factors affecting subsistence and cultural use of polar bears, to understand the current availability of polar bears for subsistence hunting and predict the potential impact of proposed actions on the availability of polar bears for subsistence use (MMPA determination)

Is the Gap/Study Relevant to Potentially Significant Effects? YES

If NO, explain: –

Is the Statement Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at this leasing stage. It is assumed that oil and gas activities subsequent to leasing will have to comply with the MMPA and ESA, which would not allow authorization of activities that could significantly impact polar bears. Fundamental Goal 4 of the PBCMP (USFWS 2016) is to "Recognize the nutritional and cultural needs of native peoples with connections to polar bear populations, including the opportunity for continued subsistence harvest of polar bears." Obtaining the desired information is consistent with the last element of the Conservation Management Strategy of the PBCMP (USFWS 2016: pp. 48–52) to conduct "strategic monitoring and research" to continually improve understanding of the factors affecting the species, for use in the species recovery process. Nevertheless, the existing MMPA ITR/LOA process has provided a substantial body of information on polar bear interactions with oil and gas activities and the attendant implications for subsistence use, gathered over more than 25 years. That body of information was used in preparing the DEIS and additional information has been added in the FEIS on the basis of comments on the DEIS. Comprehensive regulatory standards under the MMPA ITR/LOA process and ESA Section 7 consultation are expected to be sufficient to prevent significant program-related impacts on subsistence and cultural uses of polar bears. Incomplete information regarding subsistence and cultural use is, in this sense, less useful to the federal decision-maker, who is reasonably assured that no matter which alternative he or she selects, significant adverse effects on polar bears will likely be avoided. If the USFWS cannot support determinations of negligible take and no adverse unmitigable effects on subsistence harvest under the MMPA, as well as a no-jeopardy determination under the ESA, then the required ITRs for program-related activities will not be promulgated. Continuing research, primarily by the USFWS and USGS, is expected to contribute more information for subsequent use in post-leasing NEPA analyses at a later stage of the oil and gas program.

Agency/Commenter: USFWS & BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Marine Mammals (Polar Bear)

Knowledge gap/recommended study: Factors affecting human/polar bear interactions, to inform take estimates and negligible impact determinations under the MMPA and jeopardy determinations and assessment of destruction or adverse modification of critical habitat under the ESA

Is the Gap/Study Relevant to Potentially Significant Effects? YES

If NO, explain: –

Is the Statement Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Such additional information is not needed at this leasing stage. It is assumed that oil and gas activities subsequent to leasing will have to comply with the MMPA and ESA, which would not allow authorization of activities that could significantly impact polar bears. Fundamental Goal 5 of the PBCMP (USFWS 2016) is to "Continue to manage human/polar bear interactions to ensure human safety and to conserve polar bears." Obtaining the desired information is consistent with the last element of the Conservation Management Strategy of the PBCMP (USFWS 2016: pp. 48–52) to conduct "strategic monitoring and research" to continually improve understanding of the factors affecting the species, for use in the species recovery process. Nevertheless, the existing MMPA ITR/LOA process has provided a substantial body of information on human/polar bear interactions, gathered over more than 25 years. That body of information was used in preparing the DEIS and additional information has been added in the FEIS on the basis of comments on the DEIS. Comprehensive regulatory standards under the MMPA ITR/LOA process and ESA Section 7 consultation are expected to be sufficient to prevent significant program-related impacts on polar bears. Incomplete information regarding human/polar bear interactions is, in this sense, less useful to the federal decision-maker, who is reasonably assured that no matter which alternative he or she selects, significant adverse effects on polar bears will likely be avoided. If the USFWS cannot support determinations of negligible take and no adverse unmitigable effects on subsistence harvest under the MMPA, as well as determinations of no jeopardy and no destruction or adverse modification of critical habitat under the ESA, then the required ITRs for program-related activities will not be promulgated. Continuing research, primarily by USGS and USFWS biologists, is expected to contribute more information for subsequent use in post-leasing NEPA analyses at a later stage of the oil and gas program.

Q.4.14 Cultural Resources

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Cultural Resources

Knowledge gap/recommended study: Resource Inventories

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional documentation of cultural resource site information in the program area would not change the cultural resource section conclusion that Alternative D2 would have the least impact on cultural resources and that Alternative B would have the most impact on cultural resources; thus, while updated site information would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: F. Chapin, Letter 29337

Applicable Resource or Use: Cultural Resources

Knowledge gap/recommended study: Additional Surveys

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional documentation of cultural resource site information in the program area would not change the cultural resource section conclusion that Alternative D2 would have the least impact on cultural resources and that Alternative B would have the most impact on cultural resources; thus, while updated site information would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: Native Village of Venetie Tribal Government, Letter 81748

Applicable Resource or Use: Cultural Resources

Knowledge gap/recommended study: Place names

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Comment does not identify incomplete or unavailable information that would be necessary to a reasonable choice among the program alternatives.

Additional documentation of place names in the program area would not change the cultural resource section conclusion that Alternative D2 would have the least impact on cultural resources and that Alternative B would have the most impact on cultural resources; thus, while place names would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: Native Village of Venetie Tribal Government, Letter 81748

Applicable Resource or Use: Cultural Resources

Knowledge gap/recommended study: Oral Histories, Ethnohistories

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional documentation of oral histories in the program area would not change the cultural resource section conclusion that Alternative D2 would have the least impact on cultural resources and that Alternative B would have the most impact on cultural resources; thus, while oral histories would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Q.4.15 Subsistence Uses and Resources

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Subsistence Use and Resources

Knowledge gap/recommended study: Contemporary community subsistence harvest data

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The comment is inaccurate. More recent harvest data for Kaktovik from 2007, 2008, 2009, 2010, 2010-11, 2011, and 2012 are described for Kaktovik (see **Appendix M**, **Tables M-1** and **M-3**). In addition, more recent use area data from the 1996-2006 time period are described for Kaktovik (see **Appendix A**, **Map 3-28**).

Agency/Commenter: Name Withheld, Letter 59376

Applicable Resource or Use: Subsistence Use and Resources

Knowledge gap/recommended study: Arctic Village Household Harvest Survey

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Existing information and traditional knowledge provide adequate information to understand the importance of the Coastal Plain to Arctic Village subsistence harvests. Additional harvest data would not change the subsistence section conclusion that Alternative D2 would have the least impact on subsistence uses and resources and that Alternative B would have the most impact on subsistence uses and resources; thus, while updated harvest data information would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such data are not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Subsistence Use and Resources

Knowledge gap/recommended study: Follow-Up surveys of cultural sites

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional documentation of cultural resource site information prior to being lost to erosion would not change the cultural resource section conclusion that Alternative D2 would have the least impact on coastal cultural resource sites in danger of erosion and that Alternative B would have the most impact on cultural resource sites in danger of erosion; thus, while updated site information would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Subsistence Use and Resources

Knowledge gap/recommended study: Reassessment of archaeological and historical resources in the 1002 area

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional documentation of cultural resource site information in the program area would not change the cultural resource section conclusion that Alternative D2 would have the least impact on cultural resources and that Alternative B would have the most impact on cultural resources; thus, while updated site information would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Subsistence Use and Resources

Knowledge gap/recommended study: Economic Value of PCH to Subsistence Users

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional information regarding the economic value of the PCH to subsistence users would not change the subsistence section conclusion that Alternative D2 would have the least impact on subsistence uses and resources and that Alternative B would have the most impact on subsistence uses and resources; thus, while economic value data regarding caribou would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Subsistence Use and Resources

Knowledge gap/recommended study: Oral Histories and Traditional Knowledge

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Additional documentation of oral histories in the program area would not change the cultural resource section conclusion that Alternative D2 would have the least impact on cultural resources and that Alternative B would have the most impact on cultural resources; thus, while oral histories would inform the magnitude of impacts and may be essential at a later stage in the implementation of an oil and gas program, such information is not essential to a reasoned choice among alternatives at this leasing stage

Q.4.16 Recreation

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Recreation

Knowledge gap/recommended study: Baseline information on concerns listed as “effects of highest concern on use opportunities and experiences”

- Changes in opportunities for immersion in the area’s wild character; its freedom from the human intent to control, alter, or manipulate its components and ecological and evolutionary processes.
- Changes to desirability of the destination (visitor displacement resulting from new user types; and/or increased visitation by new user types).
- Changes to the timing or availability of access for recreation (both consumptive and non-consumptive uses).
- Changes to the distribution of visitors, possibly leading to crowding.
- The emergence of new behaviors, modes of travel, or activity types, possibly leading to social conflicts.
- Reduced scenic opportunities due to changes to apparent naturalness by the addition of man-made structures.
- Reduced auditory quality due to addition of man-made noise to the natural soundscape.
- Reduced quality of night sky visibility due to atmospheric light pollution.
- Reduced opportunity for solitude. Solitude coincides with the Refuge CCP where it is defined as being free of the reminders of society, its inventions, and conventions. Solitude is greater than just being isolated from other people. Reduced opportunities for immersion in undeveloped area void of

permanent structures or modern human occupation. Changes to levels of visitor satisfaction resulting from changes in overall quality of recreational opportunities.

- Changes to the quality of visitor experience could affect demand for commercial services among the majority of guide and air transporting businesses.
- Changes to the frequency of commercially supported services may further limit managers' capacity to deliver quality visitor opportunities, since managers rely heavily upon the interests of commercial service providers to act as our eyes, ears, and workforce to deliver services.

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies and adequately describes the changes to opportunities for immersion in wild character, desirability of destination, distribution of visitors, quality of visitor experience, and availability of access. The Leasing EIS also adequately describes the reductions in scenic opportunities, auditory quality, night sky, and opportunities for solitude. The emergence of new behaviors, modes of travel, or activity types and the changes to frequency of commercially supported services would be impacted by changes to the demand for recreation within the program area and are difficult to forecast with certainty. New behaviors, modes of travel, and activity types may occur; however, it is impossible at this leasing stage to identify with certainty what new types of activities or behaviors may emerge as a direct result of leasing. Changes to the frequency of commercially-supported services are discussed within the Leasing EIS, but the exact quantification as to which these changes may occur depends on the economic constraints with commercially-supported recreation.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Recreation

Knowledge gap/recommended study: River Inventories

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS describes the impacts on river floating and other river recreation opportunities in the program area, along with identifying associated transboundary impacts outside of the program area. The data on adequate flow is relevant but is not essential to making a reasoned choice among alternatives as the EIS adequately describes how the leasing program would impact river recreation across alternatives at different stages of development.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Recreation

Knowledge gap/recommended study: Fishing on Canning/Hulahula and other rivers

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS adequately describes fishing recreation as a type of recreational activity along major rivers within the program area. Furthermore, the Leasing EIS uses the most readily available data to the BLM for this analysis. While visitor use numbers are not reported, recreation within the program area is extremely limited given the remote landscape of the Coastal Plain and difficulty to access. The Leasing EIS adequately describes how river recreation, including fishing, may be impacted by the leasing program across all stages of development.

Agency/Commenter: USFWS and BLM (Rapid Response Resource Assessment)

Applicable Resource or Use: Recreation

Knowledge gap/recommended study: Reporting commercial and noncommercial use of refuge

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS describes that commercial and noncommercial recreationists access the program area; however, data is limited in the number of commercial and noncommercial recreationists. This data is not essential to the decision-maker analyzing all leasing alternatives, as the Leasing EIS adequately describes, to the best extent possible, the qualitative impacts on recreational access and recreational demand as a result of the leasing program. More information may be made available at a later stage of the oil and gas program when a project proponent would actually submit a plan on the site-specific impacts on recreation.

Agency/Commenter: Ronald Yarnell, Letter 67164

Applicable Resource or Use: Recreation

Knowledge gap/recommended study: Economic Impacts on Recreation

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS describes that recreational demand, quality, and opportunities may be impacted by leasing program. The scope of the Recreation section of the Leasing EIS is to describe how recreational opportunities and recreational access may be impacted by the leasing program, and an economic impact analysis of recreation is outside the scope of recreation analysis. The economic effects of the program area are described in the Economics section of the Leasing EIS.

Q.4.17 Public Health

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Public Health

Knowledge gap/recommended study: Health Impact Assessments for oil and gas projects across the North Slope

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The EIS includes analysis from the Nanushuk Human Health Baseline Summary (ADHSS 2018a) and the NPR-A IAP EIS (BLM 2012), which conducted a Baseline Community Health Analysis Report for the NSB (NSB 2012). These reports included information for Kaktovik. In addition, data was updated from the 2012 NSB Baseline Community Health Analysis Report where data was available including the following data sources: 2015 NSB census (NSB 2015), updated Alaska Department of Health and Social Services vital statistics (ABVS 2018), Alaska Behavioral Risk Factor Surveillance results (BRFSS 2017), and epidemiology trends (ADHSS 2018b; 2019).

Agency/Commenter: Brook Brisson, Trustees for Alaska, Letter 98270

Applicable Resource or Use: Public Health

Knowledge gap/recommended study: The demographic and health information cited within the DEIS is outdated and incomplete

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS identifies potential impacts on public health and safety based on other oil and gas projects on the North Slope. Data was updated from the 2012 NSB Baseline Community Health Analysis Report where data was available including the following data sources: 2015 NSB census (NSB 2015), updated Alaska Department of Health and Social Services vital statistics (ABVS 2018), Alaska Behavioral Risk Factor Surveillance results (BRFSS 2017), and epidemiology trends (ADHSS 2018b; 2019).

Additional analysis for Kaktovik and the NSB was included from the Nanushuk Human Health Baseline Summary (ADHSS 2018a). A Health Impact Assessment would be conducted for specific projects after the lease sales are complete.

Agency/Commenter: Brooke Brisson, Trustees for Alaska, Letter 98270

Applicable Resource or Use: Public Health

Knowledge gap/recommended study: Community-specific data is incomplete or unavailable

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: Data was updated from the 2012 NSB Baseline Community Health Analysis Report where data was available including the following data sources: 2015 NSB census (NSB 2015), updated Alaska Department of Health and Social Services vital statistics (ABVS 2018), Alaska Behavioral Risk Factor Surveillance results (BRFSS 2017), and epidemiology trends (ADHSS 2018b; 2019). Additional analysis for Kaktovik and the NSB was included from the Nanushuk Human Health Baseline Summary (ADHSS 2018a). Data specific to Kaktovik and other potentially impacts communities were presented where available in the Subsistence and Public Health and Safety sections of the EIS. The Leasing EIS identifies and adequately describes potential impacts on public health and safety for affected communities based on other oil and gas projects on the North Slope. A Health Impact Assessment would be conducted for specific projects after the lease sales are complete.

Agency/Commenter: Name Withheld, Letter 56769

Applicable Resource or Use: Public Health

Knowledge gap/recommended study: Estimate of the spread of disease bearing insects from combustion of fossil fuels

Is the Information/Study Relevant to Potentially Significant Effects? NO

If NO, explain: No reference to disease bearing insects was identified in analysis for similar projects on the North Slope including the NPR-A IAP EIS (BLM 2012) and the Nanushuk EIS (USACE 2018). Analysis and the recommended study were not necessary to determine potentially significant effects and were not included in the EIS.

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives?

If NO, explain:

Agency/Commenter: USFWS and BLM, Rapid Response Resource Assessment

Applicable Resource or Use: Public Health

Knowledge gap/recommended study: Health Impact Assessment for specific projects after lease sales include the NWT subsistence users of the PCH

Is the Information/Study Relevant to Potentially Significant Effects? YES

If NO, explain:

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? NO

If NO, explain: The Leasing EIS states that an applicant would conduct a Health Impact Assessment for specific projects after the lease sale is complete. The Alaska Department of Health and Social Services identifies Potentially Affected Communities by a list of criteria identified in the "Technical Guidance for Health Impact Assessment in Alaska" (ADHSS 2015). These criteria include "high likelihood for change in key subsistence resources." The Leasing EIS includes analysis of NWT subsistence users of the PCH in **Section 3.4.3** and the resulting impacts on public health and safety in **Section 3.4.11**. Any subsequent Health Impact Assessment would include analysis of NWT subsistence users due to potential impacts on the PCH and potential changes to subsistence activity or harvests for NWT communities.

Q.5 Literature Cited

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.

ADHSS (Alaska Department of Health and Social Services). 2015. Toolkit: Health Impact Assessment Program. 2015 (Version 2.0). HIA Toolkit. Technical Guidance for Health Impact Assessment in Alaska. Anchorage AK. Alaska Department of Health and Human Services. Health Impact Assessment Program.

_____. 2018a. Final human health baseline summary, Nanushuk Project. Environmental Public Health Program, Anchorage.

_____. 2018b. Gonorrhea update – Alaska, 20175. Bulletin No. 5, May 24, 2018. Internet website: http://epibulletins.dhss.alaska.gov/Document/Display?DocumentId=1978.

_____. 2019. Chlamydia infection update – Alaska, 2018. Bulletin No. 8, April 17, 2019. Internet website: http://epibulletins.dhss.alaska.gov/Document/Display?DocumentId=2018.

Arthur, S.M., and P.A. Del Vecchio. 2009. Effects of Oil Field Development on Calf Production and Survival in the Central Arctic herd. Research Final Technical Report, Federal Aid in Wildlife Restoration Project 3.46. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, AK.

Barboza, P.S., L.L. Van Someren, D.D. Gustine, M.S. Bret-Harte. 2018. The nitrogen window for arctic herbivores: plant phenology and protein gain of migratory caribou (Rangifer tarandus). Ecosphere 9, e02073.

Best, T.L. and T.H. Henry. 1994. Lepus arcticus. Mammalian Species No. 457: 1–9.

BLM (US Department of the Interior Bureau of Land Management). 2013. Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands. Bureau of Land Management. Cheyenne, Wyoming. April 2013.

BRFSS (Behavioral Risk Factor Surveillance System). 2017. InstantAtlas Health Profiles. Alaska Department of Health and Social Services, Division of Public Health. Internet website: http://www.hss.state.ak.us/instantatlas/brfss/hp/aa/census_5yr/report_Boroughs_and_Census_Areas_19.html.

Bromaghin, J.F., T.L. McDonald, I. Stirling, A.E. Derocher, E.S. Richardson, E.V. Regehr, D.C. Douglas, G.M. Durner, T.C. 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.

Cameron, R.D., and K.R. Whitten. 1979. Seasonal movements and sexual segregation of caribou determined by aerial survey. Journal of Wildlife Management 43: 626-633.

Cameron, R.D., W.T. Smith, R.G. White, and B. Griffith. 2005. Central Arctic caribou and petroleum development: distributional, nutritional and reproductive implications. Arctic 58: 1-9.

Cason, M.M., A.P. Baltensperger, T.L. Booms, J.J. Burns, and L.E. Olson. 2016. Revised distribution of an Alaska endemic, the Alaska hare (Lepus othus), with implications for taxonomy, biogeography, and climate change. Arctic Science 2: 50–66.

Fancy, S. G., L.F. Pank, K.R. Whitten, and W.L. Regelin. 1990. Seasonal movements of caribou in arctic Alaska as determined by satellite. Rangifer, Spec. Issue No. 3: 167. [abstract]

Fancy, S.G., and K.R. Whitten. 1991. Selection of calving sites by Porcupine herd caribou. Canadian Journal of Zoology 69: 1736-1743.

Gerhart, K.L. 1995. Nutritional and ecological determinants of growth and reproduction in caribou. Ph. D. Thesis. University of Alaska, Fairbanks, AK. 147 pp.

Griffith, B., D.C. Douglas, N.E. Walsh, D.D. Young, T.R. McCabe, D.E. Russell, R.G. White, R.D. Cameron, and K.R. Whitten. 2002. "The Porcupine Caribou Herd." Pages 8-37 in D.C. Douglas, P.E. Reynolds, E.B. Rhode, editors. Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries. US Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR-2002-0001.

Lehner N.S. 2012. Arctic Fox Winter Movement and Diet in Relation to Industrial Development on Alaska's North Slope. MS thesis, University of Alaska Fairbanks.

MacDonald, S. O., and J. A. Cook. 2009. Recent Mammals of Alaska. University of Alaska Press, Fairbanks.

NRC (National Research Council). 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. National Academies Press. Washington, DC. In: BLM. 2012. National Petroleum Reserve-Alaska (NPR-A) Final Integrated Activity Plan (IAP)/Environmental Impact Statement (EIS). Internet website: https://www.nap.edu/catalog/10639/cumulative-environmental-effects-of-oil-and-gas-activities-on-alaskas-north-slope.

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.

Pamperin, N.J., E.H. Follmann, and B.T. Person. 2008. Sea-ice use by arctic foxes in northern Alaska. Polar Biology 31: 1421–1426.

Pamperin, N. J., E.H. Follmann, and B. Petersen. 2006. Interspecific killing of an arctic fox by a red fox at Prudhoe Bay, Alaska. Arctic 59: 361–364.

Pedersen, N.J.S. 2019. Human-bear interactions in the North Slope oilfields of Alaska (USA): characteristics of grizzly bear sightings and use of infrared for bear den detection. MS Thesis, UAF.

Prichard, A. K., B. E. Lawhead, and J. H. Welch. 2019. Caribou Distribution and Movements near the Kuparuk Oilfield, 2008–2018. Report to ConocoPhillips Alaska, Inc., Anchorage, by ABR, Inc.—Environmental Research & Services, Fairbanks. 28 pp.

Roby, D.D. 1978. Behavioral patterns of barren-ground caribou of the Central Arctic Herd adjacent to the Trans-Alaska Oil Pipeline. M.S. Thesis. University of Alaska, Fairbanks, AK. 200 pp.

Russell, D., and A. Gunn. 2019. Vulnerability analysis of the Porcupine Caribou Herd to potential development of the 1002 lands in the Arctic National Wildlife Refuge, Alaska. Report prepared for: Environment Yukon, Canadian Wildlife Service, and GNWT Department of Environment and Natural Resources. 143 pp. http://www.pcmb.ca/1002

Savory, G.A., C.M. Hunter, M.J. Wooler, and D.M. O'Brien. 2014. Anthropogenic food use and diet overlap between red foxes (Vulpes vulpes) and arctic foxes (*Vulpes lagopus*) in Prudhoe Bay, Alaska. Canadian Journal of Zoology 92: 657–663.

Shideler, R., and J. Hechtel. 2000. Grizzly bear. Chapter 6, pp. 105–132 in J. C. Truett and S. R. Johnson, eds. The Natural History of an Arctic Oil Field: Development and the Biota. Academic Press, San Diego, California.

Stickney, A. A., T. Obritschkewitsch, and R.M. Burgess. 2014. Shifts in fox den occupancy in the Greater Prudhoe Bay area, Alaska. Arctic 67: 196–202.

Tape, K. D., K. Christie, G. Carroll, and J.A. O'Donnell. 2015. Novel wildlife in the Arctic: the influence of changing riparian ecosystems and shrub habitat expansion on snowshoe hares. Global Change Biology. https://doi.org/10.1111/gcb.13058

USACE (US Army Corps of Engineers). 2018. Nanushuk Project Final Environmental Impact Statement. Internet website: http://www.nanushukeis.com/documents.html

USFWS (U.S. Fish and Wildlife Service). 2015a. Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan. U.S. Fish and Wildlife Service, Final Environmental Impact Statement, Vol. 1. Internet website: https://www.fws.gov/home/arctic-ccp/

_____. 2016. Polar Bear (Ursus maritimus) Conservation Management Plan. US Fish and Wildlife Service, Region 7, Anchorage, Alaska.

_____. 2017a. Polar bear (Ursus maritimus) 5-year review: Summary and evaluation. US Fish and Wildlife Service, Region 7, Anchorage, Alaska. 67 pp.

_____. 2017b. Polar bear (Ursus maritimus): Southern Beaufort Sea stock. Draft Stock Assessment Report, U.S. Fish and Wildlife Service, Marine Mammals Management, Anchorage, Alaska. Available online: https://www.fws.gov/r7/fisheries/mmm/polarbear/pdf/Southern%20Beaufort%20Sea%20Draft%20SAR%20%20for%20public%20comment.pdf

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. doi:10.1371/journal.pone.0048697.

Yokel, D. A., A.K. Prichard, G.M. Carroll, L.S. Parrett, B.T. Person, and C. Rea. 2011. Caribou Use of Narrow Land Corridors Around Teshekpuk Lake, Alaska. BLM Alaska Open File Report 125.

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Appendix R

Market Substitutions and Greenhouse Gas Downstream Emissions

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Appendix R. Market Substitutions and Greenhouse Gas Downstream Emissions

R.1 Overview

The Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) includes an analysis on climate change that has been drafted with support from the Bureau of Ocean Energy Management (BOEM). The Leasing EIS presents an analysis of the potential impacts of implementing an oil and gas leasing program in the Arctic Refuge Coastal Plain (Coastal Plain Program). In Public Law (PL) 115-97 (December 2017), Congress directed BLM to establish an oil and gas leasing program in the Coastal Plain of the Arctic National Wildlife Refuge (Arctic Refuge). The Coastal Plain program area encompasses approximately 1.6 million acres of Federal land in the northernmost end of the Arctic Refuge. Under the Reasonably Foreseeable Development scenario (**Appendix B**), the program is expected to result in oil and gas production ranging from almost 1.5 billion barrels of oil to about 10.6 billion barrels of oil, and 0 to about 2.5 trillion cubic feet of natural gas. The bottom and top of this production range will be referred to as the Low and High scenarios, respectively.

This appendix provides the estimates for the downstream greenhouse (GHG) gas emissions associated with consumption of oil and gas produced from the Proposed Action (the Coastal Plain Program) in the Low and High scenarios, as well as the energy substitutes that would be anticipated under the No Action Alternative (i.e., not approving the program). Two models are used to determine these emissions estimates. The Market Simulation Model (MarketSim) estimates the energy substitutes that are most likely to replace production from the Coastal Plain Program, should there be no lease sales. The Greenhouse Gas Lifecycle Model (GHG Model) estimates the full lifecycle emissions from both production and consumption of Outer Continental Shelf (OCS) oil and gas resources. For this analysis, BOEM only uses the mid- and downstream portion of GHG Model, because the upstream component is derived in combination with a separate, offshore-specific model.

BOEM's GHG analysis is limited to the emissions associated with processing and consumption of oil and gas resources under the Proposed Action, and from the energy substitutes anticipated to be needed under the No Action Alternative. The emissions estimates in this analysis do not include any estimates from activities required to produce resources under the Proposed Action, or the production or upstream transport of any resources produced under the No Action Alternative.

This appendix describes the changes in substitute energy sources that could occur in the absence of the new program's production (in effect, treating Coastal Plain production as the baseline). However, the changes could conversely be discussed by treating Coastal Plain oil production (and gas, in the High scenario) as a substitute(s) for those sources that would supply energy under the No Action Alternative.

This appendix first describes MarketSim and the estimated energy market substitutions that would occur in the absence of the program under the No Action Alternative. It then describes the GHG Model and the resulting emissions estimates for the Proposed Action.

R.2 The Market Simulation Model and the Energy Market Substitutions

MarketSim models oil, gas, coal, and electricity markets and is calibrated to a special run of the Energy Information Administration's (EIA) National Energy Modeling System. The baseline used in MarketSim is a modified version of the EIA's 2018 Annual Energy Outlook reference case. The modification involves removing all production anticipated to result from OCS lease sales scheduled for 2019 and later. Removing this production anticipated from future OCS leases allows investigation of alternative new OCS leasing scenarios within the EIA's broad energy market projection using MarketSim. MarketSim uses price elasticities derived from EIA and other published elasticity studies to quantify the changes that would occur to prices, energy production, and consumption over the duration of production.

BOEM developed MarketSim to calculate the energy sources that would replace new offshore oil and natural gas production in the absence of sales in a new National OCS Oil and Gas Leasing Program. These substitute energy sources include additional oil and gas imports, onshore oil and gas production, fuel switching (e.g., using coal instead of oil), and reduced energy consumption.

Energy market substitution occurs due to changes in the feedback loops among supply, demand, and prices. Using the EIA data, MarketSim assumes a baseline supply (production) and demand (consumption) of energy from various sources, as well as baseline prices and elasticities. That baseline is the No Action Alternative, or a scenario in which none of the program lease sales occur. The model then calculates how introducing production from new leases would impact those baseline supply, price, and demand assumptions. Increased oil supply from the program would drive oil prices down, if only slightly. A reduction in oil prices would cause demand for oil to increase even as energy consumers switched (substituted) from other energy sources like coal, natural gas, or oil from other areas such as imports or domestic onshore/offshore production. Due to the increased demand resulting from lower prices, the displacement of other sources does not account for 100% of the change from the baseline.

MarketSim simulates end-use domestic consumption of oil, natural gas, coal, and electricity in four sectors (residential, commercial, industrial, and transportation), primary energy production, and the transformation of primary energy into electricity. MarketSim primarily represents U.S. energy markets, but also captures interaction with global energy markets, as appropriate. BOEM recognizes the uncertainty of its projections and the further uncertainty in attempting to model the entire set of energy market substitutions that would globally occur.

The EIA forecasts used in MarketSim account for current laws and policies, but do not forecast future laws or policies. The exact form of any potential climate policy (and even more so, its effects) would be too speculative to fully estimate and incorporate into the MarketSim model. In addition, there are currently no reliable methodologies for forecasting foreign energy cross-price elasticities and oil/gas price shock substitution responses to arrive at a global GHG emissions impact from associated domestic changes. For additional information on MarketSim, please see the documentation entitled *Consumer Surplus and Energy Substitutes for OCS Oil and Gas Production: The 2017 Revised Market Simulation Model (MarketSim)*.[1]

R.2.1 Applicability of MarketSim to BLM Decisions

While MarketSim is specifically designed to calculate the energy market substitutes for offshore oil production from proposed lease offerings, the basic model calculations allow for its use in modeling the substitutes for other oil and gas sources, including new onshore production. Since MarketSim is designed to treat production from new offshore leases as the exogenous variable, modeling substitution effects of new

[1] Industrial Economics, Inc. 2017. *Consumer surplus and energy substitutes for OCS oil and gas production: The 2017 revised Market Simulation Model (MarketSim)*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-039. Available online at: https://www.boem.gov/ESPIS/5/5612.pdf.

onshore production requires inputting the projected Coastal Plain production as new offshore oil production. This modeling approach results in a couple limiting assumptions, including the following:

- Additional onshore production from the Coastal Plain Program essentially generates the same types of energy market substitutes as offshore production.
- There would be no substitution of production from new offshore leases for forgone Coastal Plain onshore production under the No Action Alternative. The model does assume some substitution of existing offshore production (i.e., for areas currently under lease).

Even with these limiting assumptions, BOEM believes that the MarketSim model provides a reasonable approximation of the energy market substitutes for forgone onshore production if the program is not approved. Further, the emissions analysis used for this Leasing EIS only considers the mid- and downstream emissions. That is, only the emissions from refining and consumption activities are included in the analysis. Given that scope, the upstream differences specific to onshore production, offshore production, or imports are not important in the overall emissions analysis conducted for the Leasing EIS, as that analysis is driven by the substitution of oil, gas, or coal. A version of MarketSim is being adapted to BLM's needs and will be used for future energy market substitution analyses.

R.2.2 BLM MarketSim Modeling Assumptions

For this analysis, BOEM used the production schedule provided by Environmental Management and Planning Solutions, Inc. (EMPSi) in the Reasonably Foreseeable Development scenario. This included approximately 1.5 billion barrels of oil in the Low scenario, and 10.6 billion barrels of oil and 2.5 trillion cubic feet of natural gas in the High scenario. Given the lead time for the program, oil production is anticipated to begin in 2027, and natural gas production would begin in 2032. Since MarketSim can consider up to 70-year production timelines, production data for the 30 remaining years of the two scenarios (i.e., 2089 through 2126) are omitted. Due to the long timeframe of the analysis, as well as additional sources of uncertainty (e.g., technological changes), this limiting model assumption is appropriate. Sensitivity analysis around the production data confirmed that the market substitution rates do not materially change, whether 70 or 100 years of production data are considered.

Table R-1
Coastal Plain Program Alternative Production Scenarios

Scenario	Resource	Production	Start Year	End Year
Low	Gas	0	0	0
	Oil (BBO)	1.492	2027	2126
High	Gas (TCF)	2.451	2032	2061
	Oil (BBO)	10.569	2027	2126

Key: BBO = billion barrels of oil; TCF = trillion cubic feet

R.2.3 MarketSim Results

The MarketSim model estimates the energy market substitutions that would replace forgone production if the Coastal Plain Program is not implemented. Conversely, these same substitutions could be warranted as the energy market sources that would be replaced with the approval of Coastal Plain Program. MarketSim estimates the different types of fuel as well as where the fuel would be produced (i.e., onshore, offshore, or as imports). The details are used in BOEM's modeling of the upstream impacts associated with the production and substitute sources. However, for BLM's purposes, BOEM only estimates the mid- and downstream emissions. As such, the only aspect of the substitution analysis relevant is the type of substituted fuel.

Table R-2 shows the proportional substitutions of oil, natural gas, and coal for forgone Coastal Plain Program oil production if the program is not approved. For example, in the High scenario, 85.21 percent of the Coastal Plain gas production would be replaced by gas from other sources. There is no gas production in the Low scenario. The model estimates that 94.07 percent (Low scenario) to 94.08 percent (High scenario) of the program's oil production would be replaced with other oil production. For both the Low and High scenarios, additional coal is estimated to replace 0.39 percent of oil consumption. In the High scenario, 1.18 percent of the program's gas production would be replaced by coal.

These substitution factors are incorporated into the GHG Model, described below, to estimate the change in emissions generated by the Coastal Plain Program. **Table R-2** also shows that more than 96 percent of the program's oil production in both the Low and High scenarios, and 89 percent of the program's gas production (High scenario only), would be replaced with either natural gas, coal, or other oil. However, the model does estimate that some of the demand would be reduced or shifted to non-carbon emitting sources of electricity (shown in **Table R-3**). **Table R-2** shows the substitution rates for the substitution to other carbon-emitting fuel sources under the Low and High scenarios.

Table R-3 outlines the remainder of the substitutions. For example, in both scenarios, there are very slight substitutions with other sources of electricity (e.g., solar, nuclear) and biofuels, but the remainder of the Coastal Plain production would not be replaced and represents reduced demand (due to slightly higher prices without that oil in the market). While there would be a decrease in oil consumption (totaling 4.67 percent of the High scenario of Coastal Plain Program production), some of that reduction would be offset by an increase in consumption of other energy sources. If the program is not approved, the net result of these fuel substitutions and changes in consumption would be an estimated net decrease in overall energy consumption, equivalent to about 3.9 percent of the energy that would have been provided by Coastal Plain Program production.

Table R-2
Percent of Forgone Coastal Plain Production Replaced by Fuel Substitutions

Substitutes for Forgone Production	Low Scenario	High Scenario	
	Oil	Gas	Oil
Percent Replaced with Oil, Natural Gas, and Coal	96.21%	89.47%	96.22%
Replaced with Oil	94.07%	3.08%	94.08%
Replaced with Natural Gas	1.75%	85.21%	1.75%
Replaced with Coal	0.39%	1.18%	0.39%

Note: Under the Low scenario, only oil production would be anticipated; no gas production would be expected.

Table R-3
Reduced Demand and Electricity Consumption

Substitutes for Forgone Production	Low Scenario	High Scenario
Percent Replaced with Oil, Natural Gas, and Coal	**96.21%**	**95.63%**
Percent Replaced with Electricity from other sources	0.16%	0.22%
Percent Replaced with Biofuels	0.27%	0.25%
Percent Not Replaced (Reduced Demand)	3.36%	3.90%
Oil	-5.31%	-4.67%
Natural Gas	1.34%	0.19%
Coal	0.18%	0.21%
Electricity	0.43%	0.38%

Note: Under the High scenario, oil and gas effects are combined.

R.3 BOEM'S GREENHOUSE GAS LIFECYCLE MODEL

BOEM developed the GHG Model to estimate the emissions that could be anticipated as a result of the consumption of oil and natural gas from proposed OCS production as well as the emissions of oil, natural gas, and coal that would occur in the absence of a program. These GHG estimates include emissions from oil and gas refining, processing, storage, and consumption, as well as the emissions associated with energy market substitutes in the absence of that new offshore production (i.e., the No Action Alternative). Detailed information on the GHG Model can be found in *OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon*.[2]

R.3.1 BLM Adaption of the GHG Model

BOEM's GHG Model calculates the impacts of the consumption of oil, gas, coal, and electricity, and is not specific to the consumption of OCS-produced oil. As such, it is applicable to calculating the emissions impacts from the consumption of oil and gas from any source and is appropriate to use to calculate GHG emissions from the consumption of oil and gas from the Coastal Plain Program.

Since publishing the technical documentation cited above, BOEM updated the annual emissions from refineries and natural gas processing and storage systems to reflect oil and gas consumption patterns in the United States as of 2018.

To reiterate, onsite emissions (i.e., emissions associated with the production of oil and natural gas) are not calculated in this analysis. To estimate these onsite emissions as part of this analysis, a separate model designed to analyze GHG emissions from the onshore equipment and facilities would be required. Further, the upstream transportation emissions from the substitute sources are not included (e.g., tanker emissions usually associated with transportation of imports).

R.3.2 BLM GHG Model Assumptions

As described above, the GHG analysis only considers the emissions from refining and consumption. A barrel of oil domestically produced from onshore or offshore, or a barrel of oil produced in another country and transported to the United States, is assumed to have the same amount of emissions when refined and consumed. Therefore, the substitution of imports, versus additional onshore production, versus additional offshore production, is not relevant when analyzing mid- and downstream GHG emissions. The substitutions used in the GHG Model are only from processing and consumption of the fuel, and the only relevant substitution information is the proportion of oil, natural gas, coal, other negligible or non-emitting substitutions (e.g., solar, wind, biofuels), and reduced demand.

[2] Wolvovsky, E. and Anderson, W. 2016. *OCS Oil and Natural Gas: Potential Lifecycle Greenhouse Gas Emissions and Social Cost of Carbon*. BOEM OCS Report 2016-065. 44 pp. Available online at: https://www.boem.gov/ocs-oil-and-natural-gas/.

R.3.3 BLM GHG Model Results

The results of the GHG Model are shown in **Table R-4** as aggregate emissions; annualized emissions are shown in **Table R-5** and **Table R-6**. Note that individual years are more prone to error than the program total, especially later years. As shown in **Table R-3** and **Table R-4**, under the No Action Alternative, there is less oil consumption and more natural gas consumption than under the Proposed Action. Given that natural gas has a similar methane (CH_4) emissions factor, and coal has a higher CH_4 emissions factor compared to oil, CH_4 emissions in the No Action Alternative are higher than in the Proposed Action in both the Low and High scenarios. However, because oil has a far higher carbon dioxide (CO_2) emissions factor, the overall CO_2 equivalent (CO_2e) remains lower for the No Action Alternative.

Table R-4
Aggregated Downstream GHG Emissions from the Proposed Action and No Action Alternative

Alternative	High Case				Low Case			
	CO_{2e}	CO_2	CH_4	N_2O	CO_{2e}	CO_2	CH_4	N_2O
Proposed Action	4,398,696	4,377,199	426	36	599,185	596,869	32	5
No Action Alternative	4,046,094	4,024,720	460	33	551,561	549,162	41	5

Note: Emissions estimates are in thousands of metric tons.

Table R-5
Annualized Downstream GHG Emissions from the Proposed Action and No Action Alternative High Scenario

Year	Proposed Action				No Action Alternative			
	CO_2e	CO_2	CH_4	N_2O	CO_2e	CO_2	CH_4	N_2O
2019	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0	0
2027	3,861	3,846	—	—	3,633	3,618	—	—
2028	7,721	7,691	—	—	7,267	7,236	—	—
2029	11,582	11,537	1	—	10,900	10,854	1	—
2030	15,133	15,075	1	—	14,243	14,183	1	—
2031	18,401	18,330	1	—	17,318	17,245	1	—
2032	21,437	21,326	2	—	20,238	20,129	2	—
2033	24,233	24,083	4	—	22,933	22,788	3	—
2034	26,777	26,617	4	—	25,328	25,173	4	—
2035	29,118	28,949	4	—	27,531	27,367	4	—
2036	31,272	31,094	4	—	29,558	29,385	4	—
2037	33,283	33,070	5	—	31,513	31,308	5	—
2038	35,136	34,887	6	—	33,320	33,084	6	—
2039	36,813	36,558	7	—	34,899	34,655	6	—
2040	38,356	38,094	7	—	36,351	36,101	6	—

Year	Proposed Action				No Action Alternative			
	CO_2e	CO_2	CH_4	N_2O	CO_2e	CO_2	CH_4	N_2O
2041	39,775	39,508	7	—	37,687	37,432	6	—
2042	41,111	40,811	8	—	39,006	38,721	7	—
2043	42,342	42,009	9	—	40,229	39,915	9	—
2044	43,448	43,110	9	—	41,269	40,951	9	—
2045	44,465	44,123	9	—	42,226	41,904	9	—
2046	45,391	45,054	9	—	43,079	42,760	8	—
2047	46,244	45,911	9	—	43,866	43,550	8	—
2048	47,029	46,700	8	—	44,591	44,278	8	—
2049	47,752	47,425	8	—	45,260	44,948	8	—
2050	48,418	48,092	8	—	45,877	45,566	8	—
2051	49,021	48,706	8	—	46,417	46,115	7	—
2052	49,558	49,269	7	—	46,859	46,579	6	—
2053	50,073	49,789	6	—	47,330	47,053	6	—
2054	50,548	50,266	6	—	47,765	47,491	6	—
2055	50,985	50,706	6	—	48,167	47,895	6	—
2056	51,378	51,110	6	—	48,510	48,247	6	—
2057	51,722	51,481	4	—	48,770	48,530	5	—
2058	52,059	51,823	4	—	49,073	48,838	4	—
2059	52,370	52,138	4	—	49,354	49,122	4	—
2060	52,656	52,428	4	—	49,614	49,384	4	—
2061	52,920	52,694	4	—	49,854	49,626	4	—
2062	53,144	52,938	3	—	50,017	49,807	3	—
2063	53,371	53,164	3	—	50,230	50,019	3	—
2064	53,579	53,372	3	—	50,427	50,215	3	—
2065	53,771	53,563	3	—	50,607	50,395	3	—
2066	53,948	53,739	3	—	50,773	50,560	3	—
2067	54,110	53,901	3	—	50,926	50,712	3	—
2068	54,259	54,050	3	—	51,067	50,852	3	—
2069	54,397	54,187	3	—	51,196	50,981	3	—
2070	54,523	54,313	3	—	51,315	51,100	3	—
2071	54,640	54,428	3	—	51,425	51,209	3	—
2072	54,640	54,428	3	—	51,425	51,209	3	—
2073	54,640	54,428	3	—	51,425	51,209	3	—
2074	54,640	54,428	3	—	51,425	51,209	3	—
2075	54,640	54,428	3	—	51,425	51,209	3	—
2076	54,640	54,428	3	—	51,425	51,209	3	—
2077	54,640	54,428	3	—	51,425	51,209	3	—
2078	54,640	54,428	3	—	51,425	51,209	3	—
2079	54,640	54,428	3	—	51,425	51,209	3	—
2080	54,640	54,428	3	—	51,425	51,209	3	—
2081	54,640	54,428	3	—	51,425	51,209	3	—
2082	54,640	54,428	3	—	51,425	51,209	3	—
2083	54,640	54,428	3	—	51,425	51,209	3	—
2084	54,640	54,428	3	—	51,425	51,209	3	—
2085	54,640	54,428	3	—	51,425	51,209	3	—
2086	54,640	54,428	3	—	51,425	51,209	3	—

Year	Proposed Action				No Action Alternative			
	CO_2e	CO_2	CH_4	N_2O	CO_2e	CO_2	CH_4	N_2O
2087	54,640	54,428	3	—	51,425	51,209	3	—
2088	54,640	54,428	3	—	51,425	51,209	3	—
2089	54,640	54,428	3	—	51,425	51,209	3	—
2090	54,640	54,428	3	—	51,425	51,209	3	—
2091	54,640	54,428	3	—	51,425	51,209	3	—
2092	54,640	54,428	3	—	51,425	51,209	3	—
2093	54,640	54,428	3	—	51,425	51,209	3	—
2094	54,640	54,428	3	—	51,425	51,209	3	—
2095	54,640	54,428	3	—	51,425	51,209	3	—
2096	54,640	54,428	3	—	51,425	51,209	3	—
2097	54,640	54,428	3	—	51,425	51,209	3	—
2098	54,640	54,428	3	—	51,425	51,209	3	—
2099	54,640	54,428	3	—	51,425	51,209	3	—
2100	54,640	54,428	3	—	51,425	51,209	3	—
2101	54,640	54,428	3	—	51,425	51,209	3	—
2102	54,640	54,428	3	—	51,425	51,209	3	—
2103	54,640	54,428	3	—	51,425	51,209	3	—
2104	54,640	54,428	3	—	51,425	51,209	3	—
2105	54,640	54,428	3	—	51,425	51,209	3	—
2106	50,779	50,583	3	—	47,791	47,591	3	—
2107	46,919	46,737	3	—	44,158	43,973	3	—
2108	43,058	42,892	2	—	40,525	40,354	3	—
2109	39,506	39,354	2	—	37,182	37,026	2	—
2110	36,239	36,099	2	—	34,107	33,963	2	—
2111	33,233	33,104	2	—	31,277	31,146	2	—
2112	30,467	30,349	2	—	28,674	28,554	2	—
2113	27,923	27,815	1	—	26,280	26,169	2	—
2114	25,582	25,483	1	—	24,077	23,975	2	—
2115	23,428	23,338	1	—	22,050	21,957	1	—
2116	21,447	21,364	1	—	20,185	20,100	1	—
2117	19,624	19,548	1	—	18,470	18,392	1	—
2118	17,947	17,878	1	—	16,891	16,820	1	—
2119	16,404	16,341	1	—	15,439	15,374	1	—
2120	14,985	14,927	1	—	14,103	14,044	1	—
2121	13,679	13,626	1	—	12,874	12,820	1	—
2122	12,478	12,430	1	—	11,744	11,694	1	—
2123	11,373	11,329	1	—	10,703	10,658	1	—
2124	10,356	10,316	1	—	9,746	9,705	1	—
2125	9,420	9,384	1	—	8,866	8,829	1	—
2126	8,560	8,526	—	—	8,056	8,022	1	—
Total	**4,253,279**	**4,233,952**	**343**	**36**	**4,009,462**	**3,990,145**	**368**	**34**

Note: Emissions estimates are in thousands of metric tons. The dash symbol represents emissions greater than 0, but less than 500 metric tons.

Table R-6
Annualized Downstream GHG Emissions from the Proposed Action and No Action Alternative Low Scenario

Year	Proposed Action				No Action Alternative			
	CO_2e	CO_2	CH_4	N_2O	CO_2e	CH_4	CH_4	N_2O
2019	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0
2022	0	0	0	0	0	0	0	0
2023	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0
2026	0	0	0	0	0	0	0	0
2027	559	557	—	—	530	528	—	—
2028	1,118	1,114	—	—	1,060	1,055	—	—
2029	1,677	1,671	—	—	1,589	1,583	—	—
2030	2,192	2,183	—	—	2,077	2,068	—	—
2031	2,665	2,655	—	—	2,525	2,514	—	—
2032	3,101	3,089	—	—	2,938	2,925	—	—
2033	3,501	3,488	—	—	3,317	3,303	—	—
2034	3,870	3,855	—	—	3,666	3,651	—	—
2035	4,209	4,193	—	—	3,988	3,971	—	—
2036	4,521	4,503	—	—	4,283	4,265	—	—
2037	4,808	4,789	—	—	4,555	4,536	—	—
2038	5,072	5,052	—	—	4,805	4,785	—	—
2039	5,315	5,294	—	—	5,035	5,014	—	—
2040	5,538	5,517	—	—	5,247	5,225	—	—
2041	5,744	5,721	—	—	5,442	5,419	—	—
2042	5,933	5,910	—	—	5,621	5,597	—	—
2043	6,107	6,083	—	—	5,786	5,761	—	—
2044	6,267	6,243	—	—	5,937	5,912	—	—
2045	6,414	6,389	—	—	6,077	6,051	—	—
2046	6,554	6,528	—	—	6,209	6,183	—	—
2047	6,550	6,524	—	—	6,205	6,179	—	—
2048	6,789	6,763	—	—	6,432	6,405	—	—
2049	6,894	6,868	—	—	6,532	6,504	—	—
2050	6,992	6,965	—	—	6,624	6,596	—	—
2051	7,081	7,053	—	—	6,709	6,680	—	—
2052	7,163	7,135	—	—	6,786	6,758	—	—
2053	7,239	7,211	—	—	6,858	6,829	—	—
2054	7,308	7,280	—	—	6,924	6,895	—	—
2055	7,368	7,340	—	—	6,981	6,951	—	—
2056	7,431	7,402	—	—	7,040	7,011	—	—
2057	7,485	7,456	—	—	7,092	7,062	—	—
2058	7,535	7,506	—	—	7,139	7,109	—	—
2059	7,581	7,551	—	—	7,182	7,152	—	—
2060	7,623	7,593	—	—	7,222	7,192	—	—

Year	Proposed Action				No Action Alternative			
	CO_2e	CO_2	CH_4	N_2O	CO_2e	CH_4	CH_4	N_2O
2061	7,662	7,632	—	—	7,259	7,228	—	—
2062	7,662	7,632	—	—	7,259	7,228	—	—
2063	7,662	7,632	—	—	7,259	7,228	—	—
2064	7,662	7,632	—	—	7,259	7,228	—	—
2065	7,662	7,632	—	—	7,259	7,228	—	—
2066	7,662	7,632	—	—	7,259	7,228	—	—
2067	7,662	7,632	—	—	7,259	7,228	—	—
2068	7,662	7,632	—	—	7,259	7,228	—	—
2069	7,662	7,632	—	—	7,259	7,228	—	—
2070	7,662	7,632	—	—	7,259	7,228	—	—
2071	7,662	7,632	—	—	7,259	7,228	—	—
2072	7,662	7,632	—	—	7,259	7,228	—	—
2073	7,662	7,632	—	—	7,259	7,228	—	—
2074	7,662	7,632	—	—	7,259	7,228	—	—
2075	7,662	7,632	—	—	7,259	7,228	—	—
2076	7,662	7,632	—	—	7,259	7,228	—	—
2077	7,662	7,632	—	—	7,259	7,228	—	—
2078	7,662	7,632	—	—	7,259	7,228	—	—
2079	7,662	7,632	—	—	7,259	7,228	—	—
2080	7,662	7,632	—	—	7,259	7,228	—	—
2081	7,662	7,632	—	—	7,259	7,228	—	—
2082	7,662	7,632	—	—	7,259	7,228	—	—
2083	7,662	7,632	—	—	7,259	7,228	—	—
2084	7,662	7,632	—	—	7,259	7,228	—	—
2085	7,662	7,632	—	—	7,259	7,228	—	—
2086	7,662	7,632	—	—	7,259	7,228	—	—
2087	7,662	7,632	—	—	7,259	7,228	—	—
2088	7,662	7,632	—	—	7,259	7,228	—	—
2089	7,662	7,632	—	—	7,259	7,228	—	—
2090	7,662	7,632	—	—	7,259	7,228	—	—
2091	7,662	7,632	—	—	7,259	7,228	—	—
2092	7,662	7,632	—	—	7,259	7,228	—	—
2093	7,662	7,632	—	—	7,259	7,228	—	—
2094	7,662	7,632	—	—	7,259	7,228	—	—
2095	7,662	7,632	—	—	7,259	7,228	—	—
2096	7,662	7,632	—	—	7,259	7,228	—	—
2097	7,662	7,632	—	—	7,259	7,228	—	—
2098	7,662	7,632	—	—	7,259	7,228	—	—
2099	7,662	7,632	—	—	7,259	7,228	—	—
2100	7,662	7,632	—	—	7,259	7,228	—	—
2101	7,662	7,632	—	—	7,259	7,228	—	—
2102	7,662	7,632	—	—	7,259	7,228	—	—
2103	7,662	7,632	—	—	7,259	7,228	—	—
2104	7,662	7,632	—	—	7,259	7,228	—	—
2105	7,662	7,632	—	—	7,259	7,228	—	—
2106	7,103	7,075	—	—	6,729	6,701	—	—

Year	Proposed Action				No Action Alternative			
	CO_2e	CO_2	CH_4	N_2O	CO_2e	CH_4	CH_4	N_2O
2107	6,543	6,518	—	—	6,199	6,173	—	—
2108	5,984	5,961	—	—	5,670	5,646	—	—
2109	5,470	5,449	—	—	5,182	5,160	—	—
2110	4,997	4,977	—	—	4,734	4,714	—	—
2111	4,561	4,544	—	—	4,321	4,303	—	—
2112	4,161	4,144	—	—	3,942	3,925	—	—
2113	3,792	3,777	—	—	3,593	3,577	—	—
2114	3,453	3,440	—	—	3,271	3,258	—	—
2115	3,141	3,129	—	—	2,976	2,963	—	—
2116	2,854	2,843	—	—	2,704	2,693	—	—
2117	2,590	2,580	—	—	2,454	2,444	—	—
2118	2,347	2,338	—	—	2,224	2,214	—	—
2119	2,124	2,115	—	—	2,012	2,004	—	—
2120	1,918	1,911	—	—	1,817	1,810	—	—
2121	1,729	1,722	—	—	1,638	1,631	—	—
2122	1,555	1,549	—	—	1,473	1,467	—	—
2123	1,395	1,389	—	—	1,322	1,316	—	—
2124	1,248	1,243	—	—	1,182	1,177	—	—
2125	1,112	1,108	—	—	1,054	1,049	—	—
2126	987	984	—	—	936	932	—	—
Total	**600,167**	**597,848**	**32**	**5**	**568,615**	**566,212**	**38**	**5**

Note: Emissions estimates are in thousands of metric tons. The dash symbol represents emissions greater than 0, but less than 500 metric tons.

R.4 References

U.S. Census Bureau. 2010. American Fact Finder. Available online at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_PL_P2&prodType=table.

_____. 2016. American Community Survey 2012–2016 5-Year, DP03. Available online at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_DP03&prodType=table.